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Chapter 1: Introduction

The ColdFusion Developer’s Guide provides the tools needed to develop Internet applications using ColdFusion. This manual is intended for web application programmers who are learning ColdFusion or wish to extend their ColdFusion programming knowledge. It provides a solid grounding in the tools that ColdFusion provides to develop web applications.

Because of the power and flexibility of ColdFusion, you can create many different types of web applications of varying complexity. As you become more familiar with the material presented in this manual, and begin to develop your own applications, you will want to refer to the CFML Reference for details about various tags and functions.

Using this manual

This manual can help anyone with a basic understanding of HTML learn to develop ColdFusion applications. However, this manual is most useful if you have basic ColdFusion experience or have viewed the Getting Started experience, which is available from the ColdFusion Administrator. Use this manual in conjunction with the CFML Reference.

About Adobe ColdFusion 8 documentation

The ColdFusion documentation is designed to provide support for the complete spectrum of participants.

Documentation set

The ColdFusion documentation set includes the following titles:

<table>
<thead>
<tr>
<th>Manual</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing and Using ColdFusion</td>
<td>Describes system installation and basic configuration for Windows, Macintosh, Solaris, Linux, and AIX.</td>
</tr>
<tr>
<td>Configuring and Administering ColdFusion</td>
<td>Part I describes how to manage the ColdFusion environment, including connecting to your data sources and configuring security for your applications. Part II describes Verity search tools and utilities that you can use for configuring the Verity K2 Server search engine, as well as creating, managing, and troubleshooting Verity collections.</td>
</tr>
<tr>
<td>ColdFusion Developer's Guide</td>
<td>Describes how to develop your dynamic web applications, including retrieving and updating your data, using structures, and forms.</td>
</tr>
<tr>
<td>CFML Reference</td>
<td>Provides descriptions, syntax, usage, and code examples for all ColdFusion tags, functions, and variables.</td>
</tr>
</tbody>
</table>
Viewing online documentation
All ColdFusion documentation is available online in HTML and Adobe Acrobat Portable Document Format (PDF) files. Go to the documentation home page for ColdFusion on the Adobe website: www.adobe.com/support/documentation/en/coldfusion/. In addition, you can view the documentation in LiveDocs, which lets you add comments to pages and view the latest comments added by Adobe, by going to www.adobe.com/go/livedocs_cf8docs.
Chapter 1: Introducing ColdFusion

You use Adobe ColdFusion to create dynamic Internet applications.

Contents
- About Internet applications and web application servers ......................................................... 3
- About ColdFusion .................................................................................................................... 4
- About J2EE and the ColdFusion architecture ........................................................................... 7

About Internet applications and web application servers

With ColdFusion, you develop Internet applications that run on web application servers.

About web pages and Internet applications

The Internet has evolved from a collection of static HTML pages to an application deployment platform. First, the Internet changed from consisting of static web pages to providing dynamic, interactive content. Rather than providing unchanging content where organizations merely advertise goods and services, dynamic pages enable companies to conduct business ranging from e-commerce to managing internal business processes. For example, a static HTML page lets a bookstore publish its location, list services such as the ability to place special orders, and advertise upcoming events like book signings. A dynamic website for the same bookstore lets customers order books online, write reviews of books they read, and even get suggestions for purchasing books based on their reading preferences.

More recently, the Internet has become the underlying infrastructure for a wide variety of applications. With the arrival of technologies such as XML, web services, J2EE (Java 2 Platform, Enterprise Edition), and Microsoft .NET, the Internet has become a multifaceted tool for integrating business activities. Now, enterprises can use the Internet to integrate distributed activities, such as customer service, order entry, order fulfillment, and billing.

ColdFusion is a rapid application development environment that lets you build dynamic websites and Internet applications quickly and easily. It lets you develop sophisticated websites and Internet applications without knowing the details of many complex technologies, yet it lets advanced developers take advantage of the full capabilities of many of the latest Internet technologies.

About web application servers

To understand ColdFusion, you must first understand the role of web application servers. Typically, web browsers make requests, and web servers, such as Microsoft Internet Information Server (IIS) and the Apache web server, fulfill those requests by returning the requested information to the browser. This information includes, but is not limited to, HTML and Adobe Flash files.

A web server's capabilities are limited because all it does is wait for requests to arrive and attempt to fulfill those requests as soon as possible. A web server does not let you do the following tasks:

- Interact with a database, other resource, or other application.
- Serve customized information based on user preferences or requests.
• Validate user input.

A web server, basically, locates information and returns it to a web browser.

To extend the capabilities of a web server, you use a web application server, a software program that extends the web server's capabilities to do tasks such as those in the preceding list.

**How a web server and web application server work together**

The following steps explain how a web server and web application server work together to process a page request:

1. The user requests a page by typing a URL in a browser, and the web server receives the request.
2. The web server looks at the file extension to determine whether a web application server must process the page. Then, one of the following actions occur:
   • If the user requests a file that is a simple web page (often one with an HTM or HTML extension), the web server fulfills the request and sends the file to the browser.
   • If the user requests a file that is a page that a web application server must process (one with a CFM, CFML, or CFC extension for ColdFusion requests), the web server passes the request to the web application server. The web application server processes the page and sends the results to the web server, which returns those results to the browser. The following image shows this process:

Because web application servers interpret programming instructions and generate output that a web browser can interpret, they let web developers build highly interactive and data-rich websites, which can do tasks such as the following:

• Query other database applications for data.
• Dynamically populate form elements.
• Dynamically generate Flash application data.
• Provide application security.
• Integrate with other systems using standard protocols such as HTTP, FTP, LDAP, POP, and SMTP.
• Create shopping carts and e-commerce websites.
• Respond with an e-mail message immediately after a user submits a form.
• Return the results of keyword searches.

**About ColdFusion**

ColdFusion is a rapid scripting environment server for creating dynamic Internet Applications. ColdFusion Markup Language (CFML) is an easy-to-learn tag-based scripting language, with connectivity to enterprise data and powerful built-in search and charting capabilities. ColdFusion enables developers to easily build and deploy dynamic websites, content publishing systems, self-service applications, commerce sites, and more.

ColdFusion pages are plain text files that you use to create web applications. You can create your ColdFusion applications by writing all the code manually or by using wizards (provided with some editors) to generate the majority of the code for you.
Saving ColdFusion pages

In order for the ColdFusion server to process a page, you must save the ColdFusion page on a computer where ColdFusion is installed. If you are creating your pages on a local server (on which ColdFusion is running), you can save the pages locally; if you are using a remote server, you must save your pages on that server.

If you are using the J2EE configuration, you typically save ColdFusion pages under the ColdFusion web application root. For example, in the default directory structure when you use the J2EE configuration with JRun, you save pages under \jrun_root\servers\cfusion\cfusion-ear\cfusion-war.

Testing ColdFusion pages

To ensure that the code you wrote is working as expected, you view the ColdFusion page in a browser by going to the appropriate URL, for example http://localhost/test/mypage.cfm. If you are using the built-in web server, specify the port to use in the URL, for example, http://localhost:8500/test/cfpage.cfm. The address localhost is only valid when you view pages locally.

**Note:** On Vista, the address ::1 is equivalent to localhost. You can use the ColdFusion GetLocalHostIP function to get the IP address of localhost.

The URL for a remote site includes the server name or IP address of the server where ColdFusion is installed; for example, http://<serveripaddress>/test/mypage.cfm. If you are using the ColdFusion J2EE configuration, you may also need to include a context root in the URL; for example, http://<server>/<context-root>/mypage.cfm. For example, if you deploy an EAR file and use the default context root of cfconroot, you specify http://localhost/cfconroot/test/mypage.cfm.

Elements of ColdFusion

ColdFusion consists of the following core elements:

- ColdFusion scripting environment
- CFML
- ColdFusion Administrator
- Verity Search Server

The following sections describe these core components in more detail.

The ColdFusion scripting environment

The ColdFusion scripting environment provides an efficient development model for Internet applications. At the heart of the ColdFusion scripting environment is the ColdFusion Markup Language (CFML), a tag-based programming language that encapsulates many of the low-level details of web programming in high-level tags and functions.

ColdFusion Markup Language

ColdFusion Markup Language (CFML) is a tag-based language, similar to HTML, that uses special tags and functions. With CFML, you can enhance standard HTML files with database commands, conditional operators, high-level formatting functions, and other elements to rapidly produce easy-to-maintain web applications. However, CFML is not limited to enhancing HTML. For example, you can create Adobe Flash applications that consist entirely of Flash elements and CFML. Similarly, you can use CFML to create web services for use by other applications.

For more information, see “Elements of CFML” on page 10
CFML tags
CFML looks similar to HTML—it includes starting and, in most cases, ending tags, and each tag is enclosed in angle brackets. All ending tags are preceded with a forward slash (/) and all tag names are preceded with `cf`; for example:

```
<cfntagname>
    tag body text and CFML
</cfntagname>
```

CFML increases productivity by providing a layer of abstraction that hides many low-level details involved with Internet application programming. At the same time, CFML is extremely powerful and flexible. ColdFusion lets you easily build applications that integrate files, databases, legacy systems, mail servers, FTP servers, objects, and components.

CFML tags serve many functions. They provide programming constructs, such as conditional processing and loop structures. They also provide services, such as charting and graphing, full-text search, access to protocols such as FTP, SMTP/POP, and HTTP, and much more. The following table lists a few examples of commonly used ColdFusion tags:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfquery</td>
<td>Establishes a connection to a database (if one does not exist), executes a query, and returns results to the ColdFusion environment.</td>
</tr>
<tr>
<td>cfoutput</td>
<td>Displays output that can contain the results of processing ColdFusion functions, variables, and expressions.</td>
</tr>
<tr>
<td>cfset</td>
<td>Sets the value of a ColdFusion variable.</td>
</tr>
<tr>
<td>cfmail</td>
<td>Lets an application send SMTP mail messages using application variables, query results, or server files. (Another tag, cfpop, gets mail.)</td>
</tr>
<tr>
<td>cfchart</td>
<td>Converts application data or query results into graphs, such as bar charts or pie charts, in Flash, JPG, or PNG format.</td>
</tr>
<tr>
<td>cfobject</td>
<td>Invokes objects written in other programming languages, including COM (Component Object Model) components, Java objects such as Enterprise JavaBeans, or Common CORBA (Object Request Broker Architecture) objects.</td>
</tr>
</tbody>
</table>

*CFML Reference* describes the CFML tags in detail.

**CFML functions and CFScript**
CFML includes built-in functions that perform a variety of roles, including string manipulation, data management, and system functions. CFML also includes a built-in scripting language, CFScript, that lets you write code in a manner that is familiar to programmers and JavaScript writers.

**CFML extensions**
You can extend CFML further by creating custom tags or user-defined functions (UDFs), or by integrating COM, C++, and Java components (such as JSP tag libraries). You can also create ColdFusion components (CFCs), which encapsulate related functions and properties and provide a consistent interface for accessing them.

All these features let you easily create reusable functionality that is customized to the types of applications or websites that you are building.

**CFML development tools**
Adobe® Dreamweaver® CS3 helps you develop ColdFusion applications efficiently. It includes many features that simplify and enhance ColdFusion development, including tools for debugging CFML. Because CFML is written in an HTML-like text format, and you often use HTML in ColdFusion pages, you can also use an HTML editor or a text editor, such as Notepad, to write ColdFusion applications.
ColdFusion 8 includes a line debugger that you can use to debug your ColdFusion applications in Eclipse™ or Adobe Flex™ Builder™.

**Verity Search Server**

The Verity Search Server (also called the Verity search engine) provides full text search capability for documents and data on a ColdFusion site.

**ColdFusion Administrator**

ColdFusion Administrator configures and manages the ColdFusion application server. It is a secure web-based application that you can access using any web browser, from any computer with an Internet connection. It includes a Server Monitor, which lets you see the status of your ColdFusion server.

For more information about ColdFusion Administrator, see *Configuring and Administering ColdFusion*.

**About J2EE and the ColdFusion architecture**

As the Internet software market has matured, the infrastructure services required by distributed Internet applications, including ColdFusion applications, have become increasingly standardized. The most widely adopted standard today is the Java 2 Platform, Enterprise Edition (J2EE) specification. J2EE provides a common set of infrastructure services for accessing databases, protocols, and operating system functionality, across multiple operating systems.

**About ColdFusion and the J2EE platform**

ColdFusion is implemented on the Java technology platform and uses a J2EE application server for many of its base services, including database connectivity, naming and directory services, and other runtime services. ColdFusion can be configured to use an embedded J2EE server (in the server configuration) or it can be deployed as a J2EE application on an independent J2EE application server (in the multiserver configuration or the J2EE configuration). ColdFusion Enterprise includes a fully featured version of the JRun J2EE application server, or can be deployed on third-party J2EE servers such as IBM WebSphere and BEA WebLogic.

For more information on ColdFusion configurations, see *Installing and Using ColdFusion*.

By implementing the ColdFusion scripting environment on top of the J2EE platform, ColdFusion takes advantage of the power of the J2EE platform while also providing an easy-to-use scripting environment and built-in services. Moreover, because ColdFusion is built on a J2EE platform, you can easily integrate J2EE and Java functionality into your ColdFusion application. As a result, ColdFusion pages can do any of the following:

- Share session data with JSPs (Java Server Pages) and Java servlets.
- Import custom JSP tag libraries and use them like ColdFusion custom tags.
- Integrate with Java objects, including the J2EE Java API, JavaBeans, and Enterprise JavaBeans.

For more information on using J2EE features in ColdFusion, see “Integrating J2EE and Java Elements in CFML Applications” on page 927.
Part 1: The CFML Programming Language

This part contains the following topics:

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- Using ColdFusion Variables ................................................... 24
- Using Expressions and Number Signs .................................... 50
- Using Arrays and Structures ................................................. 68
- Extending ColdFusion Pages with CFML Scripting .................. 92
- Using Regular Expressions in Functions ................................. 107
Chapter 2: Elements of CFML

The basic elements of CFML, including tags, functions, constants, variables, expressions, and CFScript, make it a powerful tool for developing interactive web applications.

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CFML Basics

CFML is a dynamic application development tool with many of the features of a programming language, including functions, expressions, variables and constants, and flow-control constructs, such as if-then and loops. CFML also has a “language within a language,” CFScript, which enables you to use a syntax similar to JavaScript for many operations.

These elements and other basic CFML entities such as comments, data types, escape characters, and reserved words, let you create complex applications.

Comments

ColdFusion comments have a similar format to HTML comments. However, they use three dash characters instead of two; for example:

<!---- This is a ColdFusion Comment. Browsers do not receive it. ---->

The ColdFusion server removes all ColdFusion comments from the page before returning it to the web server. As a result, the page that a user's browser receives does not include the comment, and users cannot see the comment even if they view the page source.

You can embed CFML comments in begin tags (not just tag bodies), functions calls, and variable text in number signs. ColdFusion ignores the text in comments such as the following:
<cfset MyVar = var1 <!--- & var2 --->>>
<cfoutput>#{Dateformat(now() <!---, "dddd, mmmm yyyy" --->)}#</cfoutput>

This technique can be useful if you want to temporarily comment out parts of expressions or optional attributes or arguments.

You can also nest comments, as the following example shows:

```
<cfset errormessage1="Oops!">
<cfoutput>
#errormessage1#</cfoutput>
```

This is useful if you want to temporarily disable a section of code while you test your application.

You can embed comments within comments, however, you should use this technique carefully.

**Note:** You cannot embed comments inside a tag name or function name, such as `<cf_My<!---- New --->CustomTag>`.
You also cannot embed comments inside strings, as in the following example: `IsDefined("My<!---- New --- >Variable")`.

## Tags

ColdFusion tags tell the ColdFusion server that it must process information. The ColdFusion server only processes tag contents; it returns text outside of ColdFusion to the web server unchanged. ColdFusion provides a wide variety of built-in tags and lets you create custom tags.

### Tag syntax

ColdFusion tags have the same format as HTML tags. They are enclosed in angle brackets (< and >) and can have zero or more named attributes. Many ColdFusion tags have bodies; that is, they have beginning and end tags with text to be processed between them. For example:

```
<cfoutput>
Hello #YourName#! <br>
</cfoutput>
```

Other tags, such as `cfset` and `cfhttp`, never have bodies; all the required information goes between the beginning (<) character and the ending (>) character, as in the following example:

```
<cfset YourName="Bob">
```

**Note:** The `cfset` tag differs from other tags in that it has neither a body nor arguments. Instead, the tag encloses an assignment statement that assigns a value to a variable. The `cfset` tag can also call a function without assigning a value to a result variable.

Sometimes, although the tag can have a body, you do not need to put anything in it because the attributes specify all the required information. You can omit the end tag and put a forward slash character before the closing (>) character, as in the following example:

```
<cfprocessingdirective pageencoding="euc-tp" />
```
In most cases, you specify tag attributes directly in the tag using the format `attributeName="attributeValue"`, as the preceding example shows. However, as an alternative, you can put all the attributes in a structure and specify the structure in a single `attributeCollection` attribute, using the following format:

```html
<tagname attributeCollection="#structureName#">
```

When you use this format for all built-in ColdFusion tags except `cfmodule`, the tag must have only the `attributeCollection` attribute. This format is useful when you use dynamic arguments, where the number and values of the arguments to a tag can vary based on processing results. The following example shows this usage:

```html
<!---- Configure dynamic attribute variables. --->
<cfparam name="theURL" default="http://www.adobe.com">
<cfparam name="resolveURL" default="yes">

<!---- Code that dynamically changes values for attributes might go here. --->

<!---- Create an arguments structure using variables. --->
<cfset myArgs=StructNew()>  
<cfset myArgs.url="#theURL#">
<!---- Include a user name and password only if they are available. --->
<cfif IsDefined("username")>
  <cfset myArgs.username="#username#">
</cfif>
<cfif IsDefined("password")>
  <cfset myArgs.password="#password#">
</cfif>
<cfset myArgs.resolveURL="#resolveURL#">
<cfset myArgs.timeout="2">

<!---- Use the myArgs structure to specify the cfhttp tag attributes. --->
<cfhttp attributeCollection="#myArgs#">
<cfoutput>
  #cfhttp.fileContent#  
</cfoutput>
```

**Note:** The `attributeCollection` attribute used in the `cfmodule` tag and when calling custom tags directly is different from the `attributeCollection` attribute for all other tags. In the `cfmodule` tag and in custom tags, you can mix the `attributeCollection` attribute and explicit custom tag attributes. Also, in the `cfmodule` tag, the `attributeCollection` attribute cannot contain the `name` and `template` attributes. You must specify these attributes directly in the `cfmodule` tag.

### Built-in tags

Built-in tags make up the heart of ColdFusion. These tags have many uses, including the following:

- Manipulating variables
Custom tags
ColdFusion lets you create custom tags. You can create two types of custom tags:

- CFML custom tags that are ColdFusion pages
- CFX tags that you write in a programming language such as Java or C++

Custom tags can encapsulate frequently used business logic or display code. These tags enable you to place frequently used code in one place and call it from many places. Custom tags also let you abstract complex logic into a single, simple interface. They provide an easy way to distribute your code to others; you can even distribute encrypted versions of the tags to prevent access to the tag logic.

You can access a variety of free and commercial custom tags on the Adobe developer's exchange (www.adobe.com/devnet/coldfusion/index.html). They perform tasks ranging from checking if Cookies and JavaScript are enabled on the client's browser to moving items from one list box to another. Many of these tags are free and include source code.

CFML custom tags
When you write a custom tag in CFML, you can take advantage of all the features of the ColdFusion language, including all built-in tags and even other custom tags. CFML custom tags can include body sections and end tags. Because they are written in CFML, you do not need to know a programming language such as Java. CFML custom tags provide more capabilities than user-defined functions, but are less efficient.

For more information on CFML custom tags, see “Creating and Using Custom CFML Tags” on page 190. For information about, and comparisons among, ways to reuse ColdFusion code, including CFML custom tags, user-defined functions, and CFX tags, see “Creating ColdFusion Elements” on page 126.

CFX Tags
CFX tags are ColdFusion custom tags that you write in a programming language such as Java or C++. These tags can take full advantage of all the tools and resources provided by these languages, including their access to runtime environments. CFX tags also generally execute faster than CFML custom tags because they are compiled. CFX tags can be cross-platform, but are often platform-specific, for example if they take advantage of COM objects or the Windows API.

For more information on CFX tags, see “Building Custom CFXAPI Tags” on page 205.
Functions

Functions typically manipulate data and return a result. You can also create user-defined functions (UDFs), sometimes referred to as custom functions.

Functions have the following general form:

```
functionName([argument1[, argument2]][...])
```

Some functions, such as the `Now` function take no arguments. Other functions require one or more comma-separated arguments and can have additional optional arguments. All ColdFusion functions return a value. For example, `Round(3.14159)` returns the value 3.

Built-in functions

ColdFusion built-in functions perform a variety of tasks, including, but not limited to, the following:

- Creating and manipulating complex data variables, such as arrays, lists, and structures
- Creating and manipulating queries
- Creating, analyzing, manipulating, and formatting strings and date and time values
- Evaluating the values of dynamic data
- Determining the type of a variable value
- Converting data between formats
- Performing mathematical operations
- Getting system information and resources

For alphabetical and categorized lists of ColdFusion functions, see "ColdFusion Functions" on page 636 in the CFML Reference.

You use built-in functions throughout ColdFusion pages. Built-in functions are frequently used in a `cfset` or `cfoutput` tag to prepare data for display or further use. For example, the following line displays today's date in the format October 24, 2007:

```
<cfoutput>#DateFormat(Now(), "mmmm d, yyyy")#</cfoutput>
```

Note that this code uses two nested functions. The `Now` function returns a ColdFusion date-time value representing the current date and time. The `DateFormat` function takes the value returned by the `Now` function and converts it to the desired string representation.

Functions are also valuable in CFScript scripts. ColdFusion does not support ColdFusion tags in CFScript, so you must use functions to access ColdFusion functionality in scripts.

User-defined functions

You can write your own functions, user-defined functions (UDFs). You can use these functions in ColdFusion expressions or in CFScript. You can call a user-defined function anywhere you can use a built-in CFML function. You create UDFs using the `cffunction` tag or the CFScript `function` statement. UDFs that you create using the `cffunction` tag can include ColdFusion tags and functions. UDFs that you create in CFScript can only include functions. You can create stand-alone UDFs or encapsulate them in a ColdFusion component.
User-defined functions let you encapsulate logic and operations that you use frequently in a single unit. This way, you can write the code once and use it multiple times. UDFs ensure consistency of coding and enable you to structure your CFML more efficiently.

Typical user-defined functions include mathematical routines, such as a function to calculate the logarithm of a number; string manipulation routines, such as a function to convert a numeric monetary value to a string such as “two dollars and three cents”; and can even include encryption and decryption routines.

*Note:* The Common Function Library Project at [www.cflib.org](http://www.cflib.org) includes a number of free libraries of user-defined functions.

For more information on user-defined functions, see “Writing and Calling User-Defined Functions” on page 134.

### ColdFusion components

ColdFusion components encapsulate multiple, related, functions. A ColdFusion component is essentially a set of related user-defined functions and variables, with additional functionality to provide and control access to the component contents. ColdFusion components can make their data private, so that it is available to all functions (also called methods) in the component, but not to any application that uses the component.

ColdFusion components have the following features:

- They are designed to provide related services in a single unit.
- They can provide web services and make them available over the Internet.
- They can provide ColdFusion services that Flash clients can call directly.
- They have several features that are familiar to object-oriented programmers, including data hiding, inheritance, packages, and introspection.

For more information on ColdFusion components, see “Building and Using ColdFusion Components” on page 158.

### Constants

The value of a constant does not change during program execution. Constants are simple scalar values that you can use within expressions and functions, such as “Robert Trent Jones” and 123.45. Constants can be integers, real numbers, time and date values, Boolean values, or text strings. ColdFusion does not allow you to give names to constants.

### Variables

Variables are the most frequently used operands in ColdFusion expressions. Variable values can be set and reset, and can be passed as attributes to CFML tags. Variables can be passed as parameters to functions, and can replace most constants.

ColdFusion has a number of built-in variables that provide information about the server and are returned by ColdFusion tags. For a list of the ColdFusion built-in variables, see “Reserved Words and Variables” on page 2 in the CFML Reference.
The following two characteristics classify a variable:

- The **scope** of the variable, which indicates where the information is available and how long the variable persists
- The **data type** of the variable's value, which indicates the kind of information a variable represents, such as number, string, or date

The following section lists and briefly describes the variable scopes. "Data types" on page 17 lists data types (which also apply to constant values). For detailed information on ColdFusion variables, including data types, scopes, and their use, see "Using ColdFusion Variables" on page 24.

**Variable scopes**

The following table describes ColdFusion variable scopes:

<table>
<thead>
<tr>
<th>Scope</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables (local)</td>
<td>The default scope for variables of any type that are created with the <code>cfset</code> and <code>cfparam</code> tags. A local variable is available only on the page on which it is created and any included pages.</td>
</tr>
<tr>
<td>Form</td>
<td>The variables passed from a form page to its action page as the result of submitting the form.</td>
</tr>
<tr>
<td>URL</td>
<td>The parameters passed to the current page in the URL that is used to call it.</td>
</tr>
<tr>
<td>Attributes</td>
<td>The values passed by a calling page to a custom tag in the custom tag's attributes. Used only in custom tag pages.</td>
</tr>
<tr>
<td>Caller</td>
<td>A reference, available in a custom tag, to the Variables scope of the page that calls the tag. Used only in custom tag pages.</td>
</tr>
<tr>
<td>ThisTag</td>
<td>Variables that are specific to a custom tag, including built-in variables that provide information about the tag. Used only in custom tag pages. A nested custom tag can use the <code>cfassociate</code> tag to return values to the calling tag's ThisTag scope.</td>
</tr>
<tr>
<td>Request</td>
<td>Variables that are available to all pages, including custom tags and nested custom tags, that are processed in response to an HTTP request. Used to hold data that must be available for the duration of one HTTP request.</td>
</tr>
<tr>
<td>CGI</td>
<td>Environment variables identifying the context in which a page was requested. The variables available depend on the browser and server software.</td>
</tr>
<tr>
<td>Cookie</td>
<td>Variables maintained in a user's browser as cookies.</td>
</tr>
<tr>
<td>Client</td>
<td>Variables that are associated with one client. Client variables let you maintain state as a user moves from page to page in an application and are available across browser sessions.</td>
</tr>
<tr>
<td>Session</td>
<td>Variables that are associated with one client and persist only as long as the client maintains a session.</td>
</tr>
<tr>
<td>Application</td>
<td>Variables that are associated with one, named, application on a server. The Application.cfc initialization code or the <code>cfapplication</code> tag <code>name</code> attribute specifies the application name.</td>
</tr>
<tr>
<td>Server</td>
<td>Variables that are associated with the current ColdFusion server. This scope lets you define variables that are available to all your ColdFusion pages, across multiple applications.</td>
</tr>
<tr>
<td>Flash</td>
<td>Variables sent by an Adobe Flash movie to ColdFusion and returned by ColdFusion to the movie.</td>
</tr>
<tr>
<td>Arguments</td>
<td>Variables passed in a call to a user-defined function or ColdFusion component method.</td>
</tr>
<tr>
<td>This</td>
<td>Variables that are declared inside a ColdFusion component or in a <code>cffunction</code> tag that is not part of a ColdFusion component.</td>
</tr>
<tr>
<td>function local</td>
<td>Variables that are declared in a user-defined function and exist only while the function executes.</td>
</tr>
</tbody>
</table>
Expressions

ColdFusion expressions consist of operands and operators. Operands are comprised of constants and variables, such as "Hello" or MyVariable. Operators, such as the string concatenation operator (&) or the division operator (/) are the verbs that act on the operands. ColdFusion functions also act as operators.

The simplest expression consists of a single operand with no operators. Complex expressions consist of multiple operands and operators. For example, the following statements are all ColdFusion expressions:

```
12
MyVariable
(1 + 1)/2
"father" & "Mother"
Form.divisor/Form.dividend
Round(3.14159)
```

For detailed information on using variables, see "Using ColdFusion Variables" on page 24. For detailed information on expressions and operators, see "Using Expressions and Number Signs" on page 50.

Data types

ColdFusion is considered typeless because you do not explicitly specify variable data types.

However, ColdFusion data, the constants and the data that variables represent, do have data types, which correspond to the ways the data is stored on the computer.

ColdFusion data belongs to the following type categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description and types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>Represents one value. You can use simple data types directly in ColdFusion expressions. ColdFusion simple data types are:</td>
</tr>
<tr>
<td></td>
<td>• strings A sequence of alphanumeric characters enclosed in single or double quotation marks, such as &quot;This is a test.&quot;</td>
</tr>
<tr>
<td></td>
<td>• integers A sequence of numbers written without quotation marks, such as 356.</td>
</tr>
<tr>
<td></td>
<td>• real numbers, such as -3.14159</td>
</tr>
<tr>
<td></td>
<td>• Boolean values Use True, Yes, or 1 for true and False, No, or 0 for false. Boolean values are not case-sensitive.</td>
</tr>
<tr>
<td></td>
<td>• date-time values ColdFusion supports a variety of data formats. For more information, see &quot;Date and time formats&quot; on page 29.</td>
</tr>
<tr>
<td>Complex</td>
<td>A container for data. Complex variables generally represent more than one value. ColdFusion built-in complex data types are:</td>
</tr>
<tr>
<td></td>
<td>• arrays</td>
</tr>
<tr>
<td></td>
<td>• structures</td>
</tr>
<tr>
<td></td>
<td>• queries</td>
</tr>
<tr>
<td>Binary</td>
<td>Raw data, such as the contents of a GIF file or an executable program file</td>
</tr>
<tr>
<td>Object</td>
<td>COM, CORBA, Java, web services, and ColdFusion Component objects. Complex objects that you create and access using the cfobject tag and other specialized tags.</td>
</tr>
</tbody>
</table>
Note: ColdFusion does not have a data type for unlimited precision decimal numbers, but it can represent such numbers as strings and provides a function that supports unlimited precision decimal arithmetic. For more information, see PrecisionEvaluate in the CFML Reference.

For more information on ColdFusion data types, see “Using ColdFusion Variables” on page 24.

Flow control

ColdFusion provides several tags that let you control how a page gets executed. These tags generally correspond to programming language flow control statements, such as if, then, and else. The following tags provide ColdFusion flow control:

<table>
<thead>
<tr>
<th>Tags</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfif, cfelseif, cfelse</td>
<td>Select sections of code based on whether expressions are True or False.</td>
</tr>
<tr>
<td>cfswitch, cfcase, cfdefaultcase</td>
<td>Select among sections of code based on the value of an expression. Case processing is not limited to True and False conditions.</td>
</tr>
<tr>
<td>cfloop, cfbreak</td>
<td>Loop through code based on any of the following values: entries in a list, keys in a structure or external object, entries in a query column, an index, or the value of a conditional expression.</td>
</tr>
<tr>
<td>cfabort, cfexit</td>
<td>End processing of a ColdFusion page or custom tag.</td>
</tr>
</tbody>
</table>

This section provides a basic introduction to using flow-control tags. CFScript also provides a set of flow-control statements. For information on using flow-control statements in CFScript, see “Extending ColdFusion Pages with CFML Scripting” on page 92. For more details on using flow-control tags, see the reference pages for these tags in the CFML Reference.

**cfif, cfelseif, and cfelse**

The cfif, cfelseif, and cfelse tags provide if-then-else conditional processing, as follows:

1. The cfif tag tests a condition and executes its body if the condition is True.
2. If the preceding cfif (or cfelseif) test condition is False, the cfelseif tag tests another condition and executes its body if that condition is True.
3. The cfelse tag can optionally follow a cfif tag and zero or more cfelseif tags. Its body executes if all the preceding tags’ test conditions are False.

The following example shows the use of the cfif, cfelseif, and cfelse tags. If the value of the type variable is “Date,” the date displays; if the value is “Time,” the time displays; otherwise, both the time and date display.

```cfml
<cfif type IS "Date">
  <cfoutput>#DateFormat(Now())#</cfoutput>
</cfif>
<cfelseif type IS "Time">
  <cfoutput>#TimeFormat(Now())#</cfoutput>
</cfelseif>
<cfelse>
  <cfoutput>#TimeFormat(Now())#, #DateFormat(Now())#</cfoutput>
</cfelse>
```

**cfswitch, cfcase, and cfdefaultcase**

The cfswitch, cfcase, and cfdefaultcase tags let you select among different code blocks based on the value of an expression. ColdFusion processes these tags as follows:
1. The `cfswitch` tag evaluates an expression. The `cfswitch` tag body contains one or more `cfcase` tags and optionally includes `cfdefaultcase` tag.

2. Each `cfcase` tag in the `cfswitch` tag body specifies a value or set of values. If a value matches the value determined by the expression in the `cfswitch` tag, ColdFusion runs the code in the body of the `cfcase` tag and then exits the `cfswitch` tag. If two `cfcase` tags have the same condition, ColdFusion generates an error.

3. If none of the `cfcase` tags match the value determined by the `cfswitch` tag, and the `cfswitch` tag body includes a `cfdefaultcase` tag, ColdFusion runs the code in the `cfdefaultcase` tag body.

   **Note:** Although the `cfdefaultcase` tag does not have to follow all `cfcase` tags, it is good programming practice to put it at the end of the `cfswitch` statement.

The `cfswitch` tag provides better performance than a `cfif` tag with multiple `cfelseif` tags, and is easier to read. Switch processing is commonly used when different actions are required based on a string variable such as a month or request identifier.

The following example shows switch processing:

```cfoutput query = "GetEmployees">
<cfswitch expression = #Department#>
<cfcase value = "Sales">
    #FirstName# #LastName# is in <b>Sales</b><br><br>
</cfcase>
<cfcase value = "Accounting">
    #FirstName# #LastName# is in <b>Accounting</b><br><br>
</cfcase>
<cfcase value = "Administration">
    #FirstName# #LastName# is in <b>Administration</b><br><br>
</cfcase>
<cfdefaultcase>#FirstName# #LastName# is not in Sales, Accounting, or Administration.<br>
</cfdefaultcase>
</cfswitch>
</cfoutput>
```

**cfloop and cfbreak**

The `cfloop` tag loops through the tag body zero or more times based on a condition specified by the tag attributes. The `cfbreak` tag exits a `cfloop` tag.

**cfloop**

The `cfloop` tag provides the following types of loops:

<table>
<thead>
<tr>
<th>Loop type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>Loops through the body of the tag and increments a counter variable by a specified amount after each loop until the counter reaches a specified value.</td>
</tr>
<tr>
<td>Conditional</td>
<td>Checks a condition and runs the body of the tag if the condition is True.</td>
</tr>
<tr>
<td>Query</td>
<td>Loops through the body of the tag once for each row in a query.</td>
</tr>
<tr>
<td>List, file, or array</td>
<td>Loops through the body of the tag once for each entry in a list, each line in a file, or each item in an array.</td>
</tr>
<tr>
<td>Collection</td>
<td>Loops through the body of the tag once for each key in a ColdFusion structure or item in a COM/DCOM object.</td>
</tr>
</tbody>
</table>

The following example shows a simple index loop:

```<cfloop index = "LoopCount" from = 1 to = 5>```
The loop index is <cfoutput>#LoopCount#</cfoutput>.<br>
</cfloop>

The following example shows a simple conditional loop. The code does the following:

1. Sets up a ten-element array with the word “kumquats” in the fourth entry.
2. Loops through the array until it encounters an array element containing “kumquats” or it reaches the end of the array.
3. Prints out the value of the Boolean variable that indicates whether it found the word *kumquats* and the array index at which it exited the loop.

```cfscript
<cfset myArray = ArrayNew(1)>
<!--- Use ArraySet to initialize the first ten elements to 123 --->
<cfset ArraySet(myArray, 1, 10, 123)>
<cfset myArray[4] = "kumquats">
<cfset foundit = False>
<cfset i = 0>
<cfloop condition = "(NOT foundit) AND (i LT ArrayLen(myArray))">
    <cfset i = i + 1>
    <cfif myArray[i] IS "kumquats">
        <cfset foundit = True>
    </cfif>
</cfloop>
<cfoutput>
    i is #i#<br>
    foundit is #foundit#<br>
</cfoutput>
```

*Note:* You can get an infinite conditional loop if you do not force an end condition. In this example, the loop is infinite if you omit the `<cfset i = i + 1>` statement. To end an infinite loop, stop the ColdFusion application server.

**cfbreak**

The `cfbreak` tag exits the `cfloop` tag. You typically use it in a `<cfif>` tag to exit the loop if a particular condition occurs. The following example shows the use of a `cfbreak` tag in a query loop:

```cfscript
<cfloop query="fruitOrder">
    <cfif fruit IS "kumquat">
        <cfoutput>You cannot order kumquats!<br></cfoutput>
        <cfbreak>
    </cfif>
    <cfoutput>You have ordered #quantity# #fruit#. <br></cfoutput>
</cfloop>
```

**cfabort and cfexit**

The `cfabort` tag stops processing of the current page at the location of the `cfabort` tag. ColdFusion returns to the user or calling tag everything that was processed before the `cfabort` tag. You can optionally specify an error message to display. You can use the `cfabort` tag as the body of a `cfif` tag to stop processing a page when a condition, typically an error, occurs.

The `cfexit` tag controls the processing of a custom tag, and can only be used in ColdFusion custom tags. For more information see, “Terminating tag execution” on page 200 and the *CFML Reference.*
Character case

ColdFusion is case-insensitive. For example, the following all represent the `cfset` tag: `cfset`, `CFSET`, `CFSet`, and even `cfsEt`. However, you should get in the habit of consistently using the same case rules in your programs; for example:

- Develop consistent rules for case use, and stick to them. If you use lowercase characters for some tag names, use them for all tag names.
- Always use the same case for a variable. For example, do not use both `myvariable` and `MyVariable` to represent the same variable on a page.

Follow these rules to prevent errors on application pages where you use both CFML and case-sensitive languages, such as JavaScript.

Special characters

The double-quotation marks ("), single-quotation mark (‘), and number sign (#) characters have special meaning to ColdFusion. To include any of them in a string, double the character; for example, use `##` to represent a single # character.

The need to escape the single- and double-quotation marks is context-sensitive. Inside a double-quoted string, you do not need to escape single-quotation mark (apostrophe) characters. Inside a single-quoted string, you do not escape double-quotation mark characters.

The following example illustrates escaping special characters, including the use of mixed single- and double-quotation marks:

```cffml
cfset mystring = "We all said "Happy birthday to you.""
<cfset mystring2 = 'Then we said "How old are you now?"'>
<cfoutput>
  #mystring#
  #mystring2#
  Here is a number sign: ##
</cfoutput>
```

The output looks like this:

We all said "Happy birthday to you."
Then we said "How old are you now?"
Here is a number sign: #

Reserved words

As with any programming tool, you cannot use just any word or name for ColdFusion variables, UDFs and custom tags. You must avoid using any name that can be confused with a ColdFusion element. In some cases, if you use a word that ColdFusion uses—for example, a built-in structure name—you can overwrite the ColdFusion data.

The following list indicates words you must not use for ColdFusion variables, user-defined function names, or custom tag names. While some of these words can be used safely in some situations, you can prevent errors by avoiding them entirely. For a complete list of reserved words, see the CFML Reference.
• Built-in function names, such as Now or Hash
• Scope names, such as Form or Session
• Any name starting with cf. However, when you call a CFML custom tag directly, you prefix the custom tag page name with cf_.
• Operators, such as NE or IS
• The names of any built-in data structures, such as Error or File
• The names of any built-in variables, such as RecordCount or CGI variable names
• CFScript language element names such as for, default, or continue

You must also not create form field names ending in any of the following, except to specify a form field validation rule using a hidden form field name. (For more information on form field validation, see “Introduction to Retrieving and Formatting Data” on page 511.)

- _integer
- _float
- _range
- _date
- _time
- _eurodate

Because ColdFusion is not case-sensitive, all of the following are reserved words: IS, Is, iS, and is.

**CFScript**

*CFScript* is a language within a language. CFScript is a scripting language that is similar to JavaScript but is simpler to use. Also, unlike JavaScript, CFScript only runs on the ColdFusion server; it does not run on the client system. A CFScript script can use all ColdFusion functions and all ColdFusion variables that are available in the script’s scope.

CFScript provides a compact and efficient way to write ColdFusion logic. Typical uses of CFScript include:

- Simplifying and speeding variable setting
- Building compact flow control structures
- Encapsulating business logic in user-defined functions

The following sample script populates an array and locates the first array entry that starts with the word “key”. It shows several of the elements of CFScript, including setting variables, loop structures, script code blocks, and function calls. Also, the code uses a `cfoutput` tag to display its results. Although you can use CFScript for output, the `cfoutput` tag is usually easier to use.

```cfscript
<cfscript>
strings = ArrayNew(1);
strings[1]="the";
strings[2]="key to our";
strings[4]="idea";
for( i=1 ; i LE 4 ; i = i+1 )
{
    if(Find("key",strings[i],1))
        break;
}
```
<cfscript>
<cfoutput>Entry #i# starts with "key"</cfoutput><br>
</cfscript>

You use CFScript to create user-defined functions.

For more information on CFScript, see "Extending ColdFusion Pages with CFML Scripting" on page 92. For more information on user-defined functions, see “Writing and Calling User-Defined Functions” on page 134.
Chapter 3: Using ColdFusion Variables

Adobe ColdFusion variables are the most frequently used operands in ColdFusion expressions. Variable values can be set and reset, and can be passed as attributes to CFML tags. Variables can be passed as parameters to functions, and can replace most constants.

To create and use ColdFusion variables, you should know the following:

- How variables can represent different types of data
- How the data types get converted
- How variables exist in different scopes
- How the scopes are used
- How to use variables correctly

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Creating variables

You create most ColdFusion variables by assigning them values. (You must use the ArrayNew function to create arrays.) Most commonly, you create variables by using the cfset tag. You can also use the cfparam tag, and assignment statements in CFScript. Tags that create data objects also create variables. For example, the cfquery tag creates a query object variable.

ColdFusion automatically creates some variables that provide information about the results of certain tags or operations. ColdFusion also automatically generates variables in certain scopes, such as Client and Server. For information on these special variables, see “Reserved Words and Variables” on page 2 in the CFML Reference and the documentation of the CFML tags that create these variables.

ColdFusion generates an error when it tries to use a variable before it is created. This can happen, for example, when processing data from an incompletely filled form. To prevent such errors, test for the variable's existence before you use it. For more information on testing for variable existence, see “Ensuring variable existence” on page 46.

For more information on how to create variables, see “Creating and using variables in scopes” on page 43.
Variable naming rules

ColdFusion variable names, including form field names and custom function and ColdFusion component argument names, must conform to Java naming rules and the following guidelines:

• A variable name must begin with a letter, underscore, or Unicode currency symbol.
• The initial character can be followed by any number of letters, numbers, underscore characters, and Unicode currency symbols.
• A variable name cannot contain spaces.
• A query result is a type of variable, so it overwrites a local variable with the same name.
• ColdFusion variables are not case-sensitive. However, consistent capitalization makes the code easier to read.
• When creating a form with fields that are used in a query, match form field names with the corresponding database field names.
• Periods separate the components of structure or object names. They also separate a variable scope from the variable name. You cannot use periods in simple variable names, with the exception of variables in the Cookie and Client scopes. For more information on using periods, see “Using periods in variable references” on page 35.

The following rule applies to variable names, but does not apply to form field and argument names:

1 Prefix each variable’s name with its scope. Although some ColdFusion programmers do not use the Variables prefix for local variable names, you should use prefixes for all other scopes. Using scope prefixes makes variable names clearer and increases code efficiency. In many cases, you must prefix the scope. For more information, see “About scopes” on page 42.

Note: In some cases, when you use an existing variable name, you must enclose it with number signs (#) to allow ColdFusion to distinguish it from string or HTML text, and to insert its value, as opposed to its name. For more information, see “Using number signs” on page 55.

Variable characteristics

You can classify a variable using the following characteristics:

• The data type of the variable value, which indicates the kind of information a variable represents, such as number, string, or date
• The scope of the variable, which indicates where the information is available and how long the variable persists

The following sections provide detailed information on Data types and scopes.

Data types

ColdFusion is often referred to as typeless because you do not assign types to variables and ColdFusion does not associate a type with the variable name. However, the data that a variable represents does have a type, and the data type affects how ColdFusion evaluates an expression or function argument. ColdFusion can automatically convert many data types into others when it evaluates expressions. For simple data, such as numbers and strings, the data type is unimportant until the variable is used in an expression or as a function argument.

ColdFusion variable data belongs to one of the following type categories:
• **Simple**: One value. Can use directly in ColdFusion expressions. Include numbers, strings, Boolean values, and date-time values.

• **Complex**: A container for data. Generally represent more than one value. ColdFusion built-in complex data types include arrays, structures, queries, and XML document objects.

  You cannot use a complex variable, such as an array, directly in a ColdFusion expression, but you can use simple data type elements of a complex variable in an expression.

  For example, with a one-dimensional array of numbers called `myArray`, you cannot use the expression `myArray * 5`. However, you could use an expression `myArray[3] * 5` to multiply the third element in the array by five.

• **Binary**: Raw data, such as the contents of a GIF file or an executable program file.

• **Objects**: Complex constructs. Often encapsulate both data and functional operations. The following table lists the types of objects that ColdFusion can use, and identifies the chapters that describe how to use them:

<table>
<thead>
<tr>
<th>Object type</th>
<th>See</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component Object Model (COM)</td>
<td>“Integrating COM and CORBA Objects in CFML Applications” on page 972</td>
</tr>
<tr>
<td>Common Object Request Broker Architecture (CORBA)</td>
<td>“Integrating COM and CORBA Objects in CFML Applications” on page 972</td>
</tr>
<tr>
<td>Java</td>
<td>“Integrating J2EE and Java Elements in CFML Applications” on page 927</td>
</tr>
<tr>
<td>ColdFusion component</td>
<td>“Building and Using ColdFusion Components” on page 158</td>
</tr>
<tr>
<td>Web service</td>
<td>“Using Web Services” on page 900</td>
</tr>
</tbody>
</table>

**Data type notes**

Although ColdFusion variables do not have types, it is often convenient to use “variable type” as a shorthand for the type of data that the variable represents.

ColdFusion can validate the type of data contained in form fields and query parameters. For more information, see “Testing for a variable’s existence” on page 517 and “Using cfqueryparam” on page 399.

The `cfdump` tag displays the entire contents of a variable, including ColdFusion complex data structures. It is an excellent tool for debugging complex data and the code that handles it.

ColdFusion provides the following functions for identifying the data type of a variable:

• `IsArray`
• `IsBinary`
• `IsBoolean`
• `IsObject`
• `IsQuery`
• `IsSimpleValue`
• `IsStruct`
• `IsXmlDoc`

ColdFusion also includes the following functions for determining whether a string can be represented as or converted to another data type:

• `IsDate`
• `IsNumeric`
ColdFusion does not use a null data type. However, if ColdFusion receives a null value from an external source such as a database, a Java object, or some other mechanism, it maintains the null value until you use it as a simple value. At that time, ColdFusion converts the null to an empty string (""). Also, you can use the JavaCast function in a call to a Java object to convert a ColdFusion empty string to a Java null.

**Numbers**

ColdFusion supports integers and real numbers. You can intermix integers and real numbers in expressions; for example, 1.2 + 3 evaluates to 4.2.

**Integers**

ColdFusion supports integers between -2,147,483,648 and 2,147,483,647 (32-bit signed integers). You can assign a value outside this range to a variable, but ColdFusion initially stores the number as a string. If you use it in an arithmetic expression, ColdFusion converts it into a floating point value, preserving its value, but losing precision as the following example shows:

```cfset mybignum=12345678901234567890>
<cfset mybignumtimes10=(mybignum * 10)>
<cfoutput>mybignum is: #mybignum#</cfoutput><br>
<cfoutput>mybignumtimes10 is: #mybignumtimes10# </cfoutput><br>
```

This example generates the following output:

mybignum is: 12345678901234567890
mybignumtimes10 is: 1.23456789012E+020

**Real numbers**

Real numbers, numbers with a decimal part, are also known as floating point numbers. ColdFusion real numbers can range from approximately -10\(^{300}\) to approximately 10\(^{300}\). A real number can have up to 12 significant digits. As with integers, you can assign a variable a value with more digits, but the data is stored as a string. The string is converted to a real number, and can lose precision, when you use it in an arithmetic expression.

You can represent real numbers in scientific notation. This format is \(xE_y\), where \(x\) is a positive or negative real number in the range 1.0 (inclusive) to 10 (exclusive), and \(y\) is an integer. The value of a number in scientific notation is \(x\) times \(10^y\). For example, 4.0E2 is 4.0 times \(10^2\) which equals 400. Similarly, 2.5E-2 is 2.5 times \(10^{-2}\), which equals 0.025. Scientific notation is useful for writing very large and very small numbers.

**BigDecimal numbers**

ColdFusion does not have a special BigDecimal data type for arbitrary length decimal numbers such as 123456789098756.234678503059281. Instead, it represent such numbers as strings. ColdFusion does, however, have a PrecisionEvaluate function that can take an arithmetic expression that uses BigDecimal values, calculate the expression, and return a string with the resulting BigDecimal value. For more information, see PrecisionEvaluate in the CFML Reference.

**Strings**

In ColdFusion, text values are stored in strings. You specify strings by enclosing them in either single- or double- quotation marks. For example, the following two strings are equivalent:
"This is a string"
'This is a string'

You can write an empty string in the following ways:

- "" (a pair of double-quotation marks with nothing in between)
- '' (a pair of single-quotation marks with nothing in between)

Strings can be any length, limited by the amount of available memory on the ColdFusion server. However, the default size limit for long text retrieval (CLOB) is 64K. The ColdFusion Administrator lets you increase the limit for database string transfers, but doing so can reduce server performance. To change the limit, select the Enable retrieval of long text option on the Advanced Settings page for the data source.

**Escaping quotation marks and number signs**

To include a single-quotation character in a string that is single-quoted, use two single-quotation marks (known as escaping the single-quotation mark). The following example uses escaped single-quotation marks:

```cfc
cfset myString='This is a single-quotation mark: '' This is a double-quotation mark: "'
cfoutput #myString#<br>
```

To include a double-quotation mark in a double-quoted string, use two double-quotation marks (known as escaping the double-quotation mark). The following example uses escaped double-quotation marks:

```cfc
cfset myString="This is a single-quotation mark: ' This is a double-quotation mark: ""
cfoutput #myString#<br>
```

Because strings can be in either double-quotation marks or single-quotation marks, both of the preceding examples display the same text:

This is a single-quotation mark: ' This is a double-quotation mark: 

To insert a number sign (#) in a string, you must escape the number sign, as follows:

"This is a number sign ##"

**Lists**

ColdFusion includes functions that operate on lists, but it does not have a list data type. In ColdFusion, a list is just a string that consists of multiple entries separated by delimiter characters.

The default delimiter for lists is the comma. If you use any other character to separate list elements, you must specify the delimiter in the list function. You can also specify multiple delimiter characters. For example, you can tell ColdFusion to interpret a comma or a semicolon as a delimiter, as the following example shows:

```cfc
cfset MyList="1,2;3,4;5"
cfoutput
List length using ; and , as delimiters: #listlen(Mylist, ";,"#<br>
List length using only , as a delimiter: #listlen(Mylist)#<br>
</cfoutput>
```

This example displays the following output:

List length using ; and , as delimiters: 5
List length using only , as a delimiter: 3

Each delimiter must be a single character. For example, you cannot tell ColdFusion to require two hyphens in a row as a delimiter.
If a list has two delimiters in a row, ColdFusion ignores the empty element. For example, if MyList is "1,2,3,4,,5" and the delimiter is the comma, the list has five elements and list functions treat it the same as "1,2,3,4,5".

**Boolean values**

A *Boolean* value represents whether something is true or false. ColdFusion has two special constants—True and False—to represent these values. For example, the Boolean expression `1 IS 1` evaluates to True. The expression "Monkey" CONTAINS "Money" evaluates to False.

You can use Boolean constants directly in expressions, as in the following example:

```
<cfset UserHasBeenHere = True>
```

In Boolean expressions, True, nonzero numbers, and the string “Yes” are equivalent, and False, 0, and the string “No” are equivalent.

In Boolean expressions, True, nonzero numbers, and the strings “Yes”, “1|”, “True” are equivalent; and False, 0, and the strings “No”, “0”, and “False” are equivalent.

Boolean evaluation is not case-sensitive. For example, True, TRUE, and true are equivalent.

**Date-Time values**

ColdFusion can perform operations on date and time values. Date-time values identify a date and time in the range 100 AD to 9999 AD. Although you can specify just a date or a time, ColdFusion uses one data type representation, called a date-time object, for date, time, and date and time values.

ColdFusion provides many functions to create and manipulate date-time values and to return all or part of the value in several different formats.

You can enter date and time values directly in a `cfset` tag with a constant, as follows:

```
<cfset myDate = "October 30, 2001">
```

When you do this, ColdFusion stores the information as a string. If you use a date-time function, ColdFusion stores the value as a date-time object, which is a separate simple data type. When possible, use date-time functions such as `CreateDate` and `CreateTime` to specify dates and times, because these functions can prevent you from specifying the date or time in an invalid format and they create a date-time object immediately.

**Date and time formats**

You can directly enter a date, time, or date and time, using standard U.S. date formats. ColdFusion processes the two-digit-year values 0 to 29 as twenty-first century dates; it processes the two-digit-year values 30 to 99 as twentieth century dates. Time values can include units down to seconds. The following table lists valid date and time formats:
Locale-specific dates and times

ColdFusion provides several functions that let you input and output dates and times (and numbers and currency values) in formats that are specific to the current locale. A locale identifies a language and locality, such as English (US) or French (Swiss). Use these functions to input or output dates and times in formats other than the U.S. standard formats. (Use the SetLocale function to specify the locale.) The following example shows how to do this:

```cfml
<cfset oldlocale = SetLocale("French (Standard)")>
<cfoutput>#LSDateFormat(Now(), "ddd, dd mmmm, yyyy")#</cfoutput>
```

This example outputs a line like the following:

mar., 03 juin, 2003

For more information on international functions, see "Developing Globalized Applications" on page 336 and the CFML Reference.

How ColdFusion stores dates and times

ColdFusion stores and manipulates dates and times as date-time objects. Date-time objects store data on a time line as real numbers. This storage method increases processing efficiency and directly mimics the method used by many popular database systems. In date-time objects, one day is equal to the difference between two successive integers. The time portion of the date-and-time value is stored in the fractional part of the real number. The value 0 represents 12:00 AM 12/30/1899.

Although you can use arithmetic operations to manipulate date-and-time values directly, this method can result in code that is difficult to understand and maintain. Use the ColdFusion date-time manipulation functions instead. For information on these functions, see the CFML Reference.
**Binary data type and binary encoding**

Binary data (also referred to as a binary object) is raw data, such as the contents of a GIF file or an executable program file. You do not normally use binary data directly, but you can use the `cffile` tag to read a binary file into a variable, typically for conversion to a string binary encoding before transmitting the file using e-mail.

A string binary encoding represents a binary value in a string format that can be transmitted over the web. ColdFusion supports three binary encoding formats:

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base64</td>
<td>Encodes the binary data in the lowest six bits of each byte. It ensures that binary data and non-ANSI character data can be transmitted using e-mail without corruption. The Base64 algorithm is specified by IETF RFC 2045, at <a href="http://www.ietf.org/rfc/rfc2045.txt">www.ietf.org/rfc/rfc2045.txt</a>.</td>
</tr>
<tr>
<td>Hex</td>
<td>Uses two characters in the range 0-9 and A-F represent the hexadecimal value of each byte; for example, 3A.</td>
</tr>
<tr>
<td>UU</td>
<td>Uses the UNIX UUEncode algorithm to convert the data.</td>
</tr>
</tbody>
</table>

ColdFusion provides the following functions that convert among string data, binary data, and string encoded binary data:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BinaryDecode</td>
<td>Converts a string that contains encoded binary data to a binary object.</td>
</tr>
<tr>
<td>BinaryEncode</td>
<td>Converts binary data to an encoded string.</td>
</tr>
<tr>
<td>CharsetDecode</td>
<td>Converts a string to binary data in a specified character encoding.</td>
</tr>
<tr>
<td>CharsetEncode</td>
<td>Converts a binary object to a string in a specified character encoding.</td>
</tr>
<tr>
<td>ToBase64</td>
<td>Converts string and binary data to Base64 encoded data.</td>
</tr>
<tr>
<td>ToBinary</td>
<td>Converts Base64 encoded data to binary data. The BinaryDecode function provides a superset of the ToBase64 functionality.</td>
</tr>
<tr>
<td>ToString</td>
<td>Converts most simple data types to string data. It can convert numbers, date-time objects, and boolean values. (It converts date-time objects to ODBC timestamp strings.) Adobe recommends that you use the CharsetEncode function to convert binary data to a string in new applications.</td>
</tr>
</tbody>
</table>

**Complex data types**

Arrays, structures, and queries are ColdFusion built-in complex data types. Structures and queries are sometimes referred to as objects, because they are containers for data, not individual data values.

For details on using arrays and structures, see “Using Arrays and Structures” on page 68.

**Arrays**

Arrays are a way of storing multiple values in a table-like format that can have one or more dimensions. To create an array and specify its initial dimensions, use the ColdFusion `ArrayNew` function. For example, the following line creates an empty two-dimensional array:

```
<cfset myarray=ArrayNew(2)>
```

You reference elements using numeric indexes, with one index for each dimension. For example, the following line sets one element of a two-dimensional array to the current date and time:

```
<cfset myarray[1][2]=Now()>  ```
The `ArrayNew` function can create arrays with up to three dimensions. However, there is no limit on array size or maximum dimension. To create arrays with more than three dimensions, create arrays of arrays.

After you create an array, you can use functions or direct references to manipulate its contents.

When you assign an existing array to a new variable, ColdFusion creates a new array and copies the old array’s contents to the new array. The following example creates a copy of the original array:

```cfset newArray=myArray```

For more information on using arrays, see “Using Arrays and Structures” on page 68.

**Structures**

ColdFusion structures consist of key-value pairs, where the keys are text strings and the values can be any ColdFusion data type, including other structures. Structures let you build a collection of related variables that are grouped under a single name. To create a structure, use the ColdFusion `StructNew` function. For example, the following line creates a new, empty, structure called `depts`:

```cfset depts=StructNew()>```

You can also create a structure by assigning a value in the structure. For example, the following line creates a new structure called `MyStruct` with a key named `MyValue`, equal to 2:

```cfset MyStruct.MyValue=2```

*Note: In previous ColdFusion versions, this line created a Variables scope variable named "MyStruct.MyValue" with the value 2.*

After you create a structure, you can use functions or direct references to manipulate its contents, including adding key-value pairs.

You can use either of the following methods to reference elements stored in a structure:

- `StructureName.KeyName`
- `StructureName["KeyName"]`

The following examples show these methods:

```depts.John="Sales"
depts["John"]="Sales`"
```

When you assign an existing structure to a new variable, ColdFusion does not create a new structure. Instead, the new variable accesses the same data (location) in memory as the original structure variable. In other words, both variables are references to the same object.

For example, the following line creates a new variable, `myStructure2`, that is a reference to the same structure as the `myStructure` variable:

```cfset myStructure2=myStructure```

When you change the contents of `myStructure2`, you also change the contents of `myStructure`. To copy the contents of a structure, use the ColdFusion `Duplicate` function, which copies the contents of structures and other complex data types.

Structure key names can be the names of complex data objects, including structures or arrays. This lets you create arbitrarily complex structures.

For more information on using structures, see “Using Arrays and Structures” on page 68.
Queries

A query object, sometimes referred to as a query, query result, or record set, is a complex ColdFusion data type that represents data in a set of named columns, similar to the columns of a database table. The following ColdFusion tags can create query objects:

- `cfquery`
- `cfdirectory`
- `cfhttp`
- `cfldap`
- `cfpop`
- `cfprocresult`

In these tags, the `name` attribute specifies the query object's variable name. The `queryNew` function also creates query objects.

When you assign a query to a new variable, ColdFusion does not copy the query object. Instead, both names point to the same record set data. For example, the following line creates a new variable, `myQuery2`, that references the same record set as the `myQuery` variable:

```cfset myQuery2 = myQuery```

If you make changes to data in `myQuery`, `myQuery2` also shows those changes.

You reference query columns by specifying the query name, a period, and the column name; for example:

`myQuery.Dept_ID`

When you reference query columns inside tags, such as `cfoutput` and `cfloop`, in which you specify the query name in a tag attribute, you do not have to specify the query name.

You can access query columns as if they are one-dimensional arrays. For example, the following line assigns the contents of the `Employee` column in the second row of the `myQuery` query to the variable `myVar`:

```cfset myVar = myQuery.Employee[2]```  

*Note:* You cannot use array notation to refer to a row (of all columns) of a query. For example, `myQuery[2]` does not refer to the second row of the `myQuery` query object.

**Working with structures and queries**

Because structure variables and query variables are references to objects, the rules in the following sections apply to both types of data.

**Multiple references to an object**

When multiple variables refer to a structure or query object, the object continues to exist as long as at least one reference to the object exists. The following example shows how this works:

```cfscript>
<cfset depts = structnew();</cfscript>
<cfset newStructure=depts>
<cfset depts.John="Sales">
<cfset depts=0>
<cfoutput>
  #newStructure.John#
  #depts#
</cfoutput>
```

This example displays the following output:

Sales
After the `<cfset depts=0>` tag executes, the depts variable does not refer to a structure; it is a simple variable with the value 0. However, the variable newStructure still refers to the original structure object.

**Assigning objects to scopes**
You can give a query or structure a different scope by assigning it to a new variable in the other scope. For example, the following line creates a server variable, Server.SScopeQuery, using the local myquery variable:

```
<cfset Server.SScopeQuery = myquery>
```

To clear the server scope query variable, reassign the query object, as follows:

```
<cfset Server.SScopeQuery = 0>
```

This deletes the reference to the object from the server scope, but does not remove any other references that might exist.

**Copying and duplicating objects**
You can use the `Duplicate` function to make a true copy of a structure or query object. Changes to the copy do not affect the original.

**Using a query column**
When you are not inside a `cfloop`, `cfoutput`, or `cfmail` tag that has a query attribute, you can treat a query column as an array. However, query column references do not always behave as you might expect. This section explains the behavior of references to query columns using the results of the following `cfquery` tag in its examples:

```
<cfquery dataSource="cfdocexamples" name="myQuery">
    SELECT FirstName, LastName
    FROM Employee
</cfquery>
```

To reference elements in a query column, use the row number as an array index. For example, both of the following lines display the word “ben”:

```
<cfoutput> #myQuery.FirstName[1]# </cfoutput><br>
<cfoutput> #myQuery['FirstName'][1]# </cfoutput><br>
```

ColdFusion behavior is less straightforward, however, when you use the query column references `myQuery.FirstName` and `myQuery['FirstName']` without using an array index. The two reference formats produce different results.

If you refer to `myQuery.FirstName`, ColdFusion automatically converts it to the first row in the column. For example, the following lines print the word "ben":

```
<cfset myCol = myQuery.FirstName >
<cfoutput> #mycol#</cfoutput>
```

But the following lines display an error message:

```
<cfset myCol = myQuery.FirstName >
<cfoutput> #mycol[1]#</cfoutput><br>
```

If you refer to `Query['FirstName']`, ColdFusion does not automatically convert it to the first row of the column. For example, the following line results in an error message indicating that ColdFusion cannot convert a complex type to a simple value:

```
<cfoutput> #myQuery['FirstName']# </cfoutput><br>
```

Similarly, the following lines print the name "marjorie", the value of the second row in the column:
However, when you make an assignment that requires a simple value, ColdFusion automatically converts the query column to the value of the first row. For example, the following lines display the name "ben" twice:

```coldfusion
<cfset myCol = myQuery['Firstname']>
<cfoutput>myCol[2]</cfoutput><br>
<cfoutput>myQuery.Firstname</cfoutput><br>
<cfset myVar = myQuery['Firstname']>
<cfoutput>myVar</cfoutput><br>
```

### Using periods in variable references

ColdFusion uses the period (.) to separate elements of a complex variable such as a structure, query, XML document object, or external object, as in MyStruct.KeyName. A period also separates a variable scope identifier from the variable name, as in Variables.myVariable or CGI.HTTP_COOKIE.

With the exception of Cookie and Client scope variables, which must always be simple variable types, you cannot normally include periods in simple variable names. However, ColdFusion makes some exceptions that accommodate legacy and third-party code that does not conform to this requirement.

For more information, see "About scopes" on page 42, "Using Arrays and Structures" on page 68, and "Using XML and WDDX" on page 865.

### Understanding variables and periods

The following descriptions use a sample variable named MyVar.a.b to explain how ColdFusion uses periods when getting and setting the variable value.

#### Getting a variable

ColdFusion can correctly get variable values even if the variable name includes a period. For example, the following set of steps shows how ColdFusion gets MyVar.a.b, as in `<cfset Var2 = myVar.a.b>` or `IsDefined(myVar.a.b):

1. Looks for myVar in an internal table of names (the symbol table).
2. If myVar is the name of a complex object, including a scope, looks for an element named a in the object.
   - If myVar is not the name of a complex object, checks whether myVar.a is the name of a complex object and skips step 3.
3. If myVar is the name of a complex object, checks whether a is a complex object.
4. If a or myVar.a is the name of a complex object, checks whether b is the name of a simple variable, and returns the value of b.
   - If myVar is a complex object but a is not a complex object, checks whether a.b is the name of a simple variable and returns its value.
   - If myVar.a is not a complex object, checks whether myVar.a.b is the name of a simple variable and returns its value.

This way, ColdFusion correctly resolves the variable name and can get its value.

You can also use array notation to get a simple variable with a name that includes periods. In this form of array notation, you use the scope name (or the complex variable that contains the simple variable) as the “array” name. You put the simple variable name, in single- or double-quotiation marks, inside the square brackets.
Using array notation is more efficient than using plain dot notation because ColdFusion does not have to analyze and look up all the possible key combinations. For example, both of the following lines write the value of myVar.a.b, but the second line is more efficient than the first:

```cfoutput>myVar.a.b is: #myVar.a.b#$<br/></cfoutput>
<cfoutput>myVar.a.b is: #Variables[*myVar.a.b*]#$<br></cfoutput>

**Setting a variable**

ColdFusion cannot be as flexible when it sets a variable value as when it gets a variable, because it must determine the type of variable to create or set. Therefore, the rules for variable names that you set are stricter. Also, the rules vary depending on whether the first part of the variable name is the Cookie or Client scope identifier.

For example, assume you have the following code:

```cfset myVar.a.b = "This is a test">
```

If a variable myVar does not exist, it does the following:

1. Creates a structure named myVar.
2. Creates a structure named a in the structure myVar.
3. Creates a key named b in myVar.a.
4. Gives it the value “This is a test”.

If either myVar or myVar.a exist and neither one is a structure, ColdFusion generates an error.

In other words, ColdFusion uses the same rules as for getting a variable to resolve the variable name until it finds a name that does not exist yet. It then creates any structures that are needed to create a key named b inside a structure, and assigns the value to the key.

However, if the name before the first period is either Cookie or Client, ColdFusion uses a different rule. It treats all the text (including any periods) that follow the scope name as the name of a simple variable, because Cookie and Client scope variables must be simple. If you have the following code, you see that ColdFusion creates a single, simple Client scope variable named myVar.a.b:

```cfset Client.myVar.a.b = "This is a test">
<cfdump var=#Client.myVar.a.b#$>
```

**Creating variables with periods**

You should avoid creating the names of variables (except for dot notation in structures) that include periods. However, ColdFusion provides mechanisms for handling cases where you must do so, for example, to maintain compatibility with names of variables in external data sources or to integrate your application with existing code that uses periods in variable names. The following sections describe how to create simple variable names that include periods.

**Using brackets to create variables with periods**

You can create a variable name that includes periods by using associative array structure notation, as described in "Structure notation" on page 79. To do so, you must do the following:

- Refer to the variable as part of a structure. You can always do this, because ColdFusion considers all scopes to be structures. For more information on scopes, see "About scopes" on page 42.
- Put the variable name that must include a period inside square brackets and single- or double-quotation marks.

The following example shows this technique:
<cfset Variables['My.Variable.With.Periods'] = 12>
<cfset Request['Another.Variable.With.Periods'] = "Test variable">
<cfoutput>
    Request.Another.Variable.With.Periods is: 
        #Request.Another.Variable.With.Periods#<br>
</cfoutput>

Creating Client and Cookie variables with periods
To create a Client or Cookie variable with a name that includes one or more periods, simply assign the variable a value. For example, the following line creates a Cookie named User.Preferences.CreditCard:

<cfset Cookie.User.Preferences.CreditCard="Discover">

Data type conversion
ColdFusion automatically converts between data types to satisfy the requirements of an expression's operations, including a function's argument requirements. As a result, you generally don't need to be concerned about compatibility between data types and the conversions from one data type to another. However, understanding how ColdFusion evaluates data values and converts data between types can help you prevent errors and create code more effectively.

Operation-driven evaluation
Conventional programming languages enforce strict rules about mixing objects of different types in expressions. For example, in a language such as C++ or Basic, the expression "8" * 10 produces an error because the multiplication operator requires two numerical operands and "8" is a string. When you program in such languages, you must convert between data types to ensure error-free program execution. For example, the previous expression might have to be written as (ToNumber("8") * 10).

In ColdFusion, however, the expression "8" * 10 evaluates to the number 80 without generating an error. When ColdFusion processes the multiplication operator, it automatically attempts to convert its operands to numbers. Since "8" can be successfully converted to the number 8, the expression evaluates to 80.

ColdFusion processes expressions and functions in the following sequence:
1. For each operator in an expression, it determines the required operands. (For example, the multiplication operator requires numeric operands and the CONTAINS operator requires string operands.)
   - For functions, it determines the type required for each function argument. (For example, the Min function requires two numbers as arguments and the Len function requires a string.)
2. It evaluates all operands or function arguments.
3. It converts all operands or arguments whose types differ from the required type. If a conversion fails, it reports an error.

Conversion between types
Although the expression evaluation mechanism in ColdFusion is very powerful, it cannot automatically convert all data. For example, the expression "eight" * 10 produces an error because ColdFusion cannot convert the string "eight" to the number 8. Therefore, you must understand the rules for conversion between data types.
The following table explains how conversions are performed. The first column shows values to convert. The remaining columns show the result of conversion to the listed data type.

<table>
<thead>
<tr>
<th>Value</th>
<th>As Boolean</th>
<th>As number</th>
<th>As date-time</th>
<th>As string</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Yes&quot;</td>
<td>True</td>
<td>1</td>
<td>Error</td>
<td>&quot;Yes&quot;</td>
</tr>
<tr>
<td>&quot;No&quot;</td>
<td>False</td>
<td>0</td>
<td>Error</td>
<td>&quot;No&quot;</td>
</tr>
<tr>
<td>True</td>
<td>True</td>
<td>1</td>
<td>Error</td>
<td>&quot;Yes&quot;</td>
</tr>
<tr>
<td>False</td>
<td>False</td>
<td>0</td>
<td>Error</td>
<td>&quot;No&quot;</td>
</tr>
<tr>
<td>Number</td>
<td>True if Number is not 0; False otherwise.</td>
<td>Number</td>
<td>See &quot;Date-time values&quot; earlier in this chapter.</td>
<td>String representation of the number (for example, &quot;8&quot;).</td>
</tr>
</tbody>
</table>
| String | If "Yes", True
If "No", False
If it can be converted to 0, False
If it can be converted to any other number, True | If it represents a number (for example, "1,000" or "12.36E-12"), it is converted to the corresponding number. If it represents a date-time (see next column), it is converted to the numeric value of the corresponding date-time object. | If it is an ODBC date, time, or timestamp (for example "2001-06-14 11:30:13"), or if it is expressed in a standard U.S. date or time format, including the use of full or abbreviated month names, it is converted to the corresponding date-time value. Days of the week or unusual punctuation result in an error. Dashes, forward-slashes, and spaces are generally allowed. | String |
| Date   | Error      | The numeric value of the date-time object. | Date | An ODBC timestamp. |

ColdFusion cannot convert complex types, such as arrays, queries, and COM objects, to other types. However, it can convert simple data elements of complex types to other simple data types.

**Type conversion considerations**
The following sections detail specific rules and considerations for converting between types.

**The cfoutput tag**
The `cfoutput` tag always displays data as a string. As a result, when you display a variable using the `cfoutput` tag, ColdFusion applies the type conversion rules to any non-string data before displaying it. For example, the `cfoutput` tag displays a date-time value as an ODBC timestamp.

**Case-insensitivity and Boolean conversion**
Because ColdFusion expression evaluation is not case-sensitive, Yes, YES, and yes are equivalent; False, FALSE, and false are equivalent; No, NO, and no are equivalent; and True, TRUE, and true are equivalent.

**Converting binary data**
ColdFusion cannot automatically convert binary data to other data types. To convert binary data, use the `ToBase64` and `ToString` functions. For more information, see "Binary data type and binary encoding" on page 31.

**Converting date and time data**
To ensure that a date and time value is expressed as a real number, add zero to the variable. The following example shows this:
<cfset mynow = now()>
Use coutput to display the result of the now function:<br>
<cfoutput>#mynow#</cfoutput><br>
Now add 0 to the result and display it again:<br>
<cfset mynow = mynow + 0>
<cfoutput>#mynow#</cfoutput>

At 1:06 PM on June 6, 2003, its output looked like this:

Use coutput to display the result of the now function:
{ts '2003-06-03 13:06:44'}
Now add 0 to the result and display it again:
37775.5463426

Converting numeric values
When ColdFusion evaluates an expression that includes both integers and real numbers, the result is a real number. To convert a real number to an integer, use a ColdFusion function. The **Int**, **Round**, **Fix**, and **Ceiling** functions convert real numbers to integers, and differ in their treatment of the fractional part of the number.

If you use a hidden form field with a name that has the suffix _integer or _range to validate a form input field, ColdFusion truncates real numbers entered into the field and passes the resulting integer to the action page.

If you use a hidden form field with a name that has the suffix _integer, _float, or _range to validate a form input field, and the entered data contains a dollar amount (including a dollar sign) or a numeric value with commas, ColdFusion considers the input to be valid, removes the dollar sign or commas from the value, and passes the resulting integer or real number to the action page.

ColdFusion does not have an inherent data type for arbitrary precision decimal numbers (BigDecimal numbers). ColdFusion initially saves such numbers as strings, and if you use them in an expression, converts the value to a numeric type, often losing precision. You can retain precision by using the **PrecisionEvaluate** method, which evaluates string expressions using BigDecimal precision arithmetic and can return the result as a long string of numbers. For more information, see **PrecisionEvaluate** in the **CFML Reference**.

Evaluation and type conversion issues
The following sections explain several issues that you might encounter with type evaluation and conversion.

Comparing variables to True or False
You might expect the following two **cfif** tag examples to produce the same results:

```coldfusion
<cfif myVariable>
    <cfoutput>myVariable equals #myVariable# and is True</cfoutput>
</cfif>
<cfif myVariable IS True>
    <cfoutput>myVariable equals #myVariable# and is True</cfoutput>
</cfif>
```

However, if myVariable has a numeric value such as 12, only the first example produces a result. In the second case, the value of myVariable is not converted to a Boolean data type, because the **IS** operator does not require a specific data type and just tests the two values for identity. Therefore, ColdFusion compares the value 12 with the constant True. The two are not equal, so nothing is printed. If myVariable is 1, "Yes", or True, however, both examples print the same result, because ColdFusion considers these to be identical to Boolean True.
If you use the following code, the output statement does display, because the value of the variable, 12, is not equal to the Boolean value False:

```cfdump
<cfif myVariable IS NOT False>
  <cfoutput>myVariable equals #myVariable# and IS NOT False
</cfoutput>
</cfif>
```

As a result, you should use the test `<cfif testvariable>`, and not use the `IS` comparison operator when testing whether a variable is True or False. This issue is a case of the more general problem of ambiguous type expression evaluation, described in the following section.

### Ambiguous type expressions and strings

When ColdFusion evaluates an expression that does not require strings, including all comparison operations, such as `IS` or `GT`, it checks whether it can convert each string value to a number or date-time object. If so, ColdFusion converts it to the corresponding number or date-time value (which is stored as a number). It then uses the number in the expression.

Short strings, such as `1a` and `2P`, can produce unexpected results. ColdFusion can interpret a single "a" as AM and a single "P" as PM. This can cause ColdFusion to interpret strings as date-time values in cases where this was not intended.

Similarly, if the strings can be interpreted as numbers, you might get unexpected results.

For example, ColdFusion interprets the following expressions as shown:

<table>
<thead>
<tr>
<th>Expression</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfif &quot;1a&quot; EQ &quot;01:00&quot;&gt;</code></td>
<td>If 1:00am is 1:00am.</td>
</tr>
<tr>
<td><code>&lt;cfif &quot;1P&quot; GT &quot;2A&quot;&gt;</code></td>
<td>If 1:00pm is later than 2:00am.</td>
</tr>
<tr>
<td><code>&lt;cfset age=&quot;4a&quot;&gt;</code>&lt;cfset age=age + 7&gt;`</td>
<td>Treat the variable age as 4:00 am, convert it to the date-time value 0.16666666667, and add 7 to make it 7.16666666667.</td>
</tr>
<tr>
<td><code>&lt;cfif &quot;0.0&quot; is &quot;0&quot;&gt;</code></td>
<td>If 0 is 0.</td>
</tr>
</tbody>
</table>

To prevent such ambiguities when you compare strings, use the ColdFusion string comparison functions `Compare` and `CompareNoCase`, instead of the comparison operators.

You can also use the `IsDate` function to determine whether a string can be interpreted as a date-time value, or to add characters to a string before comparison to avoid incorrect interpretation.

### Date-time functions and queries when ODBC is not supported

Many CFML functions, including the `Now`, `CreateDate`, `CreateTime`, and `CreateDateTime` functions, return date-time objects. ColdFusion creates Open Database Connectivity (ODBC) timestamp values when it converts date-time objects to strings. As a result, you might get unexpected results when using dates with a database driver that does not support ODBC escape sequences, or when you use SQL in a query of queries.

If you use SQL to insert data into a database or in a WHERE clause to select data from a database, and the database driver does not support ODBC-formatted dates, use the `DateFormat` function to convert the date-time value to a valid format for the driver. This rule also applies to queries of queries.

For example, the following SQL statement uses the `DateFormat` function in a query of queries to select rows that have `MyDate` values in the future:
<cfquery name="MyQofQQ" dbtype="query">
SELECT *
FROM DateQuery
WHERE MyDate >= '#DateFormat(Now())#'
</cfquery>

The following query of queries fails with the error message "Error: [ts is not a valid date," because the ColdFusion Now function returns an ODBC timestamp:

<cfquery name="MyQofQQ" dbtype="query">
SELECT *
FROM DateQuery
WHERE MyDate >= '#now()#'
</cfquery>

Using JavaCast with overloaded Java methods
You can overload Java methods so a class can have several identically named methods that differ only in parameter data types. At run time, the Java virtual machine attempts to resolve the specific method to use, based on the types of the parameters passed in the call. Because ColdFusion does not use explicit types, you cannot predict which version of the method the virtual machine will use.

The ColdFusion JavaCast function helps you ensure that the right method executes by specifying the Java type of a variable, as in the following example:

<cfset emp.SetJobGrade(JavaCast("int", JobGrade))>

The JavaCast function takes two parameters: a string representing the Java data type and the variable whose type you are setting. You can specify the following Java data types: bool, int, long, float, double, and String.

For more information on the JavaCast function, see the CFML Reference.

Using quotation marks
To ensure that ColdFusion properly interprets string data, surround strings in single- or double-quotation marks. For example, ColdFusion evaluates "10/2/2001" as a string that can be converted into a date-time object. However, it evaluates 10/2/2001 as a mathematical expression, 5/2001, which evaluates to 0.00249875062469.

Examples of type conversion in expression evaluation
The following examples demonstrate ColdFusion expression evaluation.

Example 1
2 * True + "YES" - ('y' & "es")
Result value as string: "2"
Explanation: (2*True) is equal to 2; ("YES"- "yes") is equal to 0; 2 + 0 equals 2.

Example 2
"Five is " & 5
Result value as string: "Five is 5"
Explanation: 5 is converted to the string "5".

Example 3
DateFormat("October 30, 2001" + 1)
Result value as string: "31-Oct-01"
Explanation: The addition operator forces the string "October 30, 2001" to be converted to a date-time object, and then to a number. The number is incremented by one. The DateFormat function requires its argument to be a date-time object; thus, the result of the addition is converted to a date-time object. One is added to the date-time object, moving it ahead by one day to October 31, 2001.

About scopes

Variables differ in how they are set (by your code or by ColdFusion), the places in your code where they are meaningful, and how long their values persist. These considerations are generally referred to as a variable’s scope. Commonly used scopes include the Variables scope, the default scope for variables that you create, and the Request scope, which is available for the duration of an HTTP request.

Note: User-defined functions also belong to scopes. For more information, see “Specifying the scope of a function” on page 153.

Scope types

The following table describes ColdFusion scopes:

<table>
<thead>
<tr>
<th>Scope</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Contains variables that are associated with one, named application on a server. The cfapplication tag name attribute or the Application.cfc This.name variable setting specifies the application name. For more information, see “Using Persistent Data and Locking” on page 272.</td>
</tr>
<tr>
<td>Arguments</td>
<td>Variables passed in a call to a user-defined function or ColdFusion component method. For more information, see “About the Arguments scope” on page 142.</td>
</tr>
<tr>
<td>Attributes</td>
<td>Used only in custom tag pages and threads. Contains the values passed by the calling page or cftthread tag in the tag’s attributes. For more information, see “Creating and Using Custom CFML Tags” on page 190 and “Using ColdFusion Threads” on page 300.</td>
</tr>
<tr>
<td>Caller</td>
<td>Used only in custom tag pages. The custom tag’s Caller scope is a reference to the calling page’s Variables scope. Any variables that you create or change in the custom tag page using the Caller scope are visible in the calling page’s Variables scope. For more information, see “Creating and Using Custom CFML Tags” on page 190.</td>
</tr>
<tr>
<td>CGI</td>
<td>Contains environment variables identifying the context in which a page was requested. The variables available depend on the browser and server software. For a list of the commonly used CGI variables, see “Reserved Words and Variables” on page 2 in the CFML Reference.</td>
</tr>
<tr>
<td>Client</td>
<td>Contains variables that are associated with one client. Client variables let you maintain state as a user moves from page to page in an application, and are available across browser sessions. By default, Client variables are stored in the system registry, but you can store them in a cookie or a database. Client variables cannot be complex data types and can include periods in their names. For more information, see “Using Persistent Data and Locking” on page 272.</td>
</tr>
<tr>
<td>Cookie</td>
<td>Contains variables maintained in a user’s browser as cookies. Cookies are typically stored in a file on the browser, so they are available across browser sessions and applications. You can create memory-only Cookie variables, which are not available after the user closes the browser. Cookie scope variable names can include periods.</td>
</tr>
<tr>
<td>Flash</td>
<td>Variables sent by a Flash movie to ColdFusion and returned by ColdFusion to the movie. For more information, see “Using the Flash Remoting Service” on page 674.</td>
</tr>
<tr>
<td>Form</td>
<td>Contains variables passed from a Form page to its action page as the result of submitting the form. (If you use the HTML form tag, you must use method=&quot;post&quot;.) For more information, see “Introduction to Retrieving and Formatting Data” on page 511.</td>
</tr>
<tr>
<td>function local</td>
<td>Contains variables that are declared inside a user-defined function or ColdFusion component method and exist only while a function executes. For more information, see “Writing and Calling User-Defined Functions” on page 134.</td>
</tr>
</tbody>
</table>
## Creating and using variables in scopes

The following table shows how you create and refer to variables in different scopes in your code. For more information on the mechanisms for creating variables in most scopes, see “Creating variables” on page 24.

<table>
<thead>
<tr>
<th>Scope</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request</td>
<td>Used to hold data that must be available for the duration of one HTTP request. The Request scope is available to all pages, including custom tags and nested custom tags, that are processed in response to the request. This scope is useful for nested (child/parent) tags. This scope can often be used in place of the Application scope, to avoid the need for locking variables. Several chapters discuss using the Request scope.</td>
</tr>
<tr>
<td>Server</td>
<td>Contains variables that are associated with the current ColdFusion server. This scope lets you define variables that are available to all your ColdFusion pages, across multiple applications. For more information, see “Using Persistent Data and Locking” on page 272.</td>
</tr>
<tr>
<td>Session</td>
<td>Contains variables that are associated with one client and persist only as long as the client maintains a session. They are stored in the server’s memory and can be set to time out after a period of inactivity. For more information, see “Using Persistent Data and Locking” on page 272.</td>
</tr>
<tr>
<td>This</td>
<td>Exists only in ColdFusion components or cffunction tags that are part of a containing object such as a ColdFusion Struct. Exists for the duration of the component instance or containing object. Data in the This scope is accessible from outside the component or container by using the instance or object name as a prefix.</td>
</tr>
<tr>
<td>ThisTag</td>
<td>Used only in custom tag pages. The ThisTag scope is active for the current invocation of the tag. If a custom tag contains a nested tag, any ThisTag scope values you set before calling the nested tag are preserved when the nested tag returns to the calling tag. The ThisTag scope includes three built-in variables that identify the tag’s execution mode, contain the tag’s generated contents, and indicate whether the tag has an end tag. A nested custom tag can use the cffassert tag to return values to the calling tag’s ThisTag scope. For more information, see “Accessing tag instance data” on page 198.</td>
</tr>
<tr>
<td>Thread</td>
<td>Variables that are created and changed inside a ColdFusion thread, but can be read by all code on the page that creates the Thread. Each thread has a Thread scope that is a subscope of a cfthread scope. For more information, see “Using ColdFusion Threads” on page 300.</td>
</tr>
<tr>
<td>thread local</td>
<td>Variables that are available only within a ColdFusion thread. For more information, see “Using ColdFusion Threads” on page 300.</td>
</tr>
<tr>
<td>URL</td>
<td>Contains parameters passed to the current page in the URL that is used to call it. The parameters are appended to the URL in the format ?variablename = value[&amp;variablename=value...]; for example <a href="http://www.MyCompany.com/inputpage.cfm?productCode=A12CD1510&amp;quantity=3">www.MyCompany.com/inputpage.cfm?productCode=A12CD1510&amp;quantity=3</a>. <strong>Note:</strong> If a URL includes multiple parameters with the same name, the resulting variable in the ColdFusion URL scope consists of all parameter values separated by commas. For example, a URL of the form <a href="http://localhost/urlparamtest.cfm">http://localhost/urlparamtest.cfm</a>? param=1&amp;param=2&amp;param=3 results in a URL.param variable value of 1,2,3 on the ColdFusion page.</td>
</tr>
<tr>
<td>Variables (local)</td>
<td>The default scope for variables of any type that are created with the cfset and cfparam tags. A local variable is available only on the page on which it is created and any included pages (see also the Caller scope).</td>
</tr>
</tbody>
</table>

**Important:** To prevent data corruption, you lock code that uses Session, Application, or Server scope variables. For more information, see “Using Persistent Data and Locking” on page 272.
<table>
<thead>
<tr>
<th>Scope prefix (type)</th>
<th>Prefix required to reference</th>
<th>Where available</th>
<th>Created by</th>
</tr>
</thead>
<tbody>
<tr>
<td>(function local, no prefix)</td>
<td>Prohibited</td>
<td>Within the body of a user-defined function or ColdFusion component method, only while the function executes.</td>
<td>In the function or method definition, a <code>var</code> keyword in a <code>cfset</code> tag or a CFScript <code>var</code> statement.</td>
</tr>
<tr>
<td>Application</td>
<td>Yes</td>
<td>For multiple clients in one application over multiple browser sessions. Surround code that uses application variables in <code>cflock</code> blocks.</td>
<td>Specifying the prefix <code>Application</code> when you create the variable.</td>
</tr>
<tr>
<td>Arguments</td>
<td>No</td>
<td>Within the body of a user-defined function or ColdFusion component method.</td>
<td>The calling page passing an argument in the function call.</td>
</tr>
<tr>
<td>Attributes</td>
<td>Yes</td>
<td>On a custom tag page, or inside a thread</td>
<td>For custom tags, the calling page passing the values to a custom tag page in the custom tag’s attributes. For threads, the <code>cfthread</code> tag specifying attribute values.</td>
</tr>
<tr>
<td>Caller</td>
<td>On the custom tag page, Yes. On the calling page, No (Variables prefix is optional).</td>
<td>On the custom tag page, by using the Caller scope prefix. On the page that calls the custom tag, as local variables (Variables scope).</td>
<td>On the custom tag page, by specifying the prefix <code>Caller</code> when you create the variable. On the calling page, by specifying the prefix Variables, or using no prefix, when you create the variable.</td>
</tr>
<tr>
<td>Cffile</td>
<td>Yes</td>
<td>Following an invocation of <code>cffile</code>.</td>
<td>A <code>cffile</code> tag.</td>
</tr>
<tr>
<td>CGI</td>
<td>No</td>
<td>On any page. Values are specific to the latest browser request.</td>
<td>The web server. Contains the server environment variables that result from the browser request.</td>
</tr>
<tr>
<td>Client</td>
<td>No</td>
<td>For one client in one application, over multiple browser sessions.</td>
<td>Specifying the prefix <code>Client</code> when you create the variable.</td>
</tr>
<tr>
<td>Cookie</td>
<td>No</td>
<td>For one client in one or more applications and pages, over multiple browser sessions.</td>
<td>A <code>cfcookie</code> tag. You can also set memory-only cookies by specifying the prefix Cookie when you create the variable.</td>
</tr>
<tr>
<td>Flash</td>
<td>Yes</td>
<td>A ColdFusion page or ColdFusion component called by a Flash client.</td>
<td>The ColdFusion Client access. You assign a value to Flash. You can assign values to the Flash.result and Flash.pagesize variables.</td>
</tr>
<tr>
<td>Form</td>
<td>No</td>
<td>On the action page of a form and in custom tags called by the action page; cannot be used on a form page that is not also the action page.</td>
<td>A <code>form</code> or <code>cfform</code> tag. Contains the values of form field tags (such as input) in the form body when the form is submitted. The variable name is the name of the form field.</td>
</tr>
<tr>
<td>Request</td>
<td>Yes</td>
<td>On the creating page and in any pages invoked during the current HTTP request after the variable is created, including in custom tags and nested custom tags.</td>
<td>Specifying the prefix <code>Request</code> when you create the variable.</td>
</tr>
<tr>
<td>Server</td>
<td>Yes</td>
<td>To any page on the ColdFusion server. Surround all code that uses server variables in <code>cflock</code> blocks.</td>
<td>Specifying the prefix <code>Server</code> when you create the variable.</td>
</tr>
<tr>
<td>Session</td>
<td>Yes</td>
<td>For one client in one application and one browser session. Surround code that uses Session scope variables in <code>cflock</code> blocks.</td>
<td>Specifying the prefix <code>Session</code> when you create the variable.</td>
</tr>
</tbody>
</table>
Using scopes
The following sections provide details on how you can create and use variables in different scopes.

Evaluating unscoped variables
If you use a variable name without a scope prefix, ColdFusion checks the scopes in the following order to find the variable:

1. Function local (UDFs and CFCs only)
2. Thread local (inside threads only)
3. Arguments
4. Variables (local scope)
5. Thread
6. CGI
7. Cffile
8. URL
9. Form
10. Cookie

<table>
<thead>
<tr>
<th>Scope prefix (type)</th>
<th>Prefix required to reference</th>
<th>Where available</th>
<th>Created by</th>
</tr>
</thead>
<tbody>
<tr>
<td>This</td>
<td>Yes</td>
<td>Within a ColdFusion component or the body of a user-defined function that was created using the cffunction tag and put in an object, structure, or scope. In the containing page, through the component instance or containing object.</td>
<td>Within the component or function by specifying the prefix This when you create the variable. In the containing page, by specifying the component instance or object that contains the function as a prefix when you create the variable.</td>
</tr>
<tr>
<td>ThisTag</td>
<td>Yes</td>
<td>On the custom tag page.</td>
<td>Specifying the prefix ThisTag when you create the variable in the tag or using the cfassociate tag in a nested custom tag.</td>
</tr>
<tr>
<td>Thread</td>
<td>The thread name. Inside the thread that creates the variable, you can also use the keyword thread. Any code in the request.</td>
<td>Using the keyword thread or the thread name as a prefix when you create the variable. You can create Thread variables only inside the thread.</td>
<td></td>
</tr>
<tr>
<td>thread-local (no prefix)</td>
<td>none</td>
<td>Within a thread created by the cfthread tag</td>
<td>Using no prefix when you create the variable. You can also use the keyword var before the variable name.</td>
</tr>
<tr>
<td>URL</td>
<td>No</td>
<td>On the target page of the URL.</td>
<td>The system. Contains the parameters passed in the URL query string used to access the page.</td>
</tr>
<tr>
<td>Variables (Local)</td>
<td>No</td>
<td>On the current page. Cannot be accessed by a form's action page (unless the form page is also the action page). Variables in this scope used on a page that calls a custom tag can be accessed in the custom tag by using its Caller scope; however, they are not available to any nested custom tags.</td>
<td>Specifying the prefix Variables, or using no prefix, when you create the variable. (To create a Variables scope variable inside a ColdFusion thread, you must use the Variables prefix.)</td>
</tr>
</tbody>
</table>
Because ColdFusion must search for variables when you do not specify the scope, you can improve performance by specifying the scope for all variables.

To access variables in all other scopes, you must prefix the variable name with the scope identifier.

Scopes and CFX tags
ColdFusion scopes do not apply to ColdFusion Extension (CFX) tags, custom tags that you write in a programming language such as C++ or Java. The ColdFusion page that calls a CFX tag must use tag attributes to pass data to the CFX tag. The CFX tag must use the Java Request and Response interfaces or the C++ Request class to get and return data.

The Java `setVariable` Response interface method and C++ `CCFX::SetVariable` method return data to the Variables scope of the calling page. Therefore, they are equivalent to setting a Caller scope variable in a custom ColdFusion tag.

Using scopes as structures
ColdFusion makes all named scopes available as structures. You cannot access the function-local scope for user defined functions (UDFs) that you define using CFScript as a structure. (In ColdFusion 4.5 and 5, the following scopes are not available as structures: Variables, Caller, Client, and Server.)

You can reference the variables in named scopes as elements of a structure. To do so, specify the scope name as the structure name and the variable name as the key. For example, if you have a `MyVar` variable in the Request scope, you can refer to it in either of the following ways:

```
Request.MyVar
Request["MyVar"]
```

Similarly, you can use CFML structure functions to manipulate the contents of the scope. For more information on using structures, see “Using Arrays and Structures” on page 68.

Important: Do not call `StructClear(Session)` to clear session variables. This deletes the `SessionID`, `CFID`, and `CFToken` built-in variables, effectively ending the session. If you want to use `StructClear` to delete your application variables, put those variables in a structure in the Session scope, and then clear that structure. For example, put all your application variables in `Session.MyVars` and then call `StructClear(Session.MyVars)` to clear the variables.

Ensuring variable existence
ColdFusion generates an error if you try to use a variable value that does not exist. Therefore, before you use any variable whose value is assigned dynamically, you must ensure that a variable value exists. For example, if your application has a form, it must use some combination of requiring users to submit data in fields, providing default values for fields, and checking for the existence of field variable values before they are used.

There are several ways to ensure that a variable exists before you use it, including the following:

- You can use the `IsDefined` function to test for the variable's existence.
- You can use the `cfparam` tag to test for a variable and set it to a default value if it does not exist.
- You can use a `cfinput` tag with a `hidden` attribute to tell ColdFusion to display a helpful message to any user who does not enter data in a required field. For more information on this technique, see “Requiring users to enter values in form fields” on page 517.
Testing for a variable's existence
Before relying on a variable's existence in an application page, you can test to see if it exists by using the IsDefined function. To check whether a specific key exists in a structure, use the StructKeyExists function.

For example, if you submit a form with an unsettled check box, the action page does not get a variable for the check box. The following example from a form action page makes sure the Contractor check box Form variable exists before using it:

```coldfusion
<cfif IsDefined("Form.Contractor")>
  <cfoutput>Contractor: #Form.Contractor#</cfoutput>
</cfif>
```

You must always enclose the argument passed to the IsDefined function in double- quotation marks. For more information on the IsDefined function, see the CFML Reference.

If you attempt to evaluate a variable that you did not define, ColdFusion cannot process the page and displays an error message. To help diagnose such problems, turn on debugging in the ColdFusion Administrator or use the debugger in your editor. The Administrator debugging information shows which variables are being passed to your application pages.

Variable existence considerations
If a variable is part of a scope that is available as a structure, you might get a minor performance increase by testing the variable's existence using the StructKeyExists function instead of the IsDefined function.

You can also determine which Form variables exist by inspecting the contents of the Form.fieldnames built-in variable. This variable contains a list of all the fields submitted by the form. Remember, however, that form text fields are always submitted to the action page, and might contain an empty string if the user did not enter data.

The IsDefined function always returns False if you specify an array or structure element using bracket notation. For example, IsDefined("myArray[3]") always returns False, even if the array element myArray[3] has a value. To check for the existence of an array element, use `cftry`, as in the following example:

```coldfusion
<cfset items=ArrayNew(2)>
<cfset items[1][1] = "Dog">  
<cfset items[2][2] = "Cat">  
<cftry>
  <cfset temp=items[1][2]>
  <cfcatch type="any">
    <cfoutput>Items[1][2] does not exist</cfoutput>
  </cfcatch>
</cftry>
```

Using the `cfparam` tag
You can ensure that a variable exists by using the `cfparam` tag, which tests for the variable's existence and optionally supplies a default value if the variable does not exist. The `cfparam` tag has the following syntax:

```coldfusion
<cfparam name="VariableName"
   type="data_type"
   default="DefaultValue">
```

**Note:** For information on using the `type` attribute to validate the parameter data type, see the CFML Reference.

There are two ways to use the `cfparam` tag to test for variable existence, depending on how you want the validation test to proceed:

- With only the `name` attribute to test that a required variable exists. If it does not exist, the ColdFusion server stops processing the page and displays an error message.
• With the `name` and `default` attributes to test for the existence of an optional variable. If the variable exists, processing continues and the value is not changed. If the variable does not exist, it is created and set to the value of the `default` attribute, and processing continues.

The following example shows how to use the `cfparam` tag to check for the existence of an optional variable and to set a default value if the variable does not already exist:

```cfc```
<cfparam name="Form.Contract" default="Yes">
```

**Example: testing for variables**

Using the `cfparam` tag with the `name` attribute is one way to clearly define the variables that a page or a custom tag expects to receive before processing can proceed. This can make your code more readable, as well as easier to maintain and debug.

For example, the following `cfparam` tags indicate that this page expects two form variables named `StartRow` and `RowsToFetch`:

```cfc```
<cfparam name="Form.StartRow">
<cfparam name="Form.RowsToFetch">
```

If the page with these tags is called without either one of the form variables, an error occurs and the page stops processing. By default, ColdFusion displays an error message; you can also handle the error as described in “Handling Errors” on page 246.

**Example: setting default values**

The following example uses the `cfparam` tag to see if optional variables exist. If they do exist, processing continues. If they do not exist, the ColdFusion server creates them and sets them to the default values.

```cfc```
<cfparam name="Cookie.SearchString" default="temple">
<cfparam name="Client.Color" default="Grey">
<cfparam name="ShowExtraInfo" default="No">
```

You can use the `cfparam` tag to set default values for URL and Form variables, instead of using conditional logic. For example, you could include the following code on the action page to ensure that a `SelectedDepts` variable exists:

```cfc```
<cfparam name="Form.SelectedDepts" default="Marketing,Sales">
```

**Validating data**

It is often not sufficient that input data merely exists; it must also have the right format. For example, a date field must have data in a date format. A salary field must have data in a numeric or currency format. There are many ways to ensure the validity of data, including the following methods:

• Use the `cfparam` tag with the `type` attribute to validate a variable.
• Use the `IsValid` function to validate a variable.
• Use the `cfqueryparam` tag in a SQL WHERE clause to validate query parameters.
• Use `cfform` controls that have validation attributes.
• Use a form `input` tag with a `hidden` attribute to validate the contents of a form input field.

**Note:** Data validation using the `cfparam`, `cfqueryparam`, and `form` tags is done by the server. Validation using `cfform` tags and hidden fields is done using JavaScript in the user's browser, before any data is sent to the server.
For detailed information on validating data in forms and variables, see “Validating Data” on page 553 For detailed information on validating query parameters, see “Using cfqueryparam” on page 399.

Passing variables to custom tags and UDFs

The following sections describe rules for how data gets passed to custom tags and user-defined functions that are written in CFML, and to CFX custom tags that are written in Java or C++.

Passing variables to CFML tags and UDFs

When you pass a variable to a CFML custom tag as an attribute, or to a user-defined function as an argument, the following rules determine whether the custom tag or function receives its own private copy of the variable or only gets a reference to the calling page’s variable:

• Simple variables and arrays are passed as copies of the data. If your argument is an expression that contains multiple simple variables, the result of the expression evaluation is copied to the function or tag.

• Structures, queries, and cfobject objects are passed as references to the object.

If the tag or function gets a copy of the calling page’s data, changes to the variable in the custom tag or function do not change the value of the variable on the calling page. If the variable is passed by reference, changes to the variable in the custom tag or function also change the value of the variable in the calling page.

To pass a variable to a custom tag, you must enclose the variable name in number signs. To pass a variable to a function, do not enclose the variable name in number signs. For example, the following code calls a user-defined function using three Form variables:

```cfoutput>
   TOTAL INTEREST: #TotalInterest(Form.Principal, Form.AnnualPercent, Form.Months)#<br>
</cfoutput>
```

The following example calls a custom tag using two variables, MyString and MyArray:

```cf_testTag stringval=#MyString# arrayval=#MyArray#>
```

Passing variables to CFX tags

You cannot pass arrays, structures, or cfobject objects to CFX tags. You can pass a query to a CFX tag by using the query attribute when calling the tag. ColdFusion normally converts simple data types to strings when passing them to CFX tags; however, the Java Request Interface getIntAttribute method lets you get a passed integer value.
Chapter 4: Using Expressions and Number Signs

In CFML, you create expressions by using number signs to indicate expressions in Adobe ColdFusion tags such as cfoutput, in strings, and in expressions. You also use variables in variable names and strings to create dynamic expressions, and dynamic variables.

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Expressions

ColdFusion expressions consist of operands and operators. Operands are comprised of constants and variables. Operators, such as the multiplication symbol, are the verbs that act on the operands; functions are a form of operator.

The simplest expression consists of a single operand with no operators. Complex expressions have multiple operators and operands. The following are all ColdFusion expressions:

12
MyVariable
a++
(1 + 1)/2
"father" & "Mother"
Form.divisor/Form.dividend
Round(3.14159)

Operators act on the operands. Some operators, such as functions with a single argument, take a single operand. Many operators, including most arithmetic and logical operators, take two operands. The following is the general form of a two-operand expression:

Expression Operator Expression

Note that the operator is surrounded by expressions. Each expression can be a simple operand (variable or constant) or a subexpression consisting of more operators and expressions. Complex expressions are built up using subexpressions. For example, in the expression (1 + 1)/2, 1 + 1 is a subexpression consisting of an operator and two operands.

Operator types

ColdFusion has four types of operators:

- Arithmetic
- Boolean
- Decision (or comparison)
- String

Functions also can be viewed as operators because they act on operands.
**Arithmetic operators**

The following table describes the arithmetic operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ - * /</td>
<td>Basic arithmetic: Addition, subtraction, multiplication, and division. In division, the right operand cannot be zero.</td>
</tr>
<tr>
<td>++ --</td>
<td>Increment and decrement. Increase or decrease the variable by one. These operators can be used for pre-incrementing or decrementing (as in ( x = i + ++ )), where the value is changed before it is used in the expression, or post-incrementing or decrementing (as in ( x = ++i )), where the value is changed after it is used in the expression. If the value of the variable ( i ) is initially 7, for example, the value of ( x ) in ( x = ++i ) is 8 after expression evaluation, but in ( x=i++ ), the value of ( x ) is 7. In both cases, the value of ( i ) becomes 8. These operators cannot be used with expressions that involve functions, as in ( f() . a++ ). Also, you can use an expression such as (-++x), but (---x) and (+++x) cause errors, because their meanings are ambiguous. You can use parentheses to group the operators, as in (-(--x)) or (+(++x)), however.</td>
</tr>
<tr>
<td>+= -= *= /= %=</td>
<td>Compound assignment operators. The variable on the right is used as both an element in the expression and the result variable. Thus, the expression ( a+=b ) is equivalent to ( a=a+b ). An expression can have only one compound assignment operator.</td>
</tr>
<tr>
<td>+ -</td>
<td>Unary arithmetic: Set the sign of a number.</td>
</tr>
<tr>
<td>MOD or %</td>
<td>Modulus: Return the remainder after a number is divided by a divisor. The result has the same sign as the divisor. The value to the right of the operator should be an integer; using a non-numeric value causes an error, and if you specify a real number, ColdFusion ignores the fractional part (for example, ( 11 \bmod 4.7 ) is 3).</td>
</tr>
<tr>
<td>\</td>
<td>Integer division: Divide an integer by another integer. The result is also an integer; for example, ( 9\div 4 ) is 2. The right operand cannot be zero.</td>
</tr>
<tr>
<td>^</td>
<td>Exponentiation: Return the result of a number raised to a power (exponent). Use the caret character (^) to separate the number from the power; for example, ( 2^3 ) is 8. Real and negative numbers are allowed for both the base and the exponent. However, any expression that equates to an imaginary number, such as (-1^\frac{1}{2}), results in the string &quot;-1.#IND&quot;. ColdFusion does not support imaginary or complex numbers.</td>
</tr>
</tbody>
</table>

**Boolean operators**

Boolean, or logical, operators perform logical connective and negation operations. The operands of Boolean operators are Boolean (True/False) values. The following table describes the Boolean operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT or !</td>
<td>Reverse the value of an argument. For example, NOT True is False and vice versa.</td>
</tr>
<tr>
<td>AND or &amp;&amp;</td>
<td>Return True if both arguments are True; return False otherwise. For example, True AND True is True, but True AND False is False.</td>
</tr>
<tr>
<td>OR or</td>
<td></td>
</tr>
<tr>
<td>XOR</td>
<td>Exclusive or: Return True if one of the values is True and the other is False. Return False if both arguments are True or both are False. For example, True XOR True is False, but True XOR False is True.</td>
</tr>
<tr>
<td>EQV</td>
<td>Equivalence: Return True if both operands are True or both are False. The EQV operator is the opposite of the XOR operator. For example, True EQV True is True, but True EQV False is False.</td>
</tr>
<tr>
<td>IMP</td>
<td>Implication: The statement A IMP B is the equivalent of the logical statement &quot;If A Then B.&quot; A IMP B is False only if A is True and B is False. It is True in all other cases.</td>
</tr>
</tbody>
</table>
Decision operators

The ColdFusion decision, or comparison, operators produce a Boolean True/False result. Many types of operation have multiple equivalent operator forms. For example, IS and EQ perform the same operation. The following table describes the decision operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS</td>
<td>Perform a case-insensitive comparison of two values. Return True if the values are identical.</td>
</tr>
<tr>
<td>EQUAL</td>
<td></td>
</tr>
<tr>
<td>EQ</td>
<td></td>
</tr>
<tr>
<td>IS NOT</td>
<td>Opposite of IS. Perform a case-insensitive comparison of two values. Return True if the values are not identical.</td>
</tr>
<tr>
<td>NOT EQUAL</td>
<td></td>
</tr>
<tr>
<td>NEQ</td>
<td></td>
</tr>
<tr>
<td>CONTAINS</td>
<td>Return True if the value on the left contains the value on the right.</td>
</tr>
<tr>
<td>DOES NOT CONTAIN</td>
<td>Opposite of CONTAINS. Return True if the value on the left does not contain the value on the right.</td>
</tr>
<tr>
<td>GREATER THAN</td>
<td>Return True if the value on the left is greater than the value on the right.</td>
</tr>
<tr>
<td>GT</td>
<td></td>
</tr>
<tr>
<td>LESS THAN</td>
<td>Opposite of GREATER THAN. Return True if the value on the left is smaller than the value on the right.</td>
</tr>
<tr>
<td>LT</td>
<td></td>
</tr>
<tr>
<td>GREATER THAN OR EQUAL TO</td>
<td>Return True if the value on the left is greater than or equal to the value on the right.</td>
</tr>
<tr>
<td>GTE</td>
<td>GE</td>
</tr>
<tr>
<td>LESS THAN OR EQUAL TO</td>
<td>Return True if the value on the left is less than or equal to the value on the right.</td>
</tr>
<tr>
<td>LTE</td>
<td>LE</td>
</tr>
</tbody>
</table>

**Note:** In CFScript expressions only, you can also use the following decision operators. You cannot use them in expressions in tags. == (EQ), != (NEQ), > (GT), < (LT), >= (GTE), and <= (LTE).

**Decision operator rules**

The following rules apply to decision operators:

- When ColdFusion evaluates an expression that contains a decision operator other than CONTAINS or DOES NOT CONTAIN, it first determines if the data can be converted to numeric values. If they can be converted, it performs a numeric comparison on the data. If they cannot be converted, it performs a string comparison. This can sometimes result in unexpected results. For more information on this behavior, see “Evaluation and type conversion issues” on page 39.

- When ColdFusion evaluates an expression with CONTAINS or DOES NOT CONTAIN it does a string comparison. The expression A CONTAINS B evaluates to True if B is a substring of A. Therefore an expression such as the following evaluates as True:

  123.45 CONTAINS 3.4

- When a ColdFusion decision operator compares strings, it ignores the case. As a result, the following expression is True:
When a ColdFusion decision operator compares strings, it evaluates the strings from left to right, comparing the characters in each position according to their sorting order. The first position where the characters differ determines the relative values of the strings. As a result, the following expressions are True:

- "ab" LT "aba"
- "abde" LT "ac"

### String operators

String operators manipulate strings of characters. The following table describes the operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp;</td>
<td>Concatenates strings.</td>
</tr>
<tr>
<td>&amp;=</td>
<td>Compound concatenation. The variable on the right is used as both an element in the concatenation operation and the result variable. Thus, the expression <code>a &amp;= b</code> is equivalent to <code>a = a &amp; b</code>. An expression can have only one compound assignment operator.</td>
</tr>
</tbody>
</table>

**Note:** In a Query of Queries, you use `||` as the concatenation operator.

### Operator precedence and evaluation ordering

The order of precedence controls the order in which operators in an expression are evaluated. The order of precedence is as follows. (Some alternative names for operators, such as EQUALS and GREATER THAN OR EQUAL TO are omitted for brevity.)

- Unary `+`, `Unary -`
- `^`
- `*`, `/`
- `MOD`
- `+`, `-`
- `&`
- `EQ`, `NEQ`, `LT`, `LTE`, `GT`, `GTE`, `CONTAINS`, `DOES NOT CONTAIN`, `==`, `!=`, `>`, `>=`, `<`, `<=`
- `NOT`, `!`
- `AND`, `&&`
- `OR`, `||`
- `XOR`, `|||
- `EQV`
- `IMP`

To enforce a nonstandard order of evaluation, you must parenthesize expressions. For example:

- `6 - 3 * 2` is equal to `0`
- `(6 - 3) * 2` is equal to `6`

You can nest parenthesized expressions. When in doubt about the order in which operators in an expression will be evaluated, use parentheses to force the order of evaluation.

### Using functions as operators

Functions are a form of operator. Because ColdFusion functions return values, you can use function results as operands. Function arguments are expressions. For example, the following are valid expressions:

- `Rand()`  
- `UCase("This is a text: ") & ToString(123 + 456)`
Function syntax

The following table shows function syntax and usage guidelines:

<table>
<thead>
<tr>
<th>Usage</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>No arguments</td>
<td>Function()</td>
</tr>
<tr>
<td>Basic format</td>
<td>Function(Data)</td>
</tr>
<tr>
<td>Nested functions</td>
<td>Function1(Function2(Data))</td>
</tr>
<tr>
<td>Multiple arguments</td>
<td>Function(Data1, Data2, Data3)</td>
</tr>
<tr>
<td>String arguments</td>
<td>Function('This is a demo')</td>
</tr>
<tr>
<td></td>
<td>Function(&quot;This is a demo&quot;)</td>
</tr>
<tr>
<td>Arguments that are expressions</td>
<td>Function1(X*Y, Function2(&quot;Text&quot;))</td>
</tr>
</tbody>
</table>

All functions return values. In the following example, the <cfset> tag sets a variable to the value returned by the Now function:

```<cfset myDate = DateFormat(Now(), "mmmm d, yyyy")>```

You can use the values returned by functions directly to create more complex expressions, as in the following example:

```
Abs(Myvar)/Round(3.14159)
```

For more information on how to insert functions in expressions, see "Using number signs" on page 55.

Optional function arguments

Some functions take optional arguments after their required arguments. If omitted, all optional arguments default to a predefined value. For example:

- Replace("Eat and Eat", "Eat", "Drink") returns "Drink and Eat"
- Replace("Eat and Eat", "Eat", "Drink", "All") returns "Drink and Drink"

The difference in the results is because the Replace function takes an optional fourth argument that specifies the scope of replacement. The default value is "One," which explains why only the first occurrence of "Eat" was replaced with "Drink" in the first example. In the second example, a fourth argument causes the function to replace all occurrences of "Eat" with "Drink".

Expression evaluation and functions

It is important to remember that ColdFusion evaluates function attributes as expressions before it executes the function. As a result, you can use any ColdFusion expression as a function attribute. For example, consider the following lines:

```<cfset firstVariable = "we all need">  
<cfset myStringVar = UCase(firstVariable & " more sleep!")>`

When ColdFusion server executes the second line, it does the following:

1. Determines that there is an expression with a string concatenation.
2. Evaluates the firstVariable variable as the string "we all need".
3. Concatenates "we all need" with the string " more sleep!" to get "we all need more sleep!".
4. Passes the string "we all need more sleep!" to the UCase function.
5. Executes the `UCase` function on the string argument "we all need more sleep!" to get "WE ALL NEED MORE SLEEP!".

6. Assigns the string value "WE ALL NEED MORE SLEEP!" to the variable `myStringVar`. ColdFusion completes steps 1-3 before invoking the function.

### Using number signs

Number signs (#) have a special meaning in CFML. When the ColdFusion server encounters number signs in CFML text, such as the text in a `cfoutput` tag body, it checks to see if the text between the number signs is either a variable or a function.

*Number signs are also called pound signs.*

If so, it replaces the text and surrounding number signs with the variable value or the result of the function. Otherwise, ColdFusion generates an error.

For example, to output the current value of a variable named `Form.MyFormVariable`, you delimit (surround) the variable name with number signs:

```cfoutput>Value is #Form.MyFormVariable#</cfoutput>
```

In this example, the variable `Form.MyFormVariable` is replaced with the value assigned to it.

Follow these guidelines when using number signs:

- Use number signs to distinguish variables or functions from plain text.
- Surround only a single variable or function in number signs; for example, `#Variables.myVar#` or `#Left(myString, position)#`. (However, a function in number signs can contain nested functions, such as `#Left(trim(myString), position)#`.
- Do not put complex expressions, such as `1 + 2` in number signs. Although this is allowed in a `cfoutput` block, such as `<cfoutput>One plus one is #1 + 1#</cfoutput>`, doing so mixes logic and presentation.
- Use number signs only where necessary, because unneeded number signs slow processing.

The following sections provide more details on how to use number signs in CFML. For a description of using number signs to create variable names, see "Using number signs to construct a variable name in assignments" on page 59.

### Using number signs in ColdFusion tag attribute values

You can put variables, functions, or expressions inside tag attributes by enclosing the variable or expression with number signs. For example, if the variable `CookieValue` has the value "MyCookie", the following line sets the `cfcookie` value attribute to "The value is MyCookie":

```<cfcookie name="TestCookie" value="The value is #CookieValue#">```

You can optionally omit quotation marks around variables used as attribute values as shown in the following example:

```<cfcookie name = TestCookie value = #CookieValue#>```

However, surrounding all attribute values in quotation marks is more consistent with HTML coding style.
If you use string expressions to construct an attribute value, as shown in the following example, the strings inside the expression use single quotation marks (’) to differentiate the quotation marks from the quotation marks that surround the attribute value.

```cfcookie name="TestCookie2" value="The #CookieValue & 'ate the cookie!'#">
```

**Note:** You do not need to use number signs when you use the `cfset` tag to assign one variable's value to another value. For example, the following tag assigns the value of the `oldVar` variable to the new variable, `newVar`:

```
cfset newVar = oldVar.
```

**Using number signs in tag bodies**

You can put variables or functions freely inside the bodies of the following tags by enclosing each variable or expression with number signs:

- `cfoutput`
- `cfquery`
- `cfmail`

For example:

```cfoutput>
    Value is #Form.MyTextField#
</cfoutput>

```cfoutput>
    The name is #FirstName# #LastName#.
</cfoutput>

```cfoutput>
    The value of Cos(0) is #Cos(0)#
</cfoutput>
```

If you omit the number signs, the text, rather than the value, appears in the output generated by the `cfoutput` statement.

Two expressions inside number signs can be adjacent to one another, as in the following example:

```cfoutput>
    "Mo" and "nk" is #Left("Moon", 2)# #Mid("Monkey", 3, 2)#
</cfoutput>
```

This code displays the following text:

"Mo" and "nk" is Monk

ColdFusion does not interpret the double number sign as an escaped # character.

**Using number signs in strings**

You can put variables or functions freely inside strings by enclosing each variable or expression with number signs; for example:

```cfset TheString = "Value is #Form.MyTextField#">
<cfset TheString = "The name is #FirstName# #LastName#."">
<cfset TheString = "Cos(0) is #Cos(0)#">
```

ColdFusion automatically replaces the text with the value of the variable or the value returned by the function. For example, the following pairs of `cfset` statements produce the same result:
<cfset TheString = "Hello, #FirstName#!">  
<cfset TheString = "Hello, " & FirstName & "!">  
If number signs are omitted inside the string, the text, rather than the value, appears in the string. For example, the following pairs of cfset statements produce the same result:

<cfset TheString = "Hello, FirstName!">  
<cfset TheString = "Hello, " & "First" & "Name!">  
As with the cfoutput statement, two expressions can be adjacent to each other in strings, as in the following example:

<cfset TheString = "Monk is #Left("Moon", 2)##Mid("Monkey", 3, 2)#">  
The double-quotation marks around "Moon" and "Monkey" do not need to be escaped (as in ""Moon"" and ""Monkey"). This is because the text between the number signs is treated as an expression; it is evaluated before its value is inserted inside the string.

**Nested number signs**

In a few cases, you can nest number signs in an expression. The following example uses nested number signs:

<cfset Sentence = "The length of the full name is #Len("#FirstName# #LastName#")#">  
In this example, number signs are nested so that the values of the variables FirstName and LastName are inserted in the string whose length the Len function calculates.

Nested number signs imply a complex expression that can typically be written more clearly and efficiently without the nesting. For example, you can rewrite the preceding code example without the nested number signs, as follows:

<cfset Sentence2 = "The length of the full name is #Len(FirstName & " " & LastName)#">  
The following achieves the same results and can further improve readability:

<cfset FullName = "#FirstName# #LastName#">  
<cfset Sentence = "The length of the full name is #Len(FullName)#">  
A common mistake is to put number signs around the arguments of functions, as in:

<cfset ResultText = "#Len(#TheText#)#">  
<cfset ResultText = "#Min(#ThisVariable#, 5 + #ThatVariable#)#">  
<cfset ResultText = "#Len(#Left("Some text", 4)#)#">  
These statements result in errors. As a general rule, never put number signs around function arguments.

**Using number signs in expressions**

Use number signs in expressions only when necessary, because unneeded number signs reduce clarity and can increase processing time. The following example shows the preferred method for referencing variables:

<cfset SomeVar = Var1 + Max(Var2, 10 * Var3) + Var4>  
In contrast, the following example uses number signs unnecessarily and is less efficient than the previous statement:

<cfset #SomeVar# = #Var1# + #Max(Var2, 10 * Var3)# + #Var4#>
Dynamic expressions and dynamic variables

This section discusses the advanced topics of dynamic expressions, dynamic evaluation, and dynamic variable naming. Many ColdFusion programmers never encounter or need to use dynamic expressions. However, dynamic variable naming is important in situations where the variable names are not known in advance, such as in shopping cart applications.

This section also discusses the use of the IIf function, which is most often used without dynamic expressions. This function dynamically evaluates its arguments, and you must often use the DE function to prevent the evaluation. For more information on using the IIf function, see “Using the IIF function” on page 63.

Note: This section uses several tools and techniques that are documented in later chapters. If you are unfamiliar with using ColdFusion forms, structures, and arrays, you should learn about these tools before reading this section.

About dynamic variables

Dynamic variables are variables that are named dynamically, typically by creating a variable name from a static part and a variable part. For example, the following example dynamically constructs the variable name from a variable prefix and a static suffix:

```coldfusion
<cfset "#flavor#_availability" = "out of stock">
```

Using dynamic variables in this manner does not require dynamic evaluation.

About dynamic expressions and dynamic evaluation

In a dynamic expression, the actual expression, not just its variable values, is determined at execution time. In other words, in a dynamic expression the structure of the expression, such as the names of the variables, not just the values of the variables, gets built at runtime.

You create dynamic expressions using string expressions, which are expressions contained in strings, (that is, surrounded with quotation marks). Dynamic evaluation is the process of evaluating a string expression. The Evaluate and IIf functions, and only these functions, perform dynamic evaluation.

When ColdFusion performs dynamic evaluation it does the following:

1. Takes a string expression and treats it as a standard expression, as if the expression was not a string.
2. Parses the expression to determine the elements of the expression and validate the expression syntax.
3. Evaluates the expression, looking up any variables and replacing them with their values, calling any functions, and performing any required operations.

This process enables ColdFusion to interpret dynamic expressions with variable parts. However, it incurs a substantial processing overhead.

Dynamic expressions were important in early versions of ColdFusion, before it supported arrays and structures, and they still can be useful in limited circumstances. However, the ability to use structures and the ability to use associative array notation to access structure elements provide more efficient and easier methods for dynamically managing data. For information on using arrays and structures, see “Using Arrays and Structures” on page 68.

Selecting how to create variable names

The following two examples describes cases when you need dynamic variable names:
• Form applications where the number and names of fields on the form vary dynamically. In this case, the form posts only the names and values of its fields to the action page. The action page does not know all the names of the fields, although it does know how the field names (that is, the variable names) are constructed.

• If the following are true:
  - ColdFusion calls a custom tag multiple times.
  - The custom tag result must be returned to different variables each time.
  - The calling code can specify the variable in which to return the custom tag result.

In this case, the custom tag does not know the return variable name in advance, and gets it as an attribute value.

In both cases, it might appear that dynamic expressions using the `Evaluate` function are needed to construct the variable names. However, you can achieve the same ends more efficiently by using dynamic variable naming, as shown in “Example: a dynamic shopping cart” on page 64.

This does not mean that you must always avoid dynamic evaluation. However, given the substantial performance costs of dynamic evaluation, you should first ensure that one of the following techniques cannot serve your purpose:

• An array (using index variables)
• Associative array references containing expressions to access structure elements
• Dynamically generated variable names

Dynamic variable naming without dynamic evaluation
While ColdFusion does not always allow you to construct a variable name in-line from variable pieces, it does let you do so in the most common uses, as described in the following sections.

Using number signs to construct a variable name in assignments
You can combine text and variable names to construct a variable name on the left side of a `cfset` assignment. For example, the following code sets the value of the variable Product12 to the string "Widget":

```cfml
<cfset ProdNo = 12>
<cfset "Product#ProdNo#" = "Widget">
```

To construct a variable name this way, all the text on the left side of the equal sign must be in quotation marks.

This usage is less efficient than using arrays. The following example has the same purpose as the previous one, but requires less processing:

```cfml
<cfset MyArray=ArrayNew(1)>
<cfset prodNo = 12>
<cfset myArray[prodNo] = "Widget">
```

Dynamic variable limitation
When you use a dynamic variable name in quotation marks on the left side of an assignment, the name must be either a simple variable name or a complex name that uses object.property notation (such as MyStruct.#KeyName#). You cannot use an array as part of a dynamic variable name. For example, the following code generates an error:

```cfml
<cfset MyArray=ArrayNew(1)>
<cfset productClassNo = 1>
<cfset productItemNo = 9>
<cfset "myArray[#productClassNo##productItemNo#]" = "Widget">
```
However, you can construct an array index value dynamically from variables without using quotation marks on the left side of an assignment. For example, the preceding sample code works if you replace the final line with the following line:

```cfset myArray[#productClassNo# & #productItemNo#] = "Widget"```

**Dynamically constructing structure references**

The ability to use associative array notation to reference structures provides a way for you to use variables to dynamically create structure references. (For a description of associative array notation, see “Structure notation” on page 79.) Associative array structure notation allows you to use a ColdFusion expression inside the index brackets. For example, if you have a productName structure with keys of the form product_1, product_2 and so on, you can use the following code to display the value of productName.product_3:

```cfset prodNo = 3>
<cfoutput>
  Product_3 Name: #ProductName["product_" & prodNo]#
<cfoutput>
```

For an example of using this format to manage a shopping cart, see “Example: a dynamic shopping cart” on page 64.

**Using dynamic evaluation**

The following sections describe how to use dynamic evaluation and create dynamic expressions.

**ColdFusion dynamic evaluation functions**

The following table describes the functions that perform dynamic evaluation and are useful in evaluating dynamic expressions:

<table>
<thead>
<tr>
<th>Function</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>Escapes any double-quotations marks in the argument and wraps the result in double-quotations marks. The DE function is particularly useful with the IIF function, to prevent the function from evaluating a string to be output. For an example of using the DE function with the IIF function, see “Using the IIF function” on page 63.</td>
</tr>
<tr>
<td>Evaluate</td>
<td>Takes one or more string expressions and dynamically evaluates their contents as expressions from left to right. (The results of an evaluation to the left can have meaning in an expression to the right.) Returns the result of evaluating the rightmost argument. For more information on this function see “About the Evaluate function” on page 61.</td>
</tr>
<tr>
<td>IIf</td>
<td>Evaluates a boolean condition expression. Depending on whether this expression is True or False, dynamically evaluates one of two string expressions and returns the result of the evaluation. The IIF function is convenient for incorporating a cfif tag in-line in HTML. For an example of using this function, see “Using the IIF function” on page 63.</td>
</tr>
<tr>
<td>PrecisionEvaluate</td>
<td>Operates identically to the Evaluate function, except that it can calculate arbitrary precision decimal arithmetic. If one or more operands in an arithmetic expression are decimal numbers, such as 12947834.986532, and are too long to be represented exactly by a ColdFusion numeric data type, the function uses arbitrary-precision arithmetic to calculate the result, and return the result as an arbitrarily long string of numbers. For more information about this function, see PrecisionEvaluate in the CFML Reference.</td>
</tr>
<tr>
<td>SetVariable</td>
<td>Sets a variable identified by the first argument to the value specified by the second argument. This function is no longer required in well-formed ColdFusion pages; see “SetVariable function considerations” on page 63.</td>
</tr>
</tbody>
</table>
**Function argument evaluation considerations**

It is important to remember that ColdFusion always evaluates function arguments before the argument values are passed to a function:

For example, consider the following `DE` function:

```cfoutput>DE("1" & "2")</cfoutput>
```

You might expect this line to display "1" & "2". Instead, it displays "12", because ColdFusion processes the line as follows:

1. Evaluates the expression "1" & "2" as the string "12".
2. Passes the string "12" (without the quotation marks) to the `DE` function.
3. Calls the `DE` function, which adds literal quotation marks around the 12.

Similarly, if you use the expression `DE(1 + 2)`, ColdFusion evaluates 1 + 2 as the integer 3 and passes it to the function. The function converts it to a string and surrounds the string in literal quotation marks: "3".

**About the Evaluate function**

The `Evaluate` function takes one or more string expressions, dynamically evaluates their contents as expressions from left to right, and returns the result of evaluating the rightmost argument.

The following example shows the `Evaluate` function and how it works with ColdFusion variable processing:

```cfset myVar2="myVar">
<cfset myVar="27/9">
<cfoutput>
    #myVar2#
    #myVar#
    #Evaluate("myVar2")#
    #Evaluate("myVar")#
    #Evaluate(myVar2)#
    #Evaluate(myVar)#
</cfoutput>
```

**Reviewing the code**

The following table describes how ColdFusion processes this code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfset myVar2=&quot;myVar&quot;&gt;</code></td>
<td>Sets the two variables to the following strings:</td>
</tr>
<tr>
<td><code>&lt;cfset myVar=&quot;27/9&quot;&gt;</code></td>
<td>myVar</td>
</tr>
<tr>
<td></td>
<td>27/9</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td>Displays the values assigned to the variables, myVar and 27/9, respectively.</td>
</tr>
<tr>
<td><code>#myVar2#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>#myVar#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>#Evaluate(&quot;myVar2&quot;)#&lt;br&gt;</code></td>
<td>Passes the string &quot;myvar2&quot; (without the quotation marks) to the Evaluate function, which does the following:</td>
</tr>
<tr>
<td><code>#Evaluate(&quot;myVar&quot;)#&lt;br&gt;</code></td>
<td>1. Evaluates it as the variable myVar2.</td>
</tr>
<tr>
<td><code>#Evaluate(myVar2)#&lt;br&gt;</code></td>
<td>2. Returns the value of the myVar2 variable, the string &quot;myvar&quot; (without the quotation marks).</td>
</tr>
<tr>
<td><code>#Evaluate(myVar)#&lt;br&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>
As you can see, using dynamic expressions can result in substantial expression evaluation overhead, and the code can be confusing. Therefore, you should avoid using dynamic expressions wherever a simpler technique, such as using indexed arrays or structures can serve your purposes.

Avoiding the Evaluate function

Using the Evaluate function increases processing overhead, and in most cases it is not necessary. The following sections provide examples of cases where you might consider using the Evaluate function.

Example 1

You might be inclined to use the Evaluate function in code such as the following:

```
<cfoutput>1 + 1 is #Evaluate(1 + 1)#</cfoutput>
```

Although this code works, it is not as efficient as the following code:

```
<cfset Result = 1 + 1>
<cfoutput>1 + 1 is #Result#</cfoutput>
```

Example 2

This example shows how you can use an associative array reference in place of an Evaluate function. This technique is powerful because:

- Most ColdFusion scopes are accessible as structures.
- You can use ColdFusion expressions in the indexes of associative array structure references. For more information on using associative array references for structures, see "Structure notation" on page 79.

The following example uses the Evaluate function to construct a variable name:

```
<cfoutput>
    Product Name: #Evaluate("Form.product_#i#")#
</cfoutput>
```

This code comes from an example where a form has entries for an indeterminate number of items in a shopping cart. For each item in the shopping cart there is a product name field. The field name is of the form product_1, product_2, and so on, where the number corresponds to the product's entry in the shopping cart. In this example, ColdFusion does the following:

1. Replaces the variable i with its value, for example 1.
The following example has the same result as the preceding example and is more efficient:

```cfoutput>
  ProductName: #Form["product_" & i]#
</cfoutput>
```

In this code, ColdFusion does the following:

6. Evaluates the expression in the associative array index brackets as the string "product_" concatenated with the value of the variable i.

7. Determines the value of the variable i; 1.

8. Concatenates the string and the variable value to get product_1.

9. Uses the result as the key value in the Form structure to get Form[product_1]. This associative array reference accesses the same value as the object.attribute format reference Form.product_1; in this case, Air popper.

This code format does not use any dynamic evaluation, but it achieves the same effect, of dynamically creating a structure reference by using a string and a variable.

**SetVariable function considerations**

You can avoid using the `SetVariable` function by using a format such as the following to set a dynamically named variable. For example, the following lines are equivalent:

```cfdset
  <cfset SetVariable("myVar" & i, myVal)>
  <cfset "myVar#i#" = myVal>
```

In the second line, enclosing the `myVar#i#` variable name in quotation marks tells ColdFusion to evaluate the name and process any text in number signs as a variable or function. ColdFusion replaces the `#i#` with the value of the variable i, so that if the value of i is 12, this code is equivalent to the line

```cfdset
  <cfset myVar12 = myVal>
```

For more information on this usage, see “Using number signs to construct a variable name in assignments” on page 59.

**Using the IIF function**

The `IIf` function is a shorthand for the following code:

```cfdif
  <cfset result = Evaluate(argument1)>
  <cfelse>
    <cfset result = Evaluate(argument2)>
  </cfif>
```

The function returns the value of the result variable. It is comparable to the use of the JavaScript and Java `?:` operator, and can result in more compact code. As a result, the `IIF` function can be convenient even if you are not using dynamic expressions.
The `IIF` function requires the `DE` function to prevent ColdFusion from evaluating literal strings, as the following example shows:

```cfoutput>
    #IIf(IsDefined("LocalVar"), "LocalVar", DE("The variable is not defined."))#
</cfoutput>
```

If you do not enclose the string "The variable is not defined." in a `DE` function, the `IIF` function tries to evaluate the contents of the string as an expression and generates an error (in this case, an invalid parser construct error).

The `IIF` function is useful for incorporating ColdFusion logic in-line in HTML code, but it entails a processing time penalty in cases where you do not otherwise need dynamic expression evaluation.

The following example shows using `IIF` to alternate table row background color between white and gray. It also shows the use of the `DE` function to prevent ColdFusion from evaluating the color strings.

```cfoutput>
    <table border="1" cellpadding="3">
        <cfloop index="i" from="1" to="10">
            <tr bgcolor="#IIF( i mod 2 eq 0, DE("white"), DE("gray") )#">
                <td>
                    hello #i#
                </td>
            </tr>
        </cfloop>
    </table>
</cfoutput>
```

This code is more compact than the following example, which does not use `IIF` or `DE`:

```cfoutput>
    <table border="1" cellpadding="3">
        <cfloop index="i" from="1" to="10">
            <cfif i mod 2 EQ 0>
                <cfset Color = "white">
                <cfelse>
                    <cfset Color = "gray">
                </cfif>
                <tr bgcolor="#color#">
                    <td>
                        hello #i#
                    </td>
                </tr>
            </cfloop>
    </table>
</cfoutput>
```

**Example: a dynamic shopping cart**

The following example dynamically creates and manipulates variable names without using dynamic expression evaluation by using associative array notation.

You need to dynamically generate variable names in applications such as shopping carts, where the required output is dynamically generated and variable. In a shopping cart, you do not know in advance the number of cart entries or their contents. Also, because you are using a form, the action page only receives Form variables with the names and values of the form fields.
The following example shows the shopping cart contents and lets you edit your order and submit it. To simplify things, the example automatically generates the shopping cart contents using CFScript instead of having the user fill the cart. A more complete example would populate a shopping cart as the user selected items. Similarly, the example omits all business logic for committing and making the order.

Create the form

1. Create a file in your editor.

```html
<html>
<head>
<title>Shopping Cart</title>
</head>
<cfscript>
CartItems=4;
Cart = ArrayNew(1);
for ( i=1; i LE cartItems; i=i+1) {
    Cart[i]=StructNew();
    Cart[i].ID=i;
    Cart[i].Name="Product " & i;
    Cart[i].SKU=i*100+(2*i*10)+(3*i);
    Cart[i].Qty=3*i-2;
}
</cfscript>
<body>
Your shopping cart has the following items.<br>
You can change your order quantities.<br>
If you don't want any item, clear the item's check box.<br>
When you are ready to order, click submit.<br>
<br>
<cfform name="ShoppingCart" action="ShoppingCartAction.cfm" method="post">
<table>
<tr>
<td>Order?</td>
<td>Product</td>
<td>Code</td>
<td>Quantity</td>
</tr>
<cfloop index="i" from="1" to="#cartItems#">
    <cfset productName= "product_" & Cart[i].ID>
    <cfset skuName= "sku_" & Cart[i].ID>
    <cfset qtyName= "qty_" & Cart[i].ID>
    <td><cfinput type="checkbox" name="itemID" value="#Cart[i].ID#" checked>
    </td>
    <td><cfinput type="text" name="#productName#" value="#Cart[i].Name#" passThrough = "readonly = 'True'"></td>
    <td><cfinput type="text" name="#skuName#" value="#Cart[i].SKU#" passThrough = "readonly = 'True'"></td>
    <td><cfinput type="text" name="#qtyName#" value="#Cart[i].Qty#"></td>
</tr>
</cfloop>
</table>
<input type="submit" name="submit" value="submit">
</cfform>
</body>
</html>
```
2  Save the file as ShoppingCartForm.cfm.

**Reviewing the code**

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfscript&gt; CartItems=4; Cart = ArrayNew(1); for (i=1; i LE #cartItems#; i=i+1) { Cart[i]=StructNew(); Cart[i].ID=i; Cart[i].Name=&quot;Product &quot; &amp; i; Cart[i].SKU=i<em>100+(2</em>i<em>10)+(3</em>i); Cart[i].Qty=3*i-2; } &lt;/cfscript&gt;</td>
<td>Create a shopping cart as an array of structures, with each structure containing the cart item ID, product name, SKU number, and quantity ordered for one item in the cart. Populate the shopping cart by looping CartItems times and setting the structure variables to arbitrary values based on the loop counter. A real application would set the Name, SKU, and Quantity values on other pages.</td>
</tr>
</tbody>
</table>
| <cfform name="ShoppingCart" action="ShoppingCartAction.cfm" method="post"> <table> <tr> <td>Order?</td> <td>Product</td> <td>Code</td> <td>Quantity</td> </tr> Loop through the shopping cart entries to generate the cart form dynamically. For each loop, generate variables used for the form field name attributes by appending the cart item ID (Cart[i].ID) to a field type identifier, such as "sku_".

Use a single name, "itemID", for all check boxes. This way, the itemID value posted to the action page is a list of all the check box field values. The check box field value for each item is the cart item ID.

Each column in a row contains a field for a cart item structure entry. The passthrough attribute sets the product name and SKU fields to read-only; note the use of single-quotiation marks. (For more information on the cfinput tag passthrough attribute, see the CFML Reference.) The check boxes are selected by default. |
| <tr> | Create the Submit button and end the form. |
| <cfloop index="i" from="1" to="#cartItems#"> | Start the form and its embedded table. When the user clicks the submit button, post the form data to the ShoppingCartAction.cfm page. |
| | The table formats the form neatly. The first table row contains the column headers. Each following row has the data for one cart item. |
| | Create the Action page

1  Create a file in your editor.
2 Enter the following text:

```html
<html>
<head>
  <title>Your Order</title>
</head>
<body>
  <cfif isDefined("Form.submit")>
    <cfparam name="Form.itemID" default=""
    <cfoutput>
      You have ordered the following items:<br>
      <br>
      <cfloop index="i" list="#Form.itemID#">
        ProductName: #Form["product_" & i]#<br>
        Product Code: #Form["sku_" & i]#<br>
        Quantity: #Form["qty_" & i]#<br>
      </cfloop>
    </cfoutput>
  </cfif>
</body>
</html>
```

3 Save the file as ShoppingCartAction.cfm

4 Open ShoppingCartform.cfm in your browser, change the check box and quantity values, and click Submit.

**Reviewing the code**
The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfif isDefined(&quot;Form.submit&quot;)&gt;</code></td>
<td>Run the CFML on this page only if it is called by submitting a form. This is not needed if there are separate form and action pages, but is required if the form and action page were one ColdFusion page.</td>
</tr>
<tr>
<td><code>&lt;cfparam name=&quot;Form.itemID&quot; default=&quot;&quot;&gt;</code></td>
<td>Set the default Form.itemID to the empty string. This prevents ColdFusion from displaying an error if the user clears all check boxes before submitting the form (so no product IDs are submitted).</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td>Display the name, SKU number, and quantity for each ordered item.</td>
</tr>
<tr>
<td><code>You have ordered the following items:&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfloop index=&quot;i&quot; list=&quot;#Form.itemID#&quot;&gt;</code></td>
<td>The form page posts Form.itemID as a list containing the value attributes of all the check boxes. These attributes contain the shopping cart item IDs for the selected cart items. Use the list values to index a loop that outputs each ordered item.</td>
</tr>
<tr>
<td><code>ProductName: #Form[&quot;product_&quot; &amp; i]#&lt;br&gt;</code></td>
<td>Use associative array notation to access the Form scope as a structure and use expressions in the array indexes to construct the form variable names. The expressions consist of a string containing the field name's field type prefix (for example, &quot;sku_&quot;), concatenated with the variable i, which contains the shopping cart item ID number (which is also the loop index variable).</td>
</tr>
<tr>
<td><code>Product Code: #Form[&quot;sku_&quot; &amp; i]#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>Quantity: #Form[&quot;qty_&quot; &amp; i]#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;br&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5: Using Arrays and Structures

Adobe ColdFusion supports dynamic multidimensional arrays. Using arrays can enhance your ColdFusion application code.

ColdFusion also supports structures for managing lists of key-value pairs. Because structures can contain other structures or complex data types as it values, they provide a flexible and powerful tool for managing complex data.

### About arrays

Traditionally, an array is a tabular structure used to hold data, much like a spreadsheet table with clearly defined limits and dimensions.

In ColdFusion, you typically use arrays to temporarily store data. For example, if your site lets users order goods online, you can store their shopping cart contents in an array. This lets you make changes easily without committing the information, which the user can change before completing the transaction, to a database.

### Basic array concepts

Subsequent discussions of ColdFusion arrays are based on the following terms:

- **Array dimension**: The relative complexity of the array structure.
- **Index**: The position of an element in a dimension, ordinarily surrounded by square brackets: my1DArray[1], my2DArray[1][1], my3DArray[1][1][1].
- **Array element**: Data stored at an array index.

The simplest array is a one-dimensional array, similar to a row in a table. A one-dimensional array has a name (the variable name) and a numerical index. The index number references a single entry, or cell, in the array, as the following figure shows:
Thus, the following statement sets the value of the fifth entry in the one-dimensional array MyArray to “Robert”:
<cfset MyArray[5] = "Robert">

A basic two-dimensional (2D) array is like a simple table. A three-dimensional (3D) array is like a cube of data, and so on. ColdFusion lets you directly create arrays with up to three dimensions. You can use multiple statements to create arrays with more than three dimensions.

The syntax my2darray[1][3]="Paul" is the same as saying “My2dArray is a two-dimensional array and the value of the array element index [1][3] is ‘Paul’.”

**About ColdFusion arrays**

ColdFusion arrays differ from traditional arrays, because they are dynamic. For example, in a conventional array, array size is constant and symmetrical, whereas in a ColdFusion array, you can have rows of differing lengths based on the data that is added or removed.

The following figures show the differences between traditional arrays and ColdFusion arrays using 2D arrays. The differences between traditional and ColdFusion 3D arrays are similar, but much harder to show on a page.

A conventional 2D array is like a fixed-size table made up of individual cells, as the following figure shows:

```
+---+---+---+---+
+---+---+---+---+
+---+---+---+---+
+---+---+---+---+
+---+---+---+---+
```

The following figure represents a ColdFusion 2D array:
A ColdFusion 2D array is actually a one-dimensional array that contains a series of additional 1D arrays. Each of the arrays that make up a row can expand and contract independently of any other column. Similarly, a ColdFusion 3D array is essentially three nested sets of 1D arrays.

Dynamic arrays expand to accept data that you add to them and contract as you remove data from them.

Basic array techniques

Referencing array elements

You reference array elements by enclosing the index with brackets: `arrayName[x]` where `x` is the index that you want to reference. In ColdFusion, array indexes are counted starting with position 1, which means that position 1 in the `firstname` array is referenced as `firstname[1]`. For 2D arrays, you reference an index by specifying two coordinates: `myarray[1][1]`.

You can use ColdFusion variables and expressions inside the square brackets to reference an index, as the following example shows:

```coldfusion
<cfset myArray=ArrayNew(1)>
<cfset myArray[1]="First Array Element">
<cfset myArray[1 + 1]="Second Array" & "Element">
<cfset arrayIndex=3>
<cfset arrayElement="Third Array Element">
<cfset myArray[arrayIndex]=arrayElement>
<cfset myArray[++arrayIndex]="Fourth Array Element">
<cfdump var=#myArray#>
```

*Note:* The `IsDefined` function does not test the existence of array elements. Instead, put any code that might try to access an undefined array element in a try block and use a catch block to handle exceptions that arise if elements do not exist.
Creating arrays
In ColdFusion, you can create arrays explicitly, by using a function to declare the array and then assigning it data, or implicitly by using an assignment statement. You can create simple or complex, multidimensional arrays.

Creating arrays using functions
To create an array explicitly, you use the `arrayNew` function and specify the array dimensions, as in the following example:

```cfset myNewArray=ArrayNew(2)>
```

This line creates a two-dimensional array named `myNewArray`. You use this method to create an array with up to three dimensions.

After you create an array, you add array elements, which you can then reference by using the element indexes.

For example, suppose you create a one-dimensional array called `firstname`:

```cfset firstname=ArrayNew(1)>
```

The array `firstname` holds no data and is of an unspecified length. Next you add data to the array:

```cfset firstname[1]="Coleman">
<cfset firstname[2]="Charlie">
<cfset firstname[3]="Dexter">
```

After you add these names to the array, it has a length of 3.

Creating arrays implicitly
To create an array implicitly, you do not use the `ArrayNew` function. Instead, you use a new variable name on the left side of an assignment statement, and array notation on the right side of the statement, as in the following example:

```cfset firstnameImplicit=[["Coleman","Charlie","Dexter"]>
```

This single statement is equivalent to the four statements used to create the `firstname` array in Creating arrays using functions.

When you create an array implicitly, the right side of the assignment statement has square brackets ([]) surrounding the array contents and commas separating the individual array elements. The elements can be literal values, such as the strings in the example, variables, or expressions. If you specify variables, do not put the variable names in quotation marks.

You can create an empty array implicitly, as in the following example:

```cfset myArray = []>
```

You can also create an array implicitly by assigning a single entry, as the following example shows:

```cfset chPar[1] = "Charlie">
<cfset chPar[2] = "Parker">
```

ColdFusion does not allow nested implicit creation of arrays, structures, or arrays and structures. Therefore, you cannot create a multidimensional array in a single implicit statement. For example, neither of the following statements is valid:

```cfset myArray = [[],[]]>
<cfset jazzmen = [["Coleman","Charlie"],["Hawkins", "Parker"]>
```

To create a two-dimensional array, for example, use a format such as the following:

```cfset ch = ["Coleman", "Hawkins"]>
<cfset cp = ["Charlie", "Parker"]>
```
<cfset dg = ["Dexter", "Gordon"]>
<cfset players = [ch, cp, dg]>

You cannot use a dynamic variable when you create an array implicitly. For example, the following expression generates an error:

<cfset i="CP">
<cfset 
"i"=
["Charlie","Parker"]>

Creating complex multidimensional arrays
ColdFusion supports dynamic multidimensional arrays. When you declare an array with the ArrayNew function, you specify the number of dimensions. You can create an asymmetrical array or increase an existing array's dimensions by nesting arrays as array elements.

It is important to know that when you assign one array (array1) to an element of another array (array2), array1 is copied into array2. The original copy of array1 still exists, independent of array2. You can then change the contents of the two arrays independently.

The best way to understand an asymmetrical array is by looking at it. The following example creates an asymmetric, multidimensional array and the cfdump tag displays the resulting array structure. Several array elements do not yet contain data.

<cfset myarray=ArrayNew(1)>
<cfset myotherarray=ArrayNew(2)>
<cfset biggerarray=ArrayNew(3)>
<cfset biggerarray[1][1][1]=myarray>
<cfset biggerarray[1][1][1][10]=3>
<cfset biggerarray[2][1][1]=myotherarray>
<cfset biggerarray[2][1][1][4][2]="five deep">
<cfset biggestarray=ArrayNew(3)>
<cfset biggestarray[3][1][1]=biggerarray>
<cfset biggestarray[3][1][1][2][3][1]="This is complex">
<cfset myarray[3]="Can you see me">
<cfdump var=#biggestarray#><br>
<cfdump var=#myarray#>

Note: The cfdump tag displays the entire contents of an array. It is an excellent tool for debugging arrays and array-handling code.

Reviewing the code
The following table describes the code:
Adding elements to an array

You can add an element to an array by assigning the element a value or by using a ColdFusion function.

Adding an array element by assignment

You can add elements to an array by defining the value of an array element, as shown in the following `cfset` tag:

```coldfusion
<cfset myarray[5]="Test Message">
```

If an element does not exist at the specified index, ColdFusion creates it. If an element already exists at the specified index, ColdFusion replaces it with the new value. To prevent existing data from being overwritten, use the `ArrayInsertAt` function, as described in the next section.

If elements with lower-number indexes do not exist, they remain undefined. You must assign values to undefined array elements before you can use them. For example, the following code creates an array and an element at index 4. It outputs the contents of element 4, but generates an error when it tries to output the (nonexistent) element 3.

```coldfusion
<cfset myarray=ArrayNew(1)>
<cfset myarray[4]=4>
<cfoutput>
  myarray4: #myarray[4]#<br>
  myarray3: #myarray[3]#<br>
</cfoutput>
```

Adding an array element with a function

You can use the following array functions to add data to an array:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfset myarray=ArrayNew(1)&gt;</code>&lt;br&gt;<code>&lt;cfset myotherarray=ArrayNew(2)&gt;</code>&lt;br&gt;<code>&lt;cfset biggerarray=ArrayNew(3)&gt;</code></td>
<td>Create three empty arrays, a 1D array, a 2D array, and a 3D array.</td>
</tr>
<tr>
<td><code>&lt;cfset biggerarray[1][1][1]=myarray&gt;</code>&lt;br&gt;<code>&lt;cfset biggerarray[1][1][1][10]=3&gt;</code></td>
<td>Make element <code>[1][1][1]</code> of the 3D <code>biggerarray</code> array be a copy of the 1D array. Assign 3 to the <code>[1][1][1][10]</code> element of the resulting array. The <code>biggerarray</code> array is now asymmetric. For example, it does not have a <code>[1][1][1][10]</code> element.</td>
</tr>
<tr>
<td><code>&lt;cfset biggerarray[2][1][1]=myotherarray&gt;</code>&lt;br&gt;<code>&lt;cfset biggerarray[2][1][1][4][2]=&quot;five deep&quot;&gt;</code></td>
<td>Make element <code>[2][1][1]</code> of the 3D array be the 2D array, and assign the <code>[2][1][1][4][2]</code> element the value “five deep”. The <code>biggerarray</code> array is now even more asymmetric.</td>
</tr>
<tr>
<td><code>&lt;cfset biggestarray=ArrayNew(3)&gt;</code>&lt;br&gt;<code>&lt;cfset biggestarray[3][1][1]=&quot;This is complex&quot;&gt;</code></td>
<td>Create a second 3D array. Make the <code>[3][1][1]</code> element of this array a copy of the <code>biggerarray</code> array, and assign element <code>[3][1][1][2][3][1]</code>. The resulting array is very complex and asymmetric.</td>
</tr>
<tr>
<td><code>&lt;cfdump var=&quot;#biggestarray#&quot;&gt;&lt;br&gt;</code>&lt;br&gt;<code>&lt;cfdump var=&quot;#myarray#&quot;</code></td>
<td>Use <code>cfdump</code> to view the structure of <code>biggestarray</code> and <code>myarray</code>. Notice that the “Can you see me” entry appears in <code>myarray</code>, but not in <code>biggestarray</code>, because <code>biggestarray</code> has a copy of the original <code>myarray</code> values and is not affected by the change to <code>myarray</code>.</td>
</tr>
</tbody>
</table>
Because ColdFusion arrays are dynamic, if you add or delete an element from the array, any higher-numbered index values all change. For example, the following code creates a two element array and displays the array contents. It then uses `ArrayPrepend` to insert a new element at the beginning of the array and displays the result. The data that was originally in indexes 1 and 2 is now in indexes 2 and 3.

```coldfusion
<!--- Create an array with three elements. --->
<cfset myarray=ArrayNew(1)>
<cfset myarray[1]="Original First Element">
<cfset myarray[2]="Original Second Element">
<!--- Use cfdump to display the array structure --->
<cfdump var=#myarray#>
<br>
<!--- Add a new element at the beginning of the array. --->
<cfscript>
    ArrayPrepend(myarray, "New First Element");
</cfscript>
<!--- Use cfdump to display the new array structure. --->
<cfdump var=#myarray#>
For more information about these array functions, see the CFML Reference.

### Deleting elements from an array

Use the `ArrayDeleteAt` function to delete data from the array at a particular index, instead of setting the data value to zero or an empty string. If you remove data from an array, the array resizes dynamically, as the following example shows:

```coldfusion
<!--- Create an array with three elements --->
<cfset firstname=ArrayNew(1)>
<cfset firstname[1]="Robert">
    <cfset firstname[2]="Wanda">
<cfset firstname[3]="Jane">
<!--- Delete the second element from the array --->
<cfset temp=ArrayDeleteAt(firstname, 2)>
<!--- Display the array length (2) and its two entries, which are now "Robert" and "Jane" --->
<coutput>
    The array now has #ArrayLen(firstname)# indexes<br>
    The first entry is #firstname[1]#<br>
    The second entry is #firstname[2]#<br>
</coutput>
```

The `ArrayDeleteAt` function removed the original second element and resized the array so that it has two entries, with the second element now being the original third element.
Copying arrays
You can copy arrays of simple variables (numbers, strings, Boolean values, and date-time values) by assigning the original array to a new variable name. You do not have to use ArrayNew to create the new array first. When you assign the existing array to a new variable, ColdFusion creates a new array and copies the old array’s contents to the new array. The following example creates and populates a two-element array. It then copies the original array, changes one element of the copied array and dumps both arrays. As you can see, the original array is unchanged and the copy has a new second element.

```cfm
<cfset myArray=ArrayNew(1)>
<cfset myArray[1]="First Array Element">
<cfset myArray[2]="Second Array Element">
<cfset newArray=myArray>
<cfset newArray[2]="New Array Element 2">
<cfdump var=#myArray#><br>
<cfdump var=#newArray#>
```

If your array contains complex variables (structures, query objects, or external objects such as COM objects) assigning the original array to a new variable does not make a complete copy of the original array. The array structure is copied; however, the new array does not get its own copy of the complex data, only references to it. To demonstrate this behavior, run the following code:

Create an array that contains a structure.<br>
```cfm
<cfset myStruct=StructNew()>
<cfset myStruct.key1="Structure key 1">
<cfset myStruct.key2="Structure key 2">
<cfset myArray=ArrayNew(1)>
<cfset myArray[1]=myStruct>
<cfset myArray[2]="Second array element">
<cfdump var=#myArray#><br>
<br>
Copy the array and dump it.<br>
```cfm
```
<br>
<cfset myNewArray=myArray>
<cfdump var=#myNewArray#><br>
<br>
Change the values in the new array.<br>
```cfm
<cfset myNewArray[1].key1="New first array element">
<br>
Contents of the original array after the changes:<br>
```cfm
<cfdump var=#myArray#><br>
<br>
Contents of the new array after the changes:<br>
```cfm
<cfdump var=#myNewArray#>
```

The change to the new array also changes the contents of the structure in the original array.

To make a complete copy of an array that contains complex variables, use the Duplicate function.

Populating arrays with data
Array elements can store any values, including queries, structures, and other arrays. You can use a number of functions to populate an array with data, including ArraySet, ArrayAppend, ArrayInsertAt, and ArrayPrepend. These functions are useful for adding data to an existing array.

In particular, you should master the following basic techniques:

- Populating an array with the ArraySet function
• Populating an array with the cfloop tag
• Populating an array from a query

**Populating an array with the ArraySet function**
You can use the ArraySet function to populate a 1D array, or one dimension of a multidimensional array, with some initial value, such as an empty string or zero. This can be useful if you need to create an array of a certain size, but do not need to add data to it right away. One reason to do this is so that you can refer to all the array indexes. If you refer to an array index that does not contain some value, such as an empty string, you get an error.

The ArraySet function has the following form:
```
ArraySet (arrayname, startrow, endrow, value)
```

The following example initializes the array myarray, indexes 1 to 100, with an empty string:
```
ArraySet (myarray, 1, 100, "")
```

**Populating an array with the cfloop tag**
The cfloop tag provides a common and very efficient method for populating an array. The following example uses a cfloop tag and the MonthAsString function to populate a simple 1D array with the names of the months. A second cfloop outputs data in the array to the browser.

```coldfusion
<cfset months=arraynew(1)>
<cfloop index="loopcount" from=1 to=12>
  <cfset months[loopcount]=MonthAsString(loopcount)>
</cfloop>

<cfloop index="loopcount" from=1 to=12>
  <cfoutput>
    #months[loopcount]#<br>
  </cfoutput>
</cfloop>
```

**Using nested loops for 2D and 3D arrays**
To output values from 2D and 3D arrays, you must employ nested loops to return array data. With a one-dimensional (1D) array, a single cfloop is sufficient to output data, as in the previous example. With arrays of dimension greater than one, you need to maintain separate loop counters for each array level.

**Nesting cfloop tags for a 2D array**
The following example shows how to handle nested cfloop tags to output data from a 2D array. It also uses nested cfloop tags to populate the array:

```coldfusion
<cfset my2darray=arraynew(2)>
<cfloop index="loopcount" from=1 to=12>
  <cfloop index="loopcount2" from=1 to=2>
    <cfset my2darray[loopcount][loopcount2]=(loopcount * loopcount2)>
  </cfloop>
</cfloop>
<p>The values in my2darray are currently:</p>
<cfloop index="OuterCounter" from="1" to="#ArrayLen(my2darray)#">
  <cfloop index="InnerCounter" from="1" to="#ArrayLen(my2darray[OuterCounter])#">
    <cfoutput>
      <b>[#OuterCounter#][#InnerCounter#]</b>: 
    </cfoutput>
  </cfloop>
</cfloop>
```
Nesting cfloop tags for a 3D array
For 3D arrays, you simply nest an additional cfloop tag. (This example does not set the array values first to keep the code short.)

```coldfusion
<cfloop index="Dim1" from="1" to="#ArrayLen(my3darray)#">
  <cfloop index="Dim2" from="1" to="#ArrayLen(my3darray[Dim1])#">
    <cfloop index="Dim3" from="1" to="#ArrayLen(my3darray[Dim1][Dim2])#">
      <cfoutput>
        <b>
          #Dim1# [#Dim2#] [#Dim3#]): #my3darray[Dim1][Dim2][Dim3]#
        </b>
      </cfoutput>
    </cfloop>
  </cfloop>
</cfloop>
```

Populating an array from a query
When populating an array from a query, keep the following things in mind:

- You cannot add query data to an array all at once. A looping structure is generally required to populate an array from a query.
- You can reference query column data using array-like syntax. For example, `myquery.col_name[1]` references data in the first row in the `col_name` column of the `myquery` query.
- Inside a cfloop query= loop, you do not have to specify the query name to reference the query’s variables.

You can use a cfset tag with the following syntax to define values for array indexes:

```coldfusion
<cfset arrayName[index]=queryColumn[row]>
```

In the following example, a cfloop tag places four columns of data from a sample data source into an array, `myarray`.

```coldfusion
<!--- Do the query --->
<cfquery name="test" datasource="cfdocexamples">
  SELECT Emp_ID, LastName, FirstName, Email
  FROM Employees
</cfquery>

<!--- Declare the array --->
<cfset myarray=arraynew(2)>

<!--- Populate the array row by row --->
<cfloop query="test">
  <cfset myarray[CurrentRow][1]=Emp_ID>
  <cfset myarray[CurrentRow][2]=LastName>
  <cfset myarray[CurrentRow][3]=FirstName>
  <cfset myarray[CurrentRow][4]=Email>
</cfloop>

<!--- Now, create a loop to output the array contents --->
<cfset total_records=test.recordcount>
<cfloop index="Counter" from=1 to="#Total_Records#">
  <cfoutput>
    ID: #MyArray[Counter][1]#, LASTNAME: #MyArray[Counter][2]#
  </cfoutput>
</cfloop>
```
FIRSTNAME: #MyArray[Counter][3]#,  
EMAIL: #MyArray[Counter][4]# <br>
</cfoutput>
</cfloop>

This example uses the query object built-in variable CurrentRow to index the first dimension of the array.

Array functions

The following functions are available for creating, editing, and handling arrays:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArrayAppend</td>
<td>Appends an array element to the end of a specified array.</td>
</tr>
<tr>
<td>ArrayAvg</td>
<td>Returns the average of the values in the specified array.</td>
</tr>
<tr>
<td>ArrayClear</td>
<td>Deletes all data in a specified array.</td>
</tr>
<tr>
<td>ArrayDeleteAt</td>
<td>Deletes an element from a specified array at the specified index and resizes the array.</td>
</tr>
<tr>
<td>ArrayInsertAt</td>
<td>Inserts an element (with data) in a specified array at the specified index and resizes the array.</td>
</tr>
<tr>
<td>ArrayIsDefined</td>
<td>Returns True if the specified array is defined.</td>
</tr>
<tr>
<td>ArrayIsEmpty</td>
<td>Returns True if the specified array is empty of data.</td>
</tr>
<tr>
<td>ArrayLen</td>
<td>Returns the length of the specified array.</td>
</tr>
<tr>
<td>ArrayMax</td>
<td>Returns the largest numeric value in the specified array.</td>
</tr>
<tr>
<td>ArrayMin</td>
<td>Returns the smallest numeric value in the specified array.</td>
</tr>
<tr>
<td>ArrayNew</td>
<td>Creates an array of specified dimension.</td>
</tr>
<tr>
<td>ArrayPrepend</td>
<td>Adds an array element to the beginning of the specified array.</td>
</tr>
<tr>
<td>ArrayResize</td>
<td>Resets an array to a specified minimum number of elements.</td>
</tr>
<tr>
<td>ArraySet</td>
<td>Sets the elements in a 1D array in a specified range to a specified value.</td>
</tr>
<tr>
<td>ArraySort</td>
<td>Returns the specified array with elements sorted numerically or alphanumerically.</td>
</tr>
<tr>
<td>ArraySum</td>
<td>Returns the sum of values in the specified array.</td>
</tr>
<tr>
<td>ArraySwap</td>
<td>Swaps array values in the specified indexes.</td>
</tr>
<tr>
<td>ArrayToList</td>
<td>Converts the specified 1D array to a list, delimited with the character you specify.</td>
</tr>
<tr>
<td>IsArray</td>
<td>Returns True if the value is an array.</td>
</tr>
<tr>
<td>ListToArray</td>
<td>Converts the specified list, delimited with the character you specify, to an array.</td>
</tr>
</tbody>
</table>

For more information about each of these functions, see the CFML Reference.

About structures

ColdFusion structures consist of key-value pairs. Structures let you build a collection of related variables that are grouped under a single name. You can define ColdFusion structures dynamically.
You can use structures to refer to related values as a unit, rather than individually. To maintain employee lists, for example, you can create a structure that holds personnel information such as name, address, phone number, ID numbers, and so on. Then you can refer to this collection of information as a structure called `employee` rather than as a collection of individual variables.

A structure's key must be a string. The values associated with the key can be any valid ColdFusion value or object. It can be a string or integer, or a complex object such as an array or another structure. Because structures can contain any kind of data they provide a very powerful and flexible mechanism for representing complex data.

**Structure notation**

ColdFusion supports three types of notation for referencing structure contents. The notation that you use depends on your requirements.

<table>
<thead>
<tr>
<th>Notation</th>
<th>Description</th>
</tr>
</thead>
</table>
| Object.property| You can refer to a property, prop, of an object, obj, as obj.prop. This notation, also called dot notation, is useful for simple assignments, as in this example:  
    ```coldfusion```
    depts.John="Sales"
    ```coldfusion```
    Use this notation only when you know the property names (keys) in advance and they are strings, with no special characters, numbers, or spaces. You cannot use the dot notation when the property, or key, is dynamic. |
| Associative arrays| If you do not know the key name in advance, or it contains spaces, numbers, or special characters, you can use associative array notation. This notation uses structures as arrays with string indexes; for example:  
    ```coldfusion```
    depts["John"]="Sales"
    depts[employeeName]="Sales"
    ```coldfusion```
    You can use a variable (such as employeeName) as an associative array index. Therefore, you must enclose any literal key names in quotation marks.  
    For information on using associative array references containing variables, see “Dynamically constructing structure references” on page 60. |
| Structure      | You use structure notation only when you create structures and set their initial values, not when you are accessing or updating structure data, and only on the right side of an assignment expression. This notation has the following format:  
    ```coldfusion```
    {keyName=value [, keyName=value] ...}  
    where the square braces [ ] and ellipses (...) indicate optional contents that can be repeated.  
    The following example creates a structure that uses structure notation:  
    ```coldfusion```
    <cfset name={firstName = "John", lastName = "Smythe"}> |

**Referencing complex structures**

When a structure contains another structure, you reference the data in the nested structure by extending either object.property or associative array notation. You can even use a mixture of both notations.

For example, if structure1 has a key key1 whose value is a structure that has keys struct2key1, struct2key2, and so on, you can use any of the following references to access the data in the first key of the embedded structure:

- Structure1.key1.Struct2key1
- Structure1["Key1"].Struct2key1
- Structure1.key1["Struct2key1"]
- Structure1["Key1"]["Struct2key1"]

The following example shows various ways you can reference the contents of a complex structure:

```coldfusion```
<cfset myArray=ArrayNew(1)>
```coldfusion```
<cfset myArray[1]="2">  
<cfset myArray[2]="3">  
<cfset myStruct2=StructNew()>  
<cfset myStruct2.struct2key1="4">  
<cfset myStruct2.struct2key2="5">  
<cfset myStruct=StructNew()>  
<cfset myStruct.key1="1">  
<cfset myStruct.key2=myArray>  
<cfset myStruct.key3=myStruct2>  
<cfdump var=#myStruct#><br>  
<cfset key1Var="key1">  
<cfset key2Var="key2">  
<cfset key3Var="key3">  
<cfset var2="2">  
<cfoutput>  
Value of the first key<br>  
#mystruct.key1#<br>  
#mystruct["key1"]#<br>  
#mystruct[key1Var]#<br>  
<br>  
Value of the second entry in the key2 array<br>  
#myStruct.key2[2]#<br>  
#myStruct["key2"][2]#<br>  
#myStruct[key2Var][2]#<br>  
#myStruct[key2Var][var2]#<br>  
<br>  
Value of the struct2key2 entry in the key3 structure<br>  
#myStruct.struct2key2#<br>  
#myStruct["struct2key2"]#<br>  
#myStruct[myStruct2].struct2key2#<br>  
</cfoutput>  

Reviewing the code  
The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfset myArray=ArrayNew(1)&gt; &lt;cfset myArray[1]=&quot;2&quot;&gt; &lt;cfset myArray[2]=&quot;3&quot;&gt; &lt;cfset myStruct2=StructNew()&gt; &lt;cfset myStruct2.struct2key1=&quot;4&quot;&gt; &lt;cfset myStruct2.struct2key2=&quot;5&quot;&gt; &lt;cfset myStruct=StructNew()&gt; &lt;cfset myStruct.key1=&quot;1&quot;&gt; &lt;cfset myStruct.key2=myArray&gt; &lt;cfset myStruct.key3=myStruct2&gt; &lt;cfdump var=#myStruct#&gt;&lt;br&gt;</td>
<td>Create a structure with three entries: a string, an array, and an embedded structure.</td>
</tr>
<tr>
<td>&lt;cfset key1Var=&quot;key1&quot;&gt; &lt;cfset key2Var=&quot;key2&quot;&gt; &lt;cfset key3Var=&quot;key3&quot;&gt; &lt;cfset var2=&quot;2&quot;&gt;</td>
<td>Display the complete structure.</td>
</tr>
<tr>
<td>Create variables containing the names of the myStruct keys and the number 2.</td>
<td></td>
</tr>
</tbody>
</table>
Creating structures

Creating structures

In ColdFusion, you can create structures explicitly by using a function, and then populate the structure using assignment statements or functions, or you can create the structure implicitly by using an assignment statement.

Creating structures using functions

You can create structures by assigning a variable name to the structure with the `StructNew` function as follows:

```coldfusion
<cfset structName = StructNew()>
```

For example, to create a structure named departments, use the following syntax:

```coldfusion
<cfset departments = StructNew()>
```

This creates an empty structure to which you can add data.

Creating structures implicitly

You can create an empty structure implicitly, as in the following example:

```coldfusion
<cfset myStruct = {}>
```
You can also create a structure by assigning data to a variable. For example, each of the following lines creates a structure named `myStruct` with one element, `name`, that has the value `Adobe Systems Incorporated`.

```cfml
<cfset coInfo.name = "Adobe Systems Incorporated">
<cfset coInfo["name"] = "Adobe Systems Incorporated">
<cfset coInfo = {name = "Adobe Systems Incorporated"}>
```

When you use structure notation to create a structure, as shown in the third example, you can populate multiple structure fields. The following example shows this use:

```cfml
<cfset coInfo={name="Adobe Systems Incorporated", industry="software"}>
```

ColdFusion does not allow nested implicit creation of structures, arrays, or structures and arrays. The following line, for example, generates an error:

```cfml
<cfset myStruct = {structKey1 = {innerStructKey1 = "innerStructValue1"}}>
```

Similarly, you cannot use object.property notation on the left side of assignments inside structure notation. The following statement, for example, causes an error:

```cfml
<cfset myStruct=structnew()>
<cfset myStruct1=structnew()>
<cfset myStruct={structKey1 = myStruct1}>
```

You cannot use a dynamic variable when you create a structure implicitly. For example, the following expression generates an error:

```cfml
<cfset i="coInfo">
<cfset "#i#"={name = "Adobe Systems Incorporated"}>
```

**Adding and updating structure elements**

You add or update a structure element to a structure by assigning the element a value or by using a ColdFusion function. It is simpler and more efficient to use direct assignment.

You can add structure key-value pairs by defining the value of the structure key, as the following example shows:

```cfml
<cfset myNewStructure.key1="A new structure with a new key">
<cfdump var=#myNewStructure#>
<cfset myNewStructure.key2="Now I’ve added a second key">
<cfdump var=#myNewStructure#>
```

The following code uses `cfset` and `object.property` notation to create a structure element called `departments.John`, and changes John's department from Sales to Marketing. It then uses associative array notation to change his department to Facilities. Each time the department changes, it displays the results:

```cfml
<cfset departments=structnew()>
<cfset departments.John = "Sales">
Before the first change, John was in the #departments.John# Department<br>
</cfoutput>
<cfset Departments.John = "Marketing">
After the first change, John is in the #departments.John# Department<br>
</cfoutput>
<cfset Departments["John"] = "Facilities">
After the second change, John is in the #departments.John# Department<br>
</cfoutput>
```
Getting information about structures and keys
You use ColdFusion functions to find information about structures and their keys.

Getting information about structures
To find out if a given value represents a structure, use the \texttt{IsStruct} function, as follows:

\texttt{IsStruct} (variable)

This function returns True if \texttt{variable} is a ColdFusion structure. (It also returns True if \texttt{variable} is a Java object that implements the java.util.Map interface.)

Structures are not indexed numerically, so to find out how many name-value pairs exist in a structure, use the \texttt{StructCount} function, as in the following example:

\texttt{StructCount} (employee)

To discover whether a specific Structure contains data, use the \texttt{StructIsEmpty} function, as follows:

\texttt{StructIsEmpty} (structure\_name)

This function returns True if the structure is empty, and False if it contains data.

Finding a specific key and its value
To determine whether a specific key exists in a structure, use the \texttt{StructKeyExists} function, as follows:

\texttt{StructKeyExists} (structure\_name, "key\_name")

Do not put the name of the structure in quotation marks, but you do put the key name in quotation marks. For example, the following code displays the value of the MyStruct.MyKey only if it exists:

\begin{verbatim}
<cfif StructKeyExists(myStruct, "myKey")>
    <cfoutput> #mystruct.myKey#</cfoutput>
</cfif>
\end{verbatim}

You can use the \texttt{StructKeyExists} function to dynamically test for keys by using a variable to represent the key name. In this case, you do not put the variable in quotation marks. For example, the following code loops through the records of the GetEmployees query and tests the myStruct structure for a key that matches the query’s LastName field. If ColdFusion finds a matching key, it displays the Last Name from the query and the corresponding entry in the structure.

\begin{verbatim}
<cfloop query="GetEmployees">
    <cfif StructKeyExists(myStruct, LastName)>
        <cfoutput> #LastName#: #mystruct[LastName]#</cfoutput>
    </cfif>
</cfloop>
\end{verbatim}

If the name of the key is known in advance, you can also use the ColdFusion \texttt{IsDefined} function, as follows:

\texttt{IsDefined} ("structure\_name.key")

However, if the key is dynamic, or contains special characters, you must use the \texttt{StructKeyExists} function.

\textbf{Note:} Using \texttt{StructKeyExists} to test for the existence of a structure entry is more efficient than using \texttt{IsDefined}. ColdFusion scopes are available as structures and you can improve efficiency by using \texttt{StructKeyExists} to test for the existence of variables.

Getting a list of keys in a structure
To get a list of the keys in a CFML structure, you use the \texttt{StructKeyList} function, as follows:

\begin{verbatim}
<cfset temp=StructKeyList(structure\_name, [delimiter])>
\end{verbatim}
You can specify any character as the delimiter; the default is a comma.

Use the StructKeyArray function to returns an array of keys in a structure, as follows:

```coldfusion
<cfset temp=StructKeyArray(structure_name)>
```

Note: The StructKeyList and StructKeyArray functions do not return keys in any particular order. Use the ListSort or ArraySort functions to sort the results.

### Copying structures

ColdFusion provides several ways to copy structures and create structure references. The following table lists these methods and describes their uses:

<table>
<thead>
<tr>
<th>Technique</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplicate function</td>
<td>Makes a complete copy of the structure. All data is copied from the original structure to the new structure, including the contents of structures, queries, and other objects. As a result changes to one copy of the structure have no effect on the other structure. This function is useful when you want to move a structure completely into a new scope. In particular, if a structure is created in a scope that requires locking (for example, Application), you can duplicate it into a scope that does not require locking (for example, Request), and then delete it in the scope that requires locking.</td>
</tr>
<tr>
<td>StructCopy function</td>
<td>Makes a shallow copy of a structure. It creates a new structure and copies all simple variable and array values at the top level of the original structure to the new structure. However, it does not make copies of any structures, queries, or other objects that the original structure contains, or of any data inside these objects. Instead, it creates a reference in the new structure to the objects in the original structure. As a result, any change to these objects in one structure also changes the corresponding objects in the copied structure. The Duplicate function replaces this function for most, if not all, purposes.</td>
</tr>
<tr>
<td>Variable assignment</td>
<td>Creates an additional reference, or alias, to the structure. Any change to the data using one variable name changes the structure that you access using the other variable name. This technique is useful when you want to add a local variable to another scope or otherwise change a variable's scope without deleting the variable from the original scope.</td>
</tr>
</tbody>
</table>

The following example shows the different effects of copying, duplicating, and assigning structure variables:

Create a new structure:
```coldfusion
<cfset myNewStructure=StructNew()>
<cfset myNewStructure.key1="1">
<cfset myNewStructure.key2="2">
<cfset myArray=ArrayNew(1)>
<cfset myArray[1]="3">
<cfset myArray[2]="4">
<cfset myNewStructure.key3=myArray>
<cfset myNewStructure.key4=StructNew()> 
<cfset myNewStructure2=StructNew()> 
<cfset myNewStructure2.Struct2key1="5">
<cfset myNewStructure2.Struct2key2="6">
<cfset myNewStructure.key4=myNewStructure2>
<cfset var=#myNewStructure#><br>
<br>
A StructCopy copied structure<br>
<cfset CopiedStruct=StructCopy(myNewStructure)>
<cfset var=#CopiedStruct#><br>
<br>
A Duplicated structure<br>
<cfset dupStruct=Duplicate(myNewStructure)>
<cfset var=#dupStruct#><br>
<br>
A new reference to a structure<br>
<cfset structRef=myNewStructure>
<cfdump var=#structRef#><br>
<br>
Change a string, array element, and structure value in the StructCopy copy.<br>
<br>
<cfset CopiedStruct.key1="1A">
<cfset CopiedStruct.key3[2]="4A">
<cfset CopiedStruct.key4.Struct2key2="6A">
Original structure<br>
<cfdump var=#myNewStructure#><br>
Copied structure<br>
<cfdump var=#CopiedStruct#><br>
Duplicated structure<br>
<cfdump var=#DupStruct#><br>
Structure reference<br>
<cfdump var=#structRef#><br>
<br>
Change a string, array element, and structure value in the Duplicate.<br>
<br>
<cfset DupStruct.key1="1B">
<cfset DupStruct.key3[2]="4B">
<cfset DupStruct.key4.Struct2key2="6B">
Original structure<br>
<cfdump var=#myNewStructure#><br>
Copied structure<br>
<cfdump var=#CopiedStruct#><br>
Duplicated structure<br>
<cfdump var=#DupStruct#><br>
Structure reference<br>
<cfdump var=#structRef#><br>
<br>
Change a string, array element, and structure value in the reference.<br>
<br>
<cfset structRef.key1="1C">
<cfset structRef.key3[2]="4C">
<cfset structRef.key4.Struct2key2="6C">
Original structure<br>
<cfdump var=#myNewStructure#><br>
Copied structure<br>
<cfdump var=#CopiedStruct#><br>
Duplicated structure<br>
<cfdump var=#DupStruct#><br>
Structure reference<br>
<cfdump var=#structRef#><br>
<br>
Clear the original structure<br>
<cfset foo=structclear(myNewStructure)>
Original structure<br>
<cfdump var=#myNewStructure#><br>
Copied structure<br>
<cfdump var=#CopiedStruct#><br>
Duplicated structure<br>
<cfdump var=#DupStruct#><br>
Structure reference<br>
<cfdump var=#structRef#><br>
Deleting structure elements and structures

To delete a key and its value from a structure, use the `StructDelete` function, as follows:

```
StructDelete(structure_name, key [, indicateNotExisting ])
```

The `indicateNotExisting` argument tells the function what to do if the specified key does not exist. By default, the function always returns True. However, if you specify True for the `indicateNotExisting` argument, the function returns True if the key exists and False if it does not.

You can also use the `StructClear` function to delete all the data in a structure but keep the structure instance itself, as follows:

```
StructClear(structure_name)
```

If you use `StructClear` to delete a structure that you have copied using the `StructCopy` function, the specified structure is deleted, but the copy is unaffected.

If you use `StructClear` to delete a structure that has a multiple references, the function deletes the contents of the structure and all references point to the empty structure, as the following example shows:

```
<cfset myStruct.Key1="Adobe">
Structure before StructClear<br>
<cfdump var="#myStruct#">
<cfset myCopy=myStruct>
<cfset StructClear(myCopy)>
After Clear:<br>
myStruct: <cfdump var="#myStruct#"><br>
myCopy: <cfdump var="#myCopy#">
```

Looping through structures

You can loop through a structure to output its contents, as the following example shows:

```
<!--- Create a structure and set its contents. --->
<cfset departments=structnew()>
<cfset val=StructInsert(departments, "John", "Sales")>
<cfset val=StructInsert(departments, "Tom", "Finance")>
<cfset val=StructInsert(departments, "Mike", "Education")>

<!--- Build a table to display the contents --->
<cfoutput>
<table cellpadding="2" cellspacing="2">
  <tr>
    <td><b>Employee</b></td>
    <td><b>Department</b></td>
  </tr>
  <!--- Use cfloop to loop through the departments structure. The item attribute specifies a name for the structure key. --->
  <cfloop collection=#departments# item="person">
    <tr>
      <td><b>Employee</b></td>
      <td>Department</td>
    </tr>
    <!--- Use cfloop to loop through the departments structure. The item attribute specifies a name for the structure key. --->
    <cfloop collection=#departments# item="person">
      <tr>
        <td><b>Employee</b></td>
        <td>Department</td>
      </tr>
    </cfloop>
  </cfloop>
</table>
</cfoutput>
```
Structure examples

Structures are particularly useful for grouping together a set of variables under a single name. The example in this section uses structures to collect information from a form, and to submit that information to a custom tag, named cf_addemployee. For information on creating and using custom tags, see "Creating and Using Custom CFML Tags" on page 190.

Example file newemployee.cfm
The following ColdFusion page shows how to create structures and use them to add data to a database. It calls the cf_addemployee custom tag, which is defined in the addemployee.cfm file.

```html
<html>
<head>
<title>Add New Employees</title>
</head>

<body>
<h1>Add New Employees</h1>
<!--- Action page code for the form at the bottom of this page. --->
<!--- Establish parameters for first time through --->
<cfparam name="Form.firstname" default="">
<cfparam name="Form.lastname" default="">
<cfparam name="Form.email" default="">
<cfparam name="Form.phone" default="">
<cfparam name="Form.department" default="">

<!--- If at least the firstname form field is passed, create a structure named employee and add values. --->
<cfif #Form.firstname# eq ">
<p>Please fill out the form.</p>
<cfelse>
<cfoutput>
<cfscript>
employee=StructNew();
employee.firstname = Form.firstname;
employee.lastname = Form.lastname;
employee.email = Form.email;
employee.phone = Form.phone;
employee.department = Form.department;
</cfscript>
<!--- Display results of creating the structure. --->
 First name is #StructFind(employee, "firstname")#<br>
 Last name is #StructFind(employee, "lastname")#<br>
 EMail is #StructFind(employee, "email")#<br>
 Phone is #StructFind(employee, "phone")#<br>
 Department is #StructFind(employee, "department")#<br>
</cfoutput>

<!--- Call the custom tag that adds employees. --->
<cf_addemployee empinfo="#employee#">
</cfif>

<!--- The form for adding the new employee information --->
<br>
<form action="newemployee.cfm" method="Post">
 First Name:
 <input name="firstname" type="text" hspace="30" maxlength="30"><br>
</form>
</body>
</html>
```
Reviewing the code

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfparam name=&quot;Form.firstname&quot; default=&quot;&quot;&gt; &lt;cfparam name=&quot;Form.lastname&quot; default=&quot;&quot;&gt; &lt;cfparam name=&quot;Form.email&quot; default=&quot;&quot;&gt; &lt;cfparam name=&quot;Form.phone&quot; default=&quot;&quot;&gt; &lt;cfparam name=&quot;Form.department&quot; default=&quot;&quot;&gt;</td>
<td>Set default values of all form fields so that they exist the first time this page is displayed and can be tested.</td>
</tr>
<tr>
<td>&lt;cfif #form.firstname# eq &quot;&quot;&gt; Please fill out the form.&lt;br&gt;</td>
<td>Test the value of the form's firstname field. This field is required. The test is False the first time the page displays. If there is no data in the Form.firstname variable, display a message requesting the user to fill the form.</td>
</tr>
</tbody>
</table>
Example file addemployee.cfm
The following file is an example of a custom tag used to add employees. Employee information is passed through the
employee structure (the empinfo attribute). For databases that do not support automatic key generation, you must also add the Emp_ID.

```coldfusion
<cfif StructIsEmpty(attributes.empinfo)>
  <cfoutput>
    Error. No employee data was passed.<br>
  </cfoutput>
  <cfexit method="ExitTag">
<cfelse>
<!--- Add the employee --->
<cfquery name="AddEmployee" datasource="cfdocexamples">
  INSERT INTO Employees
  (FirstName, LastName, Email, Phone, Department)
  VALUES
  (attributes.empinfo.firstname,
  attributes.empinfo.lastname,
  attributes.empinfo.email,
  attributes.empinfo.phone,
  attributes.empinfo.department);
</cfquery>
  First name is #attributes.empinfo.firstname#<br>
  Last name is #attributes.empinfo.lastname#<br>
  Email is #attributes.empinfo.email#<br>
  Phone is #attributes.empinfo.phone#<br>
  Department is #attributes.empinfo.department#<br>
</cfoutput>
<cf_addemployee empinfo="#duplicate(attributes.empinfo)#">
</cfif>
</cfelse>
<form action="newemployee.cfm" method="Post">
  First Name:&nbsp;<input name="firstname" type="text" hspace="30" maxlength="30"><br>
  Last Name:&nbsp;<input name="lastname" type="text" hspace="30" maxlength="30"><br>
  Email:&nbsp;<input name="email" type="text" hspace="30" maxlength="30"><br>
  Phone:&nbsp;<input name="phone" type="text" hspace="20" maxlength="20"><br>
  Department:&nbsp;<input name="department" type="text" hspace="30" maxlength="30"><br>
  <br>
  <input type="Submit" value="OK">
</form>
```

The data form. When the user clicks Submit, the form posts the data to this ColdFusion page.

If Form.firstname contains text, the user submitted the form.
Use CFScript to create a new structure named employee and fill it with the form field data.
Then display the contents of the structure.

The duplicate function ensures that the custom tag gets a copy of the employee structure in the empinfo attribute.
Although this is not necessary in this example, it is good practice because it prevents the custom tag from modifying the calling page's structure contents.
Reviewing the code

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>`&lt;cfif StructIsEmpty(Attributes.empinfo)&gt;</td>
<td>If the custom tag was called without an empinfo attribute, displays an</td>
</tr>
<tr>
<td>&lt;cfoutput&gt;</td>
<td>error message and exit the tag.</td>
</tr>
<tr>
<td>Error. No employee data was passed.</td>
<td></td>
</tr>
<tr>
<td>&lt;/cfoutput&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;cfexit method=&quot;ExitTag&quot;&gt;</td>
<td></td>
</tr>
<tr>
<td>`&lt;cfelse&gt;</td>
<td>Add the employee data passed in the empinfo structure to the Employees</td>
</tr>
<tr>
<td>&lt;cfquery name=&quot;AddEmployee&quot; datasource=&quot;cfdocexamples&quot;</td>
<td>table of the cfdocexamples database.</td>
</tr>
<tr>
<td>INSERT INTO Employees</td>
<td>Use direct references to the structure entries, not StructFind functions.</td>
</tr>
<tr>
<td>(FirstName, LastName, Email, Phone,</td>
<td>If the database does not support automatic generation of the Emp_ID key,</td>
</tr>
<tr>
<td>Department)</td>
<td>you must add an Emp_ID entry to the form and add it to the query.</td>
</tr>
<tr>
<td>VALUES</td>
<td></td>
</tr>
<tr>
<td>'#attributes.empinfo.firstname#',</td>
<td></td>
</tr>
<tr>
<td>'#attributes.empinfo.lastname#',</td>
<td></td>
</tr>
<tr>
<td>'#attributes.empinfo.email#',</td>
<td></td>
</tr>
<tr>
<td>'#attributes.empinfo.phone#',</td>
<td></td>
</tr>
<tr>
<td>'#attributes.empinfo.department#' }</td>
<td></td>
</tr>
<tr>
<td>&lt;/cfquery&gt;</td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfif&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

`<hr>Employee Add Complete`                                          Display a completion message. This code does not have to be inside the cfelse block because the cfexit tag prevents it from being run if the empinfo structure is empty.

`<cfoutput>`                                                        

`<cfoutput>`                                                        

`<hr>Employee Add Complete`                                          

Structure functions

You can use the following functions to create and manage structures in ColdFusion applications. The table describes each function's purpose and provides specific, but limited, information that can assist you in determining whether to use the function instead of other techniques.

All functions except StructDelete throw an exception if a referenced key or structure does not exist.

For more information on these functions, see the CFML Reference.

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplicate</td>
<td>Returns a complete copy of the structure.</td>
</tr>
<tr>
<td>IsStruct</td>
<td>Returns True if the specified variable is a ColdFusion structure or a Java object that implements the java.util.Map interface.</td>
</tr>
<tr>
<td>StructAppend</td>
<td>Appends one structure to another.</td>
</tr>
<tr>
<td>StructClear</td>
<td>Removes all data from the specified structure.</td>
</tr>
<tr>
<td>StructCopy</td>
<td>Returns a 'shallow' copy of the structure. All embedded objects are references to the objects in the original structure. The Duplicate function has replaced this function for most purposes.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>StructCount</td>
<td>Returns the number of keys in the specified structure.</td>
</tr>
<tr>
<td>StructDelete</td>
<td>Removes the specified item from the specified structure.</td>
</tr>
<tr>
<td>StructFind</td>
<td>Returns the value associated with the specified key in the specified structure. This function is redundant with accessing structure elements using associative array notation.</td>
</tr>
<tr>
<td>StructFindKey</td>
<td>Searches through a structure for the specified key name and returns an array containing data on the found key or keys.</td>
</tr>
<tr>
<td>StructFindValue</td>
<td>Searches through a structure for the specified simple data value (for example, a string or number) and returns an array containing information on the value location in the structure.</td>
</tr>
<tr>
<td>StructGet</td>
<td>Returns a reference to a substructure contained in a structure at the specified path. This function is redundant with using direct reference to a structure. If you accidentally use this function on a variable that is not a structure, it replaces the value with an empty structure.</td>
</tr>
<tr>
<td>StructInsert</td>
<td>Inserts the specified key-value pair into the specified structure. Unlike a direct assignment statement, this function generates an error by default if the specified key exists in the structure.</td>
</tr>
<tr>
<td>StructIsEmpty</td>
<td>Indicates whether the specified structure contains data. Returns True if the structure contains no data, and False if it does contain data.</td>
</tr>
<tr>
<td>StructKeyArray</td>
<td>Returns an array of keys in the specified structure.</td>
</tr>
<tr>
<td>StructKeyExists</td>
<td>Returns True if the specified key is in the specified structure. You can use this function in place of the IsDefined function to check for the existence of variables in scopes that are available as structures.</td>
</tr>
<tr>
<td>StructKeyList</td>
<td>Returns a list of keys in the specified structure.</td>
</tr>
<tr>
<td>StructNew</td>
<td>Returns a new structure.</td>
</tr>
<tr>
<td>StructSort</td>
<td>Returns an array containing the key names of a structure in the order determined by the sort criteria.</td>
</tr>
<tr>
<td>StructUpdate</td>
<td>Updates the specified key with the specified value. Unlike a direct assignment statement, this function generates an error if the structure or key does not exist.</td>
</tr>
</tbody>
</table>
Chapter 6: Extending ColdFusion Pages with CFML Scripting

Adobe ColdFusion offers a server-side scripting language, CFScript, that provides ColdFusion functionality in script syntax. This JavaScript-like language gives developers the same control flow as ColdFusion, but without tags. You can also use CFScript to write user-defined functions that you can use anywhere that a ColdFusion expression is allowed.

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Using CFScript statements .................................................. 97
Handling exceptions ......................................................... 103
CFScript example .............................................................. 104

About CFScript

CFScript is a language within a language. It is a scripting language that is similar to JavaScript but is simpler to use. Also, unlike JavaScript, CFScript only runs on the ColdFusion server; it does not run on the client system. CFScript code can use all the ColdFusion functions and expressions, and has access to all ColdFusion variables that are available in the script's scope.

CFScript provides a compact and efficient way to write ColdFusion logic. Typical uses of CFScript include the following:

- Simplifying and speeding variable setting
- Building compact JavaScript-like flow control structures
- Creating user-defined functions

Because you use functions and expressions directly in CFScript, you do not have to surround each assignment or function in a cfset tag. Also, CFScript assignments are often faster than cfset tags.

CFScript provides a set of decision and flow-control structures that are more familiar than ColdFusion tags to most programmers.

In addition to variable setting, other operations tend to be slightly faster in CFScript than in tags.

ColdFusion 5 and later releases let you use CFScript to create user-defined functions, or UDFs (also known as custom functions). You call UDFs in the same manner that you call standard ColdFusion functions. UDFs are to ColdFusion built-in functions what custom tags are to ColdFusion built-in tags. Typical uses of UDFs include data manipulation and mathematical calculation routines.

You cannot include ColdFusion tags in CFScript. However, a number of functions and CFScript statements are equivalent to commonly used tags. For more information, see "CFScript functional equivalents to ColdFusion tags" on page 96.
Comparing tags and CFScript

The following examples show how you can use CFML tags and CFScript to do the same thing. Each example takes data submitted from a form and puts it in a structure; if the form does not have a last name and department field, it displays a message.

Using CFML tags

```cfml
<cfif IsDefined("Form.submit")>
  <cfif (Form.lastname NEQ ") AND (Form.department NEQ ")>
    <cfset employee=structnew()>
    <cfset employee.firstname=Form.firstname>
    <cfset employee.lastname=Form.lastname>
    <cfset employee.email=Form.email>
    <cfset employee.phone=Form.phone>
    <cfset employee.department=Form.department>
    <cfoutput>
      Adding #Form.firstname# #Form.lastname# <br>
    </cfoutput>
  </cfif>
  <cfelse>
    <cfoutput>
      You must enter a Last Name and Department. <br>
    </cfoutput>
  </cfelse>
</cfif>
```

Using CFScript

```cfscript
<cfscript>
  if (IsDefined("Form.submit")) {
    if ((Form.lastname NEQ ") AND (Form.department NEQ ") {
      employee=StructNew();
      employee.firstname=Form.firstname;
      employee.lastname=Form.lastname;
      employee.email=Form.email;
      employee.phone=Form.phone;
      employee.department=Form.department;
      WriteOutput("Adding #Form.firstname# #Form.lastname# <br>");
    } else
      WriteOutput("You must enter a Last Name and Department. <br>");
  }
</cfscript>
```

The CFScript language

This section explains the syntax of the CFScript language.

Identifying CFScript

You enclose CFScript regions inside `<cfscript>` and `</cfscript>` tags. No other CFML tags are allowed inside a `cfscript` region. The following lines show a minimal script:

```cfscript
<cfscript>
a = 2;
</cfscript>
```
Variables
CFScript variables can be of any ColdFusion type, such as numbers, strings, arrays, queries, and objects. The CFScript code can read and write any variables that are available in the page that contains the script. This includes all common scope variables, such as session, application, and server variables.

Expressions and operators
CFScript supports all CFML expressions. CFML expressions include operators (such as +, -, EQ, and so on), as well as all CFML functions.

You can use several comparison operators in CFScript only, not in CFML tags. (You can also use the corresponding CFML operators in CFScript.) The following table lists the CFScript-only operators and the equivalent operator that you can use in CFML tags or CFScript:

<table>
<thead>
<tr>
<th>CFScript operator</th>
<th>CFML operator</th>
<th>CFScript operator</th>
<th>CFML operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>==</td>
<td>EQ</td>
<td>!=</td>
<td>NEQ</td>
</tr>
<tr>
<td>&lt;</td>
<td>LT</td>
<td>&lt;=</td>
<td>LTE</td>
</tr>
<tr>
<td>&gt;</td>
<td>GT</td>
<td>&gt;=</td>
<td>GTE</td>
</tr>
</tbody>
</table>

For information about CFML expressions, operators, and functions, see "Using Expressions and Number Signs" on page 50.

Statements
CFScript supports the following statements:

<table>
<thead>
<tr>
<th>assignment</th>
<th>for-in</th>
<th>try-catch</th>
</tr>
</thead>
<tbody>
<tr>
<td>function call</td>
<td>while</td>
<td>function (function definition)</td>
</tr>
<tr>
<td>if-else</td>
<td>do-while</td>
<td>var (in custom functions only)</td>
</tr>
<tr>
<td>switch-case-default</td>
<td>break</td>
<td>return (in custom functions only)</td>
</tr>
<tr>
<td>for</td>
<td>continue</td>
<td></td>
</tr>
</tbody>
</table>

The following rules apply to statements:
- You must put a semicolon at the end of a statement.
- Line breaks are ignored. A single statement can cross multiple lines.
- White space is ignored. For example, it does not matter whether you precede a semicolon with a space character.
- Use curly braces to group multiple statements together into one logical statement unit.
- Unless otherwise indicated, you can use any ColdFusion expression in the body of a statement.

Note: This chapter documents all statements except function, var, and return. For information on these statements, see "Defining functions in CFScript" on page 135.

Statement blocks
Curly brace characters ({ and }) group multiple CFScript statements together so that they are treated as a single unit or statement. This enables you to create code blocks in conditional statements, such as the following:
if(score GT 0) {
    result = "positive";
    Positives = Positives + 1;
}

In this example, both assignment statements are executed if the score is greater than 0. If they were not in the code block, only the first line would execute.

You do not have to put brace characters on their own lines in the code. For example, you could put the open brace in the preceding example on the same line as the if statement, and some programmers use this style. However, putting at least the ending brace on its own line makes it easier to read the code and separate out code blocks.

Comments

CFScript has two forms of comments: single line and multiline.

A single line comment begins with two forward slashes (//) and ends at the line end; for example:

// This is a single-line comment.
// This is a second single-line comment.

A multiline comment starts with a /* marker and continues until it reaches a */ marker; for example:

/* This is a multiline comment.
   You do not need to start each line with a comment indicator.
   This is the last line in the comment. */

The following rules apply to comments:

1. Comments do not have to start at the beginning of a line. They can follow active code on a line. For example, the following line is valid:

   MyVariable = 12; // Set MyVariable to the default value.

2. The end of a multiline comment can be followed on the same line by active code. For example, the following line is valid, although it is poor coding practice:

   End of my long comment */ foo = "bar";

3. You can use multiline format for a comment on a single line, for example:

   /* This is a single line comment using multiline format. */

   • You cannot nest /* and */ markers inside other comment lines.
   • CFML comments (<!-- and -->) do not work in CFScript.

Reserved words

In addition to the names of ColdFusion functions and words reserved by ColdFusion expressions (such as NOT, AND, IS, and so on), the following words are reserved in CFScript. Do not use these words as variables or identifiers in your scripting code:

<table>
<thead>
<tr>
<th>break</th>
<th>default</th>
<th>function</th>
<th>switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>case</td>
<td>do</td>
<td>if</td>
<td>try</td>
</tr>
<tr>
<td>catch</td>
<td>else</td>
<td>in</td>
<td>var</td>
</tr>
<tr>
<td>continue</td>
<td>for</td>
<td>return</td>
<td>while</td>
</tr>
</tbody>
</table>
Differences from JavaScript

Although CFScript and JavaScript are similar, they have several key differences. The following list identifies CFScript features that differ from JavaScript:

- CFScript uses ColdFusion expressions, which are neither a superset nor a subset of JavaScript expressions. In particular, ColdFusion expressions do not support bitwise operators, and the ColdFusion MOD or % operator operates differently from the corresponding JavaScript % operator: In ColdFusion, the operator does integer arithmetic and ignores fractional parts. ColdFusion expressions also support the EQV, IMP, CONTAINS, and DOES NOT CONTAIN operators that are not supported in JavaScript.

- Variable declarations (`var` keyword) are only used in user-defined functions and threads.

- CFScript is case-insensitive.

- All statements end with a semicolon, and line breaks in the code are ignored.

- Assignments are statements, not expressions, and therefore cannot be used in situations that require the assignment operation to be evaluated.

- JavaScript objects, such as Window and Document, are not available.

- Only the ColdFusion server processes CFScript. There is no client-side CFScript.

CFScript limitation

You cannot include ColdFusion tags in CFScript. However, you can include `cfscript` blocks inside other ColdFusion tags, such as `cfoutput`.

CFScript functional equivalents to ColdFusion tags

<table>
<thead>
<tr>
<th>Tag</th>
<th>CFScript equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cfset</code></td>
<td>Direct assignment, such as <code>Myvar=1;</code></td>
</tr>
<tr>
<td><code>cfoutput</code></td>
<td><code>WriteOutput</code> function</td>
</tr>
<tr>
<td><code>cfif, cfelseif, cfelse</code></td>
<td><code>if</code> and <code>else</code> statements</td>
</tr>
<tr>
<td><code>cfswitch, cfcase, cfdefaultcase</code></td>
<td><code>switch</code>, <code>case</code>, and <code>default</code> statements</td>
</tr>
<tr>
<td>Indexed <code>cfloop</code></td>
<td><code>for</code> loops</td>
</tr>
<tr>
<td><code>cfloop for</code></td>
<td><code>while</code> loops and <code>do while</code> loops</td>
</tr>
<tr>
<td><code>cfbreak</code></td>
<td><code>break</code> statement. CFScript also has a <code>continue</code> statement that has no equivalent CFML tag.</td>
</tr>
<tr>
<td><code>cftry, cfcatch</code></td>
<td><code>try</code> and <code>catch</code> statements</td>
</tr>
<tr>
<td><code>cfcookie</code></td>
<td>Direct assignment of Cookie scope memory-only variables. You cannot use direct assignment to set persistent cookies that are stored on the user’s system.</td>
</tr>
<tr>
<td><code>cfobject</code></td>
<td><code>CreateObject</code> function</td>
</tr>
</tbody>
</table>

For example, the following example loops through a query in CFScript:

```xml
...<cfscript>
// Loop through the qGetEmails RecordSet
```
for (x = 1; x LTE qGetEmails.RecordCount; x=x+1) {
    This_id = qGetEmails.Emails_id[x];
    This_Subject = qGetEmails.Subject[x];
    This_RecFrom = qGetEmails.RecFrom[x];
    This_SentTo = qGetEmails.SentTo[x];
    This_dReceived = qGetEmails.dReceived[x];
    This_Body = qGetEmails.Body[x];
    ...
} // More code goes here.
</cfscript>

Using CFScript statements

The following sections describe how to use these CFScript statements:

- Using assignment statements and functions
- Using conditional processing statements
- Using looping statements

Using assignment statements and functions

CFScript assignment statements are the equivalent of the cfset tag. These statements have the following form:

```
lval = expression;
```

*lval* is any ColdFusion variable reference; for example:

```
x = "positive";
y = x;
a[3]=5;
structure.member=10;
ArrayCopy=myArray;
```

You can use ColdFusion function calls, including UDFs, directly in CFScript. For example, the following line is a valid CFScript statement:

```
StructInsert(employee,"lastname",FORM.lastname);
```

Using conditional processing statements

CFScript includes the following conditional processing statements:

- if and else statements, which serve the same purpose as the cfif, cfelseif, and cfelse tags
- switch, case, and default statements, which are the equivalents of the cfswitch, cfcase, and cfdefaultcase tags

Using if and else statements

The if and else statements have the following syntax:

```
if(expr) statement [else statement]
```

In its simplest form, an if statement looks like this:

```
if(value EQ 2700)
    message = "You’ve reached the maximum";
```

A simple if-else statement looks like the following:
if(score GT 1)
    result = "positive";
else
    result = "negative";

CFScript does not include an elseif statement. However, you can use an if statement immediately after an else statement to create the equivalent of a cfelseif tag, as the following example shows:

if(score GT 1)
    result = "positive";
else if(score EQ 0)
    result = "zero";
else
    result = "negative";

As with all conditional processing statements, you can use curly braces to enclose multiple statements for each condition, as follows:

if(score GT 1) {
    result = "positive";
    message = "The result was positive.";
}
else {
    result = "negative";
    message = "The result was negative.";
}

Note: Often, you can make your code clearer by using braces even where they are not required.

Using switch and case statements
The switch statement and its dependent case and default statements have the following syntax:

switch (expression) {
    case constant: [case constant:]... statement(s) break;
    [case constant: [case constant:]... statement(s) break;]...
    [default: statement(s)]
}

Use the following rules and recommendations for switch statements:

- You cannot mix Boolean and numeric constant values in a switch statement.
- Each constant value must be a constant (that is, not a variable, a function, or other expression).
- Multiple case constant: statements can precede the statement or statements to execute if any of the cases are true. This lets you specify several matches for one code block.
- No two constant values can be the same.
- The statements following the colon in a case statement block do not have to be in braces. If a constant value equals the switch expression, ColdFusion executes all statements through the break statement.
- The break statement at the end of the case statement tells ColdFusion to exit the switch statement. ColdFusion does not generate an error message if you omit a break statement. However, if you omit it, ColdFusion executes all the statements in the following case statement, even if that case is false. In nearly all circumstances, this is not what you want to do.
- You can have only one default statement in a switch statement block. ColdFusion executes the statements in the default block if none of the case statement constants equals the expression value.
- The default statement does not have to follow all switch statements, but it is good programming practice to do so. If any switch statements follow the default statement you must end the default block code with a break statement.
• The `default` statement is not required. However, you should use one if the `case` constants do not include all possible values of the expression.

• The `default` statement does not have to follow all the `case` statements; however, it is good programming practice to put it there.

The following `switch` statement takes the value of a name variable:

1. If the name is John or Robert, it sets both the male variable and the found variable to True.
2. If the name is Mary, it sets the male variable to False and the found variable to True.
3. Otherwise, it sets the found variable to False.

```coldfusion
switch(name) {
  case "John": case "Robert":
    male=True;
    found=True;
    break;
  case "Mary":
    male=False;
    found=True;
    break;
  default:
    found=False;
} //end switch
```

Using looping statements

CFScript provides a richer selection of looping constructs than those supplied by CFML tags. It enables you to create efficient looping constructs similar to those in most programming and scripting languages. CFScript provides the following looping constructs:

• For
• While
• Do-while
• For-in

CFScript also includes the `continue` and `break` statements that control loop processing.

The following sections describe these types of loops and their uses.

Using for loops

The `for` loop has the following format:

```
for (initial-expression; test-expression; final-expression) statement
```

The `initial-expression` and `final-expression` can be one of the following:

• A single assignment expression; for example, x=5 or loop=loop+1
• Any ColdFusion expression; for example, SetVariable("a",a+1)
• Empty

The `test-expression` can be one of the following:

• Any ColdFusion expression; for example:
  ```
  A LT 5
  index LE x
  ```
status EQ "not found" AND index LT end

- Empty

**Note:** The test expression is re-evaluated before each repeat of the loop. If code inside the loop changes any part of the test expression, it can affect the number of iterations in the loop.

The **statement** can be a single semicolon terminated statement or a statement block in curly braces.

When ColdFusion executes a for loop, it does the following:

1. Evaluates the **initial expression**.
2. Evaluates the **test-expression**.
3. If the **test-expression** is False, exits the loop and processing continues following the **statement**.
   - If the **test-expression** is True:
     a. Executes the **statement** (or statement block).
     b. Evaluates the **final-expression**.
     c. Returns to Step 2.

For loops are most commonly used for processing in which an index variable is incremented each time through the loop, but it is not limited to this use.

The following simple for loop sets each element in a 10-element array with its index number.

```coldfusion
for(index=1; index LTE 10; index = index + 1)
a[index]=index;
```

The following, more complex, example demonstrates two features:

- The use of curly braces to group multiple statements into a single block.
- An empty condition statement. All loop control logic is in the statement block.

```coldfusion
<cfscript>
strings=ArrayNew(1);
ArraySet(strings, 1, 10, "lock");
strings[5]="key";
indx=0;
for( ; ; ) {
    indx=indx+1;
    if(Find("key",strings[indx],1)) {
        WriteOutput("Found key at " & indx & ".\br");
        break;
    }
    else if (indx IS ArrayLen(strings)) {
        WriteOutput("Exited at " & indx & ".\br");
        break;
    }
}
</cfscript>
```

This example shows one important issue that you must remember when creating loops: you must always ensure that the loop ends. If this example lacked the else if statement, and there was no “key” in the array, ColdFusion would loop forever or until a system error occurred; you would have to stop the server to end the loop.
The example also shows two issues with index arithmetic: in this form of loop you must make sure to initialize the index, and you must keep track of where the index is incremented. In this case, because the index is incremented at the top of the loop, you must initialize it to 0 so it becomes 1 in the first loop.

**Using while loops**

The while loop has the following format:

```
while (expression) statement
```

The while statement does the following:

1. Evaluates the expression.
2. If the expression is True, it does the following:
   a. Executes the statement, which can be a single semicolon-terminated statement or a statement block in curly braces.
   b. Returns to step 1.

If the expression is False, processing continues with the next statement.

The following example uses a while loop to populate a 10-element array with multiples of five.

```
a = ArrayNew(1);
loop = 1;
while (loop LE 10) {
a[loop] = loop * 5;
loop = loop + 1;
}
```

As with other loops, you must make sure that at some point the while expression is False and you must be careful to check your index arithmetic.

**Using do-while loops**

The do-while loop is like a while loop, except that it tests the loop condition after executing the loop statement block. The do-while loop has the following format:

```
do statement while (expression);
```

The do-while statement does the following:

1. Executes the statement, which can be a single semicolon-terminated statement or a statement block in curly braces.
2. Evaluates the expression.
3. If the expression is true, it returns to step 1.

If the expression is False, processing continues with the next statement.

The following example, like the while loop example, populates a 10-element array with multiples of five:

```
a = ArrayNew(1);
loop = 1;
do {
a[loop] = loop * 5;
loop = loop + 1;
}
while (loop LE 10);
```
Because the loop index increment follows the array value assignment, the example initializes the loop variable to 1 and tests to make sure that it is less than or equal to 10.

The following example generates the same results as the previous two examples, but it increments the index before assigning the array value. As a result, it initializes the index to 0, and the end condition tests that the index is less than 10.

```coldfusion
a = ArrayNew(1);
loop = 0;
do {
   loop = loop + 1;
   a[loop] = loop * 5;
}while (loop LT 10);
```

The following example loops through a query:

```coldfusion
<cfquery ... name="myQuery">
... sql goes here...
</cfquery>
<cfscript>
if (myQuery.RecordCount gt 0) {
currRow=1;
do {
   theValue=myQuery.myField[CurrRow];
currRow=currRow+1;
} while (currRow LTE myQuery.RecordCount);
}
</cfscript>
```

Using for-in loops

The for-in loop loops over the elements in a ColdFusion structure. It has the following format:

```coldfusion
for (variable in structure) statement
```

The `variable` can be any ColdFusion identifier; it holds each structure key name as ColdFusion loops through the structure. The `structure` must be the name of an existing ColdFusion structure. The `statement` can be a single semicolon terminated statement or a statement block in curly braces.

The following example creates a structure with three elements. It then loops through the structure and displays the name and value of each key. Although the curly braces are not required here, they make it easier to determine the contents of the relatively long `WriteOutput` function. In general, you can make structured control flow, especially loops, clearer by using curly braces.

```coldfusion
myStruct=StructNew();
myStruct.productName="kumquat";
myStruct.quality="fine";
myStruct.quantity=25;
for (keyName in myStruct) {
   WriteOutput("myStruct." & Keyname & " has the value: " &
   myStruct[keyName] &"<br>");
}
```

**Note:** Unlike the `cfloop` tag, CFScript for-in loops do not provide built-in support for looping over queries and lists.

Using continue and break statements

The continue and break statements enable you to control the processing inside loops:

- The `continue` statement tells ColdFusion to skip to the beginning of the next loop iteration.
• The **break** statement exits the current loop or **case** statement.

**Using continue**
The **continue** statement ends the current loop iteration, skips any code following it in the loop, and jumps to the beginning of the next loop iteration. For example, the following code loops through an array and displays each value that is not an empty string:

```coldfusion
for (loop=1; loop LE 10; loop = loop+1) {
    if(a[loop] EQ ") continue;
    WriteOutput(loop);
}
```

(To test this code snippet, you must first create an array, a, with 10 or more elements, some of which are not empty strings.)

In general, the **continue** statement is particularly useful if you loop over arrays or structures and you want to skip processing for array elements or structure members with specific values, such as the empty string.

**Using break**
The **break** statement exits the current loop or **case** statement. Processing continues at the next CFScript statement. You end case statement processing blocks with a **break** statement. You can also use a test case with a **break** statement to prevent infinite loops, as shown in the following example. This script loops through an array and prints out the array indexes that contain the value key. It uses a conditional test and a **break** statement to make sure that the loop ends when at the end of the array.

```coldfusion
strings=ArrayNew(1);
ArraySet(strings, 1, 10, "lock");
strings[5]="key";
strings[9]="key";
indx=0;
for( ; ; ) {
    indx=indx+1;
    if(Find("key", strings[indx], 1)) {
        WriteOutput("Found a key at " & indx & ".<br>");
    }
    else if (indx IS ArrayLen(strings)) {
        WriteOutput("Array ends at index " & indx & ".<br>");
        break;
    }
}
```

**Handling exceptions**
ColdFusion provides two statements for exception handling in CFScript: **try** and **catch**. These statements are equivalent to the CFML **cftry** and **cfcatch** tags.

*Note: This section does not explain exception-handling concepts. For a discussion of exception handling in ColdFusion, see "Handling Errors" on page 246.*

**Exception handling syntax and rules**
Exception-handling code in CFScript has the following format:

```coldfusion
try {
    Code where exceptions will be caught
}
```
```coldfusion

catch(exceptionType exceptionVariable) {
    Code to handle exceptions of type exceptionType that occur in the try block
}
...
catch(exceptionTypeN exceptionVariableN) {
    Code to handle exceptions of type exceptionTypeN that occur in the try block
}

Note: In CFScript, catch statements follow the try block; you do not put them inside the try block. This structure differs from that of the cftry tag, which must include the cfcatch tags in its body.

When you have a try statement, you must have a catch statement. In the catch block, the exceptionVariable variable contains the exception type. This variable is the equivalent of the cfcatch tag cfcatch.Type built-in variable.

Exception handling example
The following code shows exception handling in CFScript. It uses a CreateObject function to create a Java object. The catch statement executes only if the CreateObject function generates an exception. The displayed information includes the exception message; the except.Message variable is the equivalent of calling the Java getMessage method on the returned Java exception object.

```coldfusion
<cfscript>
try {
    emp = CreateObject("Java", "Employees");
}
catch(Any except) {
    WriteOutput("The application was unable to perform a required operation.<br>
Please try again later.<br>
If this problem persists, contact Customer Service and include the following information:<br>
#except.Message#<br>
";
}
</cfscript>

CFScript example
The example in this section uses the following CFScript features:

- Variable assignment
- Function calls
- For loops
- If-else statements
- WriteOutput functions
- Switch statements

The example uses CFScript without any other ColdFusion tags. It creates a structure of course applicants. This structure contains two arrays; the first has accepted students, the second has rejected students. The script also creates a structure with rejection reasons for some (but not all) rejected students. It then displays the accepted applicants followed by the rejected students and their rejection reasons.
<html>
<head>
  <title>CFScript Example</title>
</head>
<body>
<cfscript>

// Set the variables
acceptedApplicants[1] = "Cora Cardozo";
acceptedApplicants[2] = "Betty Bethone";
acceptedApplicants[3] = "Albert Albertson";
rejectedApplicants[1] = "Hema Hrp";
rejectedApplicants[2] = "David Dalhousie";
rejectedApplicants[3] = "Franny Farkle";
applicants.accepted=acceptedApplicants;
applicants.rejected=rejectedApplicants;
rejectCode=StructNew();
rejectCode["David Dalhousie"] = "score";
rejectCode["Franny Farkle"] = "too late";

// Sort and display accepted applicants
ArraySort(applicants.accepted,"text","asc");
WriteOutput("The following applicants were accepted:<hr>");
for (j=1; j <= ArrayLen(applicants.accepted); j=j+1) {
  WriteOutput(applicants.accepted[j] & "<br>");
}
WriteOutput("<br>");

// Sort and display rejected applicants with reasons information
ArraySort(applicants.rejected,"text","asc");
WriteOutput("The following applicants were rejected:<hr>");
for (j=1; j <= ArrayLen(applicants.rejected); j=j+1) {
  applicant=applicants.rejected[j];
  WriteOutput(applicant & "<br>");
  if (StructKeyExists(rejectCode,applicant)) {
    switch(rejectCode[applicant]) {
      case "score":
        WriteOutput("Reject reason: Score was too low.<br>");
        break;
      case "late":
        WriteOutput("Reject reason: Application was late.<br>");
        break;
      default:
        WriteOutput("Rejected with invalid reason code.<br>");
    } // end switch
  } // end if
  else {
    WriteOutput("Reject reason was not defined.<br>");
  } // end else
}
WriteOutput("<br>");
</cfscript>

Reviewing the code
The following table describes the code:
Code Description

```<cfscript>
acceptedApplicants[1] = "Cora Cardozo";
acceptedApplicants[2] = "Betty Bethone";
acceptedApplicants[3] = "Albert Albertson";
rejectedApplicants[1] = "Erma Erp";
rejectedApplicants[2] = "David Dalhousie";
rejectedApplicants[3] = "Franny Farkle";
applicants.accepted = acceptedApplicants;
applicants.rejected = rejectedApplicants;
rejectCode = StructNew();
rejectCode["David Dalhousie"] = "score";
rejectCode["Franny Farkle"] = "too late";
ArraySort(applicants.accepted, "text", "asc");
WriteOutput("The following applicants were accepted:<br>");
for (j=1; j <= ArrayLen(applicants.accepted); j=j+1) {
    WriteOutput(applicants.accepted[j] & "<br>");
}
WriteOutput("<br>");
ArraySort(applicants.rejected, "text", "asc");
WriteOutput("The following applicants were rejected:<br>");
for (j=1; j <= ArrayLen(applicants.rejected); j=j+1) {
    applicant = applicants.rejected[j];
    WriteOutput(applicant & "<br>");
    if (StructKeyExists(rejectCode, applicant)) {
        switch(rejectCode[applicant]) {
            case "score":
                WriteOutput("Reject reason: Score was too low.<br>");
                break;
            case "late":
                WriteOutput("Reject reason: Application was late.<br>");
                break;
            default:
                WriteOutput("Rejected with invalid reason code.<br>");
        } //end switch
    } //end if
else {
    WriteOutput("Reject reason was not defined.<br>");
}
} //end for
</cfscript>
```

Creates two one-dimensional arrays, one with the accepted applicants and another with the rejected applicants. The entries in each array are in random order.

Creates a structure and assign each array to an element of the structure.

Creates a structure with rejection codes for rejected applicants. The `rejectCode` structure does not have entries for all rejected applicants, and one of its values does not match a valid code. The structure element references use associative array notation in order to use key names that contain spaces.

Sorts the accepted applicants alphabetically.

Displays a heading.

Sorts `rejectedApplicants` array alphabetically and writes a heading.

Loops through the accepted applicants and writes their names. Braces enhance clarity, although they are not needed for a single statement loop.

Loops through the rejected applicants.

Sets the applicant variable to the applicant name. This makes the code clearer and enables you to easily reference the `rejectCode` array later in the block.

Checks the `rejectCode` structure for a rejection code for the applicant.

If a code exists, enters a switch statement that examines the rejection code value.

If the rejection code value matches one of the known codes, displays an expanded explanation of the meaning. Otherwise (the default case), displays an indication that the rejection code is not valid.

Comments at the end of blocks help clarify the control flow.

If there is no entry for the applicant in the `rejectCode` structure, displays a message indicating that the reason was not defined.

Displays a blank line after each rejected applicant.

Ends the for loop that handles each rejected applicant.

Ends the CFScript.
Chapter 7: Using Regular Expressions in Functions

Regular expressions let you perform string matching operations using ColdFusion functions; in particular, regular expressions work with the following functions:

- `REFind`
- `REFindNoCase`
- `REReplace`
- `REReplaceNoCase`

Regular expressions used in the `cfinput` and `cftextinput` tags are JavaScript regular expressions, which have a slightly different syntax than ColdFusion regular expressions. For information on JavaScript regular expressions, see "Building Dynamic Forms with cfform Tags" on page 530.

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About regular expressions

In traditional string matching, as used by the ColdFusion `Find` and `Replace` functions, you provide the string pattern to search for and the string to search. The following example searches a string for the pattern "BIG" and returns a string index if found. The string index is the location in the search string where the string pattern begins.

```
<cfset IndexOfOccurrence=Find(" BIG ", "Some BIG string")>
<!--- The value of IndexOfOccurrence is 5 --->
```

You must provide the exact string pattern to match. If the exact pattern is not found, `Find` returns an index of 0. Because you must specify the exact string pattern to match, matches for dynamic data can be very difficult, if not impossible, to construct.

The next example uses a regular expression to perform the same search. This example searches for the first occurrence in the search string of any string pattern that consists entirely of uppercase letters enclosed by spaces:

```
<cfset IndexOfOccurrence=REFind(" [A-Z]+ ", "Some BIG string")>
<!--- The value of IndexOfOccurrence is 5 --->
```

The regular expression " [A-Z]+ " matches any string pattern consisting of a leading space, followed by any number of uppercase letters, followed by a trailing space. Therefore, this regular expression matches the string " BIG " and any string of uppercase letters enclosed in spaces.
By default, the matching of regular expressions is case-sensitive. You can use the case-insensitive functions, REFindNoCase and REReplaceNoCase, for case-insensitive matching.

Because you often process large amounts of dynamic textual data, regular expressions are invaluable in writing complex ColdFusion applications.

**Using ColdFusion regular expression functions**

ColdFusion supplies four functions that work with regular expressions:

- REFind
- REFindNoCase
- REReplace
- REReplaceNoCase

REFind and REFindNoCase use a regular expression to search a string for a pattern and return the string index where it finds the pattern. For example, the following function returns the index of the first instance of the string "BIG":

```
<cfset IndexOfOccurrence=REFind(" BIG ", "Some BIG BIG string")>
<!--- The value of IndexOfOccurrence is 5 --->
```

To find the next occurrence of the string "BIG", you must call the REFind function a second time. For an example of iterating over a search string to find all occurrences of the regular expression, see "Returning matched subexpressions" on page 117.

REReplace and REReplaceNoCase use regular expressions to search through a string and replace the string pattern that matches the regular expression with another string. You can use these functions to replace the first match, or to replace all matches.

For detailed descriptions of the ColdFusion functions that use regular expressions, see the **CFML Reference**.

**Basic regular expression syntax**

The simplest regular expression contains only a literal characters. The literal characters must match exactly the text being searched. For example, you can use the regular expression function REFind to find the string pattern "BIG", just as you can with the Find function:

```
<cfset IndexOfOccurrence=REFind(" BIG ", "Some BIG string")>
<!--- The value of IndexOfOccurrence is 5 --->
```

In this example, REFind must match the exact string pattern "BIG".

To use the full power of regular expressions, combine literal characters with character sets and special characters, as in the following example:

```
<cfset IndexOfOccurrence=REFind(" [A-Z]+ ", "Some BIG string")>
<!--- The value of IndexOfOccurrence is 5 --->
```

The literal characters of the regular expression consists of the space characters at the beginning and end of the regular expression. The character set consists of that part of the regular expression in square brackets. This character set specifies to find a single uppercase letter from A to Z, inclusive. The plus sign (+) after the square brackets is a special character specifying to find one or more occurrences of the character set.

If you removed the + from the regular expression in the previous example, " [A-Z] " matches a literal space, followed by any single uppercase letter, followed by a single space. This regular expression matches "B" but not "BIG". The REFind function returns 0 for the regular expression, meaning that it did not find a match.
You can construct very complicated regular expressions containing literal characters, character sets, and special characters. Like any programming language, the more you work with regular expressions, the more you can accomplish with them. The examples in this section are fairly basic. For more examples, see “Regular expression examples” on page 121.

**Regular expression syntax**

This section describes the basic rules for creating regular expressions.

**Using character sets**

The pattern within the square brackets of a regular expression defines a character set that is used to match a single character. For example, the regular expression “ [A-Za-z] ” specifies to match any single uppercase or lowercase letter enclosed by spaces. In the character set, a hyphen indicates a range of characters.

The regular expression “ B[IAU]G ” matches the strings “ BIG “, “ BAG “, and “ BUG “, but does not match the string “ BOG “.

If you specified the regular expression as “ B[IA][GN] “, the concatenation of character sets creates a regular expression that matches the corresponding concatenation of characters in the search string. This regular expression matches a space, followed by “B”, followed by an “I” or “A”, followed by a “G” or “N”, followed by a trailing space. The regular expression matches “ BIG ”, “ BAG ”, “ BIN ”, and “BAN ”.

The regular expression [A-Z][a-z]* matches any word that starts with an uppercase letter and is followed by zero or more lowercase letters. The special character * after the closing square bracket specifies to match zero or more occurrences of the character set.

**Note:** The * only applies to the character set that immediately precedes it, not to the entire regular expression.

A + after the closing square bracket specifies to find one or more occurrences of the character set. You interpret the regular expression “ [A-Z]+ “ as matching one or more uppercase letters enclosed by spaces. Therefore, this regular expression matches “ BIG ” and also matches “ LARGE “, “ HUGE “, “ ENORMOUS “, and any other string of uppercase letters surrounded by spaces.

**Considerations when using special characters**

Since a regular expression followed by an * can match zero instances of the regular expression, it can also match the empty string. For example,

```coldfusion
cfoutput
    REReplace("Hello","[T]*","7","ALL") - #REReplace("Hello","[T]*","7","ALL")#<BR>
</cfoutput>
```

results in the following output:

REReplace("Hello","[T]*","7","ALL") - 7H7e7l7l7o

The regular expression [T]* can match empty strings. It first matches the empty string before “H” in "Hello". The "ALL" argument tells REReplace to replace all instances of an expression. The empty string before “e” is matched and so on until the empty string before “o” is matched.

This result might be unexpected. The workarounds for these types of problems are specific to each case. In some cases you can use [T]+, which requires at least one “T”, instead of [T]*. Alternatively, you can specify an additional pattern after [T]*.
In the following examples the regular expression has a "W" at the end:

```cfc
<cfoutput>
    REReplace("Hello World","[T]*W","7","ALL") - #REReplace("Hello World","[T]*W","7","ALL")#<BR>
</cfoutput>
```

This expression results in the following more predictable output:

```cfc
REReplace("Hello World","[T]*W","7","ALL") - Hello 7orld
```

### Finding repeating characters

In some cases, you might want to find a repeating pattern of characters in a search string. For example, the regular expression "a{2,4}" specifies to match two to four occurrences of "a". Therefore, it would match: "aa", "aaa", "aaaa", but not "a" or "aaaaa". In the following example, the `REFind` function returns an index of 6:

```cfc
<cfset IndexOfOccurrence=REFind("a{2,4}", "hahahahaaaaahaaaaahhh")>

<!--- The value of IndexOfOccurrence is 6--->
```

The regular expression "[0-9]{3,}" specifies to match any integer number containing three or more digits: "123", "45678", etc. However, this regular expression does not match a one-digit or two-digit number.

You use the following syntax to find repeating characters:

1. `{m,n}
   - Where $m$ is 0 or greater and $n$ is greater than or equal to $m$. Match $m$ through $n$ (inclusive) occurrences.
   - The expression `{0,1}` is equivalent to the special character `?`.

2. `{m,}
   - Where $m$ is 0 or greater. Match at least $m$ occurrences. The syntax `{,n}` is not allowed.
   - The expression `{1,}` is equivalent to the special character `+`, and `{0,}` is equivalent to `*`.

3. `{m}
   - Where $m$ is 0 or greater. Match exactly $m$ occurrences.

### Case sensitivity in regular expressions

ColdFusion supplies case-sensitive and case-insensitive functions for working with regular expressions. `REFind` and `REReplace` perform case-sensitive matching and `REFindNoCase` and `REReplaceNoCase` perform case-insensitive matching.

You can build a regular expression that models case-insensitive behavior, even when used with a case-sensitive function. To make a regular expression case insensitive, substitute individual characters with character sets. For example, the regular expression `[Jj][Aa][Vv][Aa]`, when used with the case-sensitive functions `REFind` or `REReplace`, matches all of the following string patterns:

- JAVA
- java
- Java
- jAva
- All other combinations of case
Using subexpressions

Parentheses group parts of regular expressions together into grouped subexpressions that you can treat as a single unit. For example, the regular expression "ha" specifies to match a single occurrence of the string. The regular expression "(ha)+" matches one or more instances of "ha".

In the following example, you use the regular expression "B(ha)+" to match the letter "B" followed by one or more occurrences of the string "ha":

```coldfusion
<cfset IndexOfOccurrence=REFind("B(ha)+", "hahaBhahahaha")>
<!--- The value of IndexOfOccurrence is 5 --->
```

You can use the special character | in a subexpression to create a logical "OR". You can use the following regular expression to search for the word "jelly" or "jellies":

```coldfusion
<cfset IndexOfOccurrence=REFind("jell(y|ies)", "I like peanut butter and jelly")>
<!--- The value of IndexOfOccurrence is 26--->
```

Using special characters

Regular expressions define the following list of special characters:

- `+`  - Matches one or more occurrences of the preceding character.
- `*`  - Matches zero or more occurrences of the preceding character.
- `?`   - Matches zero or one occurrence of the preceding character.
- `.`  - Matches any single character, including newline.
- `\`  - A backslash followed by any special character matches the literal character itself, that is, the backslash escapes the special character. For example, "+" matches the plus sign, and "\\" matches a backslash.
- `[`  - A one-character character set that matches any of the characters in that set. A hyphen in a character set indicates a range of characters; for example, `[a-z]` matches any single lowercase letter.
- `[^`  - Matches any character except those in the set. It does not match the empty string.
- `^`  - If the caret is at the beginning of a regular expression, the matched string must be at the beginning of the string being searched. For example, the regular expression `^ColdFusion` matches the string "ColdFusion lets you use regular expressions" but not the string "In ColdFusion, you can use regular expressions."
- `$`  - If the dollar sign is at the end of a regular expression, the matched string must be at the end of the string being searched. For example, the regular expression "ColdFusion$" matches the string "I like ColdFusion" but not the string "ColdFusion is fun."

The following table describes the special characters for regular expressions:

<table>
<thead>
<tr>
<th>Special Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>\</td>
<td>A backslash followed by any special character matches the literal character itself, that is, the backslash escapes the special character. For example, &quot;+&quot; matches the plus sign, and &quot;\&quot; matches a backslash.</td>
</tr>
<tr>
<td>.</td>
<td>A period matches any character, including newline. To match any character except a newline, use \^[#chr(13)#chr(10)#], which excludes the ASCII carriage return and line feed codes. The corresponding escape codes are \r and \n.</td>
</tr>
<tr>
<td>]</td>
<td>A one-character character set that matches any of the characters in that set. For example, <code>[akm]</code> matches an &quot;a&quot;, &quot;k&quot;, or &quot;m&quot;. A hyphen in a character set indicates a range of characters; for example, <code>[a-z]</code> matches any single lowercase letter. If the first character of a character set is the caret (^), the regular expression matches any character except those in the set. It does not match the empty string. For example, [^akm] matches any character except &quot;a&quot;, &quot;k&quot;, or &quot;m&quot;. The caret loses its special meaning if it is not the first character of the set.</td>
</tr>
<tr>
<td>^</td>
<td>If the caret is at the beginning of a regular expression, the matched string must be at the beginning of the string being searched. For example, the regular expression <code>^ColdFusion</code> matches the string &quot;ColdFusion lets you use regular expressions&quot; but not the string &quot;In ColdFusion, you can use regular expressions.&quot;</td>
</tr>
<tr>
<td>$</td>
<td>If the dollar sign is at the end of a regular expression, the matched string must be at the end of the string being searched. For example, the regular expression &quot;ColdFusion$&quot; matches the string &quot;I like ColdFusion&quot; but not the string &quot;ColdFusion is fun.&quot;</td>
</tr>
<tr>
<td>Special Character</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>?</td>
<td>A character set or subexpression followed by a question mark matches zero or one occurrences of the character set or subexpression. For example, xy?z matches either “xyz” or “xz”.</td>
</tr>
<tr>
<td></td>
<td>The OR character allows a choice between two regular expressions. For example, jelly</td>
</tr>
<tr>
<td>+</td>
<td>A character set or subexpression followed by a plus sign matches one or more occurrences of the character set or subexpression. For example, [a-z]+ matches one or more lowercase characters.</td>
</tr>
<tr>
<td>*</td>
<td>A character set or subexpression followed by an asterisk matches zero or more occurrences of the character set or subexpression. For example, [a-z]* matches zero or more lowercase characters.</td>
</tr>
<tr>
<td>( )</td>
<td>Parentheses group parts of a regular expression into subexpressions that you can treat as a single unit. For example, (ha)+ matches one or more instances of “ha”.</td>
</tr>
</tbody>
</table>
| (?x)              | If at the beginning of a regular expression, it specifies to ignore whitespace in the regular expression and lets you use ## for end-of-line comments. You can match a space by escaping it with a backslash. For example, the following regular expression includes comments, preceded by ##, that are ignored by ColdFusion: `reFind("(?x)
 one ##first option
 |two ##second option
 |three\ point\ five ## note escaped spaces
 ", "three point five")` |
| (?m)              | If at the beginning of a regular expression, it specifies the multilne mode for the special characters ^ and $. When used with ^, the matched string can be at the start of the of entire search string or at the start of new lines, denoted by a linefeed character or chr(10), within the search string. For $, the matched string can be at the end the search string or at the end of new lines. Multiline mode does not recognize a carriage return, or chr(13), as a new line character. The following example searches for the string “two” across multiple lines: `#reFind("(?m)\"two\", "one\chr(10)\two\")#` This example returns 4 to indicate that it matched “two” after the chr(10) linefeed. Without (?m), the regular expression would not match anything, because ^ only matches the start of the string. The character (?m) does not affect \A or \Z, which always match the start or end of the string, respectively. For information on \A and \Z, see “Using escape sequences” on page 113. |
| (?i)              | If at the beginning of a regular expression for REFind(), it specifies to perform a case-insensitive compare. For example, the following line would return an index of 1: `#reFind("(?i)hi", "HI")#` If you omit the (?i), the line would return an index of zero to signify that it did not find the regular expression. |
You must be aware of the following considerations when using special characters in character sets, such as `[a-z]`:

- To include a hyphen (-) in the square brackets of a character set as a literal character, you cannot escape it as you can other special characters because ColdFusion always interprets a hyphen as a range indicator. Therefore, if you use a literal hyphen in a character set, make it the last character in the set.
- To include a closing square bracket (']) in the character set, escape it with a backslash, as in `[1-3]\A-z]`. You do not have to escape the ] character outside of the character set designator.

Using escape sequences

Escape sequences are special characters in regular expressions preceded by a backslash (\). You typically use escape sequences to represent special characters within a regular expression. For example, the escape sequence \t represents a tab character within the regular expression, and the \d escape sequence specifies any digit, similar to `[0-9]`. In ColdFusion the escape sequences are case-sensitive.

The following table lists the escape sequences that ColdFusion supports:
Using character classes

In character sets within regular expressions, you can include a character class. You enclose the character class inside square brackets, as the following example shows:

```cfm
REReplace ("Adobe Web Site","[[:space:]]*","**","ALL")
```

This code replaces all the spaces with *, producing this string:

Adobe*Web*Site

You can combine character classes with other expressions within a character set. For example, the regular expression `[[:space:]123]` searches for a space, 1, 2, or 3. The following example also uses a character class in a regular expression:

```cfml
<cfset IndexOfOccurrence=REFind("[[:space:]]A-Z+[[:space:]]", "Some BIG string")>
```

<table>
<thead>
<tr>
<th>Escape Sequence</th>
<th>Description</th>
</tr>
</thead>
</table>
| \b             | Specifies a boundary defined by a transition from an alphanumeric character to a nonalphanumeric character, or from a nonalphanumeric character to an alphanumeric character. For example, the string "Big" contains boundary defined by the space (nonalphanumeric character) and the "B" (alphanumeric character). The following example uses the \b escape sequence in a regular expression to locate the string "Big" at the end of the search string and not the fragment "big" inside the word "ambiguous". `reFindNoCase("\bBig\b","Don't be ambiguous about Big")`<br/>--- The value of IndexOfOccurrence is 26 ---|}
| \B             | Specifies a boundary defined by no transition of character type. For example, two alphanumeric character in a row or two nonalphanumeric character in a row; opposite of \b. |}
| \A             | Specifies a beginning of string anchor, much like the ^ special character. However, unlike ^, you cannot combine \A with (?m) to specify the start of newlines in the search string. |}
| \Z             | Specifies an end of string anchor, much like the $ special character. However, unlike $, you cannot combine \Z with (?m) to specify the end of newlines in the search string. |}
| \n             | Newline character |}
| \r             | Carriage return |}
| \t             | Tab |}
| \f             | Form feed |}
| \d             | Any digit, similar to [0-9] |}
| \D             | Any nondigit character, similar to [^0-9] |}
| \w             | Any alphanumeric character, similar to [:alnum:] |}
| \W             | Any nonalphanumeric character, similar to [^[:alnum:]] |}
| \s             | Any whitespace character including tab, space, newline, carriage return, and form feed. Similar to [\t\n\r\f]. |}
| \S             | Any nonwhitespace character, similar to [^\t\n\r\f] |}
| \xddd          | A hexadecimal representation of a character, where d is a hexadecimal digit |}
| \ddd           | An octal representation of a character, where d is an octal digit, in the form \000 to \377 |}
The following table shows the character classes that ColdFusion supports. Regular expressions using these classes match any Unicode character in the class, not just ASCII or ISO-8859 characters.

<table>
<thead>
<tr>
<th>Character class</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha:</td>
<td>Any alphabetic character.</td>
</tr>
<tr>
<td>:upper:</td>
<td>Any uppercase alphabetic character.</td>
</tr>
<tr>
<td>:lower:</td>
<td>Any lowercase alphabetic character</td>
</tr>
<tr>
<td>:digit:</td>
<td>Any digit. Same as \d.</td>
</tr>
<tr>
<td>:alnum:</td>
<td>Any alphanumeric character. Same as \w.</td>
</tr>
<tr>
<td>:xdigit:</td>
<td>Any hexadecimal digit. Same as [0-9A-Fa-f].</td>
</tr>
<tr>
<td>:blank:</td>
<td>Space or a tab.</td>
</tr>
<tr>
<td>:space:</td>
<td>Any whitespace character. Same as \s.</td>
</tr>
<tr>
<td>:print:</td>
<td>Any alphanumeric, punctuation, or space character.</td>
</tr>
<tr>
<td>:punct:</td>
<td>Any punctuation character</td>
</tr>
<tr>
<td>:graph:</td>
<td>Any alphanumeric or punctuation character.</td>
</tr>
<tr>
<td>:cntrl:</td>
<td>Any character not part of the character classes [upper:], [lower:], [alpha:], [digit:], [punct:], [graph:], [print:], or [xdigit:].</td>
</tr>
<tr>
<td>:word:</td>
<td>Any alphanumeric character, plus the underscore (_)</td>
</tr>
<tr>
<td>:ascii:</td>
<td>The ASCII characters, in the Hexadecimal range 0 - 7F</td>
</tr>
</tbody>
</table>

### Using backreferences

You use parenthesis to group components of a regular expression into subexpressions. For example, the regular expression "(ha)+" matches one or more occurrences of the string "ha".

ColdFusion performs an additional operation when using subexpressions; it automatically saves the characters in the search string matched by a subexpression for later use within the regular expression. Referencing the saved subexpression text is called **backreferencing**.

You can use backreferencing when searching for repeated words in a string, such as “the the” or “is is”. The following example uses backreferencing to find all repeated words in the search string and replace them with an asterisk:

```coldfusion
REReplace("There is is coffee in the the kitchen",
" [ ]+( [A-Za-z]+ ) [ ]+\1"," * ","ALL")
```

Using this regular expression, ColdFusion detects the two occurrences of “is” as well as the two occurrences of “the”, replaces them with an asterisk enclosed in spaces, and returns the following string:

```
There * coffee in * kitchen
```

You interpret the regular expression `[ ]+( [A-Za-z]+ )[ ]+\1` as follows:

Use the subexpression `( [A-Za-z]+ )` to search for character strings consisting of one or more letters, enclosed by one or more spaces, `[ ]+`, followed by the same character string that matched the first subexpression, `\1`. 
You reference the matched characters of a subexpression using a slash followed by a digit \(n\) (where) where the first subexpression in a regular expression is referenced as \(\backslash1\), the second as \(\backslash2\), etc. The next section includes an example using multiple backreferences.

**Using backreferences in replacement strings**

You can use backreferences in the replacement string of both the `REReplace` and `REReplaceNoCase` functions. For example, to replace the first repeated word in a text string with a single word, use the following syntax:

```coldfusion
REReplace("There is is a cat in in the kitchen",
        "([A-Za-z \ ]\+\)\1\","\1")
```

This results in the sentence:

"There is a cat in the kitchen"

You can use the optional fourth parameter to `REReplace`, `scope`, to replace all repeated words, as in the following code:

```coldfusion
REReplace("There is is a cat in in the kitchen",
        "([A-Za-z \ ]\+\)\1\","\1","ALL")
```

This results in the following string:

"There is a cat in the kitchen"

The next example uses two backreferences to reverse the order of the words "apples" and "pears" in a sentence:

```coldfusion
<cfset astring = "apples and pears, apples and pears, apples and pears">
<cfset newString = REReplace("#astring#", "(apples) and (pears)", "\2 and \1","ALL")>
```

In this example, you reference the subexpression (apples) as \(\backslash1\) and the subexpression (pears) as \(\backslash2\). The `REReplace` function returns the string:

"pears and apples, pears and apples, pears and apples"

**Note:** To use backreferences in either the search string or the replace string, you must use parentheses within the regular expression to create the corresponding subexpression. Otherwise, ColdFusion throws an exception.

**Using backreferences to perform case conversions in replacement strings**

The `REReplace` and `REReplaceNoCase` functions support special characters in replacement strings to convert replacement characters to uppercase or lowercase. The following table describes these special characters:

<table>
<thead>
<tr>
<th>Special character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>\u</td>
<td>Converts the next character to uppercase.</td>
</tr>
<tr>
<td>\l</td>
<td>Converts the next character to lowercase.</td>
</tr>
<tr>
<td>\U</td>
<td>Converts all characters to uppercase until encountering \E.</td>
</tr>
<tr>
<td>\L</td>
<td>Converts all characters to lowercase until encountering \E.</td>
</tr>
<tr>
<td>\E</td>
<td>End \U or \L.</td>
</tr>
</tbody>
</table>

To include a literal \u, or other code, in a replacement string, escape it with another backslash; for example \\u .

For example, the following statement replaces the uppercase string "HELLO" with a lowercase "hello". This example uses backreferences to perform the replacement. For more information on using backreferences, see "Using backreferences in replacement strings" on page 116.
reReplace("HELLO", "([[upper:]]*)", "Don't shout\scream \L\1")

The result of this example is the string "Don't shout\scream hello".

**Escaping special characters in replacement strings**

You use the backslash character, \\, to escape backreference and case-conversion characters in replacement strings. For example, to include a literal "\u" in a replacement string, escape it, as in "\\u".

**Omitting subexpressions from backreferences**

By default, a set of parentheses will both group the subexpression and capture its matched text for later referral by backreferences. However, if you insert "?:" as the first characters of the subexpression, ColdFusion performs all operations on the subexpression except that it will not capture the corresponding text for use with a back reference.

This is useful when alternating over subexpressions containing differing numbers of groups would complicate backreference numbering. For example, consider an expression to insert a "Mr." in between Bonjour|Hi|Hello and Bond, using a nested group for alternating between Hi & Hello:

```coldfusion
<cfset regex = "Bonjour[Hi|ello])( Bond)">
<cfset replaceString = "\1 Mr.\2">
<cfset string = "Hello Bond">
#reReplace(string, regex, replaceString)#
```

This example returns "Hello Mr. Bond". If you did not prohibit the capturing of the Hi/Hello group, the \2 backreference would end up referring to that group instead of " Bond", and the result would be "Hello Mr.ello".

**Returning matched subexpressions**

The `REFind` and `REFindNoCase` functions return the location in the search string of the first match of the regular expression. Even though the search string in the next example contains two matches of the regular expression, the function only returns the index of the first:

```coldfusion
<cfset IndexOfOccurrence=REFind(" BIG ", "Some BIG BIG string")>
<cf-- The value of IndexOfOccurrence is 5 ---
```

To find all instances of the regular expression, you must call the `REFind` and `REFindNoCase` functions multiple times.

Both the `REFind` and `REFindNoCase` functions take an optional third parameter that specifies the starting index in the search string for the search. By default, the starting location is index 1, the beginning of the string.

To find the second instance of the regular expression in this example, you call `REFind` with a starting index of 8:

```coldfusion
<cfset IndexOfOccurrence=REFind(" BIG ", "Some BIG BIG string", 8)>  
<cf-- The value of IndexOfOccurrence is 9 -->
```

In this case, the function returns an index of 9, the starting index of the second string " BIG ".

To find the second occurrence of the string, you must know that the first string occurred at index 5 and that the string's length was 5. However, `REFind` only returns starting index of the string, not its length. So, you either must know the length of the matched string to call `REFind` the second time, or you must use subexpressions in the regular expression.
The `REFind` and `REFindNoCase` functions let you get information about matched subexpressions. If you set these functions' fourth parameter, `ReturnSubExpression`, to True, the functions return a CFML structure with two arrays, `pos` and `len`, containing the positions and lengths of text strings that match the subexpressions of a regular expression, as the following example shows:

```cfset sLenPos=REFind(" BIG ", "Some BIG BIG string", 1, "True")>
<cfoutput>
  <cfdump var="#sLenPos#">  
</cfoutput><br>
The following image shows the output of the `cfdump` tag:

![Image: LEN 15 POS 15]

Element one of the `pos` array contains the starting index in the search string of the string that matched the regular expression. Element one of the `len` array contains length of the matched string. For this example, the index of the first "BIG" string is 5 and its length is also 5. If there are no occurrences of the regular expression, the `pos` and `len` arrays each contain one element with a value of 0.

You can use the returned information with other string functions, such as `mid`. The following example returns that part of the search string matching the regular expression:

```cfset myString="Some BIG BIG string">
<cfset sLenPos=REFind(" BIG ", myString, 1, "True")>
<cfoutput>
  #mid(myString, sLenPos.pos[1], sLenPos.len[1])#
</cfoutput>
```

Each additional element in the `pos` array contains the position of the first match of each subexpression in the search string. Each additional element in `len` contains the length of the subexpression's match.

In the previous example, the regular expression "BIG" contained no subexpressions. Therefore, each array in the structure returned by `REFind` contains a single element.

After executing the previous example, you can call `REFind` a second time to find the second occurrence of the regular expression. This time, you use the information returned by the first call to make the second:

<!-- subtract 1 because you need to start at the first space -->
<cfset sLenPos2=REFind(" BIG ", "Some BIG BIG string", newstart, "True")>
<cfoutput>
  <cfdump var="#sLenPos2#">  
</cfoutput><br>
```

The following image shows the output of the `cfdump` tag:

![Image: LEN 15 POS 19]
If you include subexpressions in your regular expression, each element of pos and len after element one contains the position and length of the first occurrence of each subexpression in the search string.

In the following example, the expression \([A-Za-z]+\) is a subexpression of a regular expression. The first match for the expression \((A-Za-z)+([ ]+1)\), is “is is”.

```cfc
cfset sLenPos=REFind("(A-Za-z)+([ ]+1)\", "There is is a cat in in the kitchen", 1, "True")
cfoutput
cfdump var="#sLenPos#"
cfoutput<br>
```

The following image shows the output of the cfdump tag:

![Output Image]

The entries sLenPos.pos[1] and sLenPos.len[1] contain information about the match of the entire regular expression. The array elements sLenPos.pos[2] and sLenPos.len[2] contain information about the first subexpression (“is”). Because REFind returns information on the first regular expression match only, the sLenPos structure does not contain information about the second match to the regular expression, “in”.

The regular expression in the following example uses two subexpressions. Therefore, each array in the output structure contains the position and length of the first match of the entire regular expression, the first match of the first subexpression, and the first match of the second subexpression.

```cfc
cfset sString = "apples and pears, apples and pears, apples and pears"
cfset regex = "(apples) and (pears)"
cfset sLenPos = REFind(regex, sString, 1, "True")
cfoutput
cfdump var="#sLenPos#"
cfoutput<br><br>
```

The following image shows the output of the cfdump tag:
For a full discussion of subexpression usage, see the sections on `REFind` and `REFindNoCase` in the ColdFusion functions chapter in the *CFML Reference*.

**Specifying minimal matching**

The regular expression quantifiers ?, *, +, {min,} and {min,max} specify a minimum and/or maximum number of instances of a given expression to match. By default, ColdFusion locates the greatest number characters in the search string that match the regular expression. This behavior is called *maximal matching*.

For example, you use the regular expression `"<b>(.*)</b>\"` to search the string `"<b>one</b> <b>two</b>\"`. The regular expression `"<b>(.*)</b>\"`, matches both of the following:

- `<b>one</b>\n`<br>`<b>two</b>`

By default, ColdFusion always tries to match the regular expression to the largest string in the search string. The following code shows the results of this example:

```coldfusion
<cfset sLenPos=REFind("<b>(.*)</b>\", "<b>one</b> <b>two</b>\", 1, "True")>
<cfoutput>
  <cfdump var="#sLenPos#">
</cfoutput><br>
```

The following image shows the output of the `cfdump` tag:

Thus, the starting position of the string is 1 and its length is 21, which corresponds to the largest of the two possible matches.
However, sometimes you might want to override this default behavior to find the shortest string that matches the regular expression. ColdFusion includes minimal-matching quantifiers that let you specify to match on the smallest string. The following table describes these expressions:

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>*?</code></td>
<td>minimal-matching version of *</td>
</tr>
<tr>
<td><code>+?</code></td>
<td>minimal-matching version of +</td>
</tr>
<tr>
<td><code>??</code></td>
<td>minimal-matching version of ?</td>
</tr>
<tr>
<td><code>(min,)?</code></td>
<td>minimal-matching version of (min,)</td>
</tr>
<tr>
<td><code>(min,max)</code></td>
<td>minimal-matching version of (min,max)</td>
</tr>
<tr>
<td><code>(n)</code></td>
<td>(no different from [n], supported for notational consistency)</td>
</tr>
</tbody>
</table>

If you modify the previous example to use the minimal-matching syntax, the code is as follows:

```coldfusion
<cfset sLenPos=REFind("<b>(.*?)</b>", "<b>one</b> <b>two</b>" , 1 , "True")>
<cfoutput>
  <cfdump var="#sLenPos#">
</cfoutput><br>
```

The following image shows the output of the `cfdump` tag:

Thus, the length of the string found by the regular expression is 10, corresponding to the string "<b>one</b>".

### Regular expression examples

The following examples show some regular expressions and describe what they match:

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>{\?\&amp;}</code></td>
<td>A URL parameter value in a URL.</td>
</tr>
<tr>
<td><code>[A-Z]:\([A-Z0-9_.]+\)</code></td>
<td>An uppercase DOS/Windows path in which (a) is not the root of a drive, and (b) has only letters, numbers, and underscores in its text.</td>
</tr>
<tr>
<td><code>^[A-Za-z] [A-Za-z0-9_.]*</code></td>
<td>A ColdFusion variable with no qualifier.</td>
</tr>
<tr>
<td><code>([A-Za-z] [A-Za-z0-9_.]* </code></td>
<td>A ColdFusion variable with no more than one qualifier; for example, Form.VarName, but not Form.Image.VarName.</td>
</tr>
<tr>
<td><code>\.</code> <code>([A-Za-z] [A-Za-z0-9_.]*</code></td>
<td>A ColdFusion variable with no more than one qualifier; for example, Form.VarName, but not Form.Image.VarName.</td>
</tr>
</tbody>
</table>
Regular expressions in CFML

The following examples of CFML show some common uses of regular expression functions:

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+</td>
<td>-)?[1-9]\d*</td>
</tr>
<tr>
<td>(+</td>
<td>-)?[0-9]+.\d*</td>
</tr>
<tr>
<td>(+</td>
<td>-)?[0-9]+E(+</td>
</tr>
<tr>
<td>a{2,4}</td>
<td>Two to four occurrences of &quot;a&quot;: aa, aaa, aaaa.</td>
</tr>
<tr>
<td>[ba][3,]</td>
<td>At least three &quot;ba&quot; pairs: bababa, babababa, and so on.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>REReplace (CGI.Query_String, &quot;CFID=[0-9]+&amp;\d*&quot;, &quot;&quot;)</td>
<td>The query string with parameter CFID and its numeric value stripped out.</td>
</tr>
<tr>
<td>REReplace(&quot;I Love Jellies&quot;, &quot;[[:lower:]]&quot;,&quot;x&quot;,&quot;ALL&quot;</td>
<td>I Lxxx Jxxxxx</td>
</tr>
<tr>
<td>REReplaceNoCase(&quot;cabaret&quot;,&quot;[A-Z]&quot;, &quot;G&quot;,&quot;ALL&quot;)</td>
<td>GGGGGGG</td>
</tr>
<tr>
<td>REReplace (Report,&quot;$[0-9,]<em>[0-9]</em>&quot;,&quot;$*<strong>.</strong>&quot;)&quot;, &quot;&quot;)</td>
<td>The string value of the variable Report with all positive numbers in the dollar format changed to &quot;$*<strong>.</strong>&quot;.</td>
</tr>
<tr>
<td>REFind (&quot;[Uu].[Ss].[Aa].&quot;?, Report)</td>
<td>The position in the variable Report of the first occurrence of the abbreviation USA. The letters can be in either case and the abbreviation can have a period after any letter.</td>
</tr>
<tr>
<td>REFindNoCase(&quot;a+c&quot;,&quot;ABCAACCDD&quot;)</td>
<td>4</td>
</tr>
<tr>
<td>REReplace(&quot;There is is coffee in the the kitchen&quot;,&quot;([A-Za-z]+[ ]<em>[ ]</em>[ ]<em>[ ]</em>\&quot;,&quot;&quot;,&quot;ALL&quot;)</td>
<td>There * coffee in * kitchen</td>
</tr>
<tr>
<td>REReplace(report, &quot;&lt;[.]*&gt;&quot;,&quot;&quot;,&quot;All&quot;)</td>
<td>Removes all HTML tags from a string value of the report variable.</td>
</tr>
</tbody>
</table>

Types of regular expression technologies

Many types of regular expression technologies are available to programmers. JavaScript, Perl, and POSIX are all examples of different regular expression technologies. Each technology has its own syntax specifications and is not necessarily compatible with other technologies.

ColdFusion supports regular expressions that are Perl compliant with a few exceptions:

- A period, ., always matches newlines.
- In replacement strings, use \n instead of $n for backreference variables. ColdFusion escapes all $ in the replacement string.
- You do not have to escape backslashes in replacement strings. ColdFusion escapes them, with the exception of case conversion sequences or escaped versions (e.g., \u or \\u).
- Embedded modifiers ( (?i), etc.) always affect the entire expression, even if they are inside a group.
• \Q and the combinations \u\L and \l\U are not supported in replacement strings.

The following Perl statements are not supported:
• Lookbehind (?<=) (<?!)  
• \x{hhhh}  
• \N  
• \p  
• \C  

Part 2: Building Blocks of ColdFusion Applications

This part contains the following topics:

- Creating ColdFusion Elements ......................................................... 126
- Writing and Calling User-Defined Functions ................................. 134
- Building and Using ColdFusion Components .............................. 158
- Creating and Using Custom CFML Tags ....................................... 190
- Building Custom CFXAPI Tags .................................................... 205
Chapter 8: Creating ColdFusion Elements

You can create ColdFusion elements to organize your code. When you create any of these elements, you write your code once and use it, without copying it, in many places.

Contents
About CFML elements that you create ................................................................. 126
Including pages with the cfinclude tag ............................................................. 127
About user-defined functions .......................................................................... 128
Using ColdFusion components ...................................................................... 129
Using custom CFML tags ............................................................................... 130
Using CFX tags .............................................................................................. 131
Selecting among ColdFusion code reuse methods ....................................... 132

About CFML elements that you create

ColdFusion provides you with several techniques and elements to create sections of code that you can use multiple times in an application. Many of the elements also let you extend the built-in capabilities of ColdFusion. ColdFusion provides the following techniques and elements:

• ColdFusion pages you include using the cfinclude tag
• User-defined functions (UDFs)
• ColdFusion components
• Custom CFML tags
• CFX (ColdFusion Extension) tags

The following sections describe the features of each of these elements and provide guidelines for determining which to use in your application. Other chapters describe the elements in detail. The last section in this chapter includes a table to help you choose among these techniques and elements for different purposes.

ColdFusion can also use elements developed using other technologies, including the following:

• JSP tags from JSP tag libraries. For information on using JSP tags, see “Integrating J2EE and Java Elements in CFML Applications” on page 927.
• Java objects, including objects in the Java run-time environment and JavaBeans. For information on using Java objects, see “Integrating J2EE and Java Elements in CFML Applications” on page 927.
• Microsoft COM (Component Object Model) objects. For information on using COM objects, see “Integrating COM and CORBA Objects in CFML Applications” on page 972.
• CORBA (Common Object Request Broker Architecture) objects. For information on using CORBA objects, see “Integrating COM and CORBA Objects in CFML Applications” on page 972.
• Web services. For information on using web services, see “Using Web Services” on page 900.
Including pages with the \texttt{cfinclude} tag

The \texttt{cfinclude} tag adds the contents of a ColdFusion page to another ColdFusion page, as if the code on the included page were part of the page that uses the \texttt{cfinclude} tag. It lets you pursue a “write once use multiple times” strategy for ColdFusion elements that you incorporate in multiple pages. Instead of copying and maintaining the same code on multiple pages, you can store the code in one page and then refer to it in many pages. For example, the \texttt{cfinclude} tag is commonly used to put a header and footer on multiple pages. This way, if you change the header or footer design, you only change the contents of a single file.

The model of an included page is that it is part of your page; it just resides in a separate file. The \texttt{cfinclude} tag cannot pass parameters to the included page, but the included page has access to all the variables on the page that includes it. The following image shows this model:

Using the \texttt{cfinclude} tag

When you use the \texttt{cfinclude} tag to include one ColdFusion page in another ColdFusion page, the page that includes another page is referred to as the \textit{calling} page. When ColdFusion encounters a \texttt{cfinclude} tag it replaces the tag on the calling page with the output from processing the included page. The included page can also set variables in the calling page.

The following line shows a sample \texttt{cfinclude} tag:

\begin{verbatim}
<cfinclude template = "header.cfm">
\end{verbatim}

\textbf{Note:} You cannot break CFML code blocks across pages. For example, if you open a \texttt{cfoutput} block in a ColdFusion page, you must close the block on the same page; you cannot include the closing portion of the block in an included page.

ColdFusion searches for included files as follows:

- The \texttt{template} attribute specifies a path relative to the directory of the calling page.
- If the template value is prefixed with a forward slash (/), ColdFusion searches for the included file in directories that you specify on the Mappings page of the ColdFusion Administrator.

\textbf{Important:} A page must not include itself. Doing so causes an infinite processing loop, and you must stop the ColdFusion server to resolve the problem.

Include code in a calling page

1. Create a ColdFusion page named header.cfm that displays your company's logo. Your page can consist of just the following lines, or it can include many lines to define an entire header:
(For this example to work, you must also put your company's logo as a GIF file in the same directory as the header.cfm file.)

2 Create a ColdFusion page with the following content:

```html
<html>
<head>
  <title>Test for Include</title>
</head>
<body>
  <cfinclude template="header.cfm">
</body>
</html>
```

3 Save the file as includeheader.cfm and view it in a browser.
The header should appear along with the logo.

**Recommended uses**
Consider using the `cfinclude` tag in the following cases:

- For page headers and footers
- To divide a large page into multiple logical chunks that are easier to understand and manage
- For large "snippets" of code that are used in many places but do not require parameters or fit into the model of a function or tag

**About user-defined functions**

User-defined functions (UDFs) let you create application elements in a format in which you pass in arguments and get a return a value. You can define UDFs using CFScript or the `cffunction` tag. The two techniques have several differences, of which the following are the most important:

- If you use the `cffunction` tag, your function can include CFML tags.
- If you write your function using CFScript, you cannot include CFML tags.

You can use UDFs in your application pages just as you use standard ColdFusion functions. When you create a function for an algorithm or procedure that you use frequently, you can then use the function wherever you need the procedure, just as you would use a ColdFusion built-in function. For example, the following line calls the function `MyFunct` and passes it two arguments:

```cfset returnValue=MyFunct(Arg1, Arg2)`
```

You can group related functions in a ColdFusion component. For more information, see “Using ColdFusion components” on page 129.

As with custom tags, you can easily distribute UDFs to others. For example, the Common Function Library Project at www.cflib.org is an open-source collection of CFML user-defined functions.

**Recommended uses**

Typical uses of UDFs include, but are not limited to, the following:
• Data manipulation routines, such as a function to reverse an array
• String and date and time routines, such as a function to determine whether a string is a valid IP address
• Mathematical calculation routines, including standard trigonometric and statistical operations or calculating loan amortization
• Routines that call functions externally, for example using COM or CORBA, such as routines to determine the space available on a Windows file system drive

Consider using UDFs in the following circumstances:

• You must pass in a number of arguments, process the results, and return a value. UDFs can return complex values, including structures that contain multiple simple values.
• You want to provide logical units, such as data manipulation functions.
• Your code must be recursive.
• You distribute your code to others.

If you can create either a UDF or a custom CFML tag for a particular purpose, first consider creating a UDF because invoking it requires less system overhead than using a custom tag.

For more information
For more information on user-defined functions, see “Writing and Calling User-Defined Functions” on page 134.

Using ColdFusion components

ColdFusion components (CFCs) are ColdFusion templates that contain related functions and arguments that each function accepts. The CFC contains the CFML tags necessary to define its functions and arguments and return a value. ColdFusion components are saved with a .cfc extension.

CFCs combine the power of objects with the simplicity of CFML. By packaging related functionality into a single unit, they provide an object or class shell from which functions can be called.

ColdFusion components can make their data private, so that it is available to all functions (also called methods) in the component, but not to any application that uses the component.

ColdFusion components have the following features:

• They are designed to provide related services in a single unit.
• They can provide web services and make them available over the Internet.
• They can provide ColdFusion services that Flash clients can call directly.
• They have several features that are familiar to object-oriented programmers, including data hiding, inheritance, packages, and introspection.

Recommended uses
Consider using ColdFusion components when doing the following:

• Creating web services. (To create web services in ColdFusion, you must use components.)
• Creating services that are callable by Flash clients.
• Creating libraries of related functions, particularly if they must share data.
• Using integrated application security mechanisms based on roles and the requestor location.
• Developing code in an object-oriented manner, in which you use methods on objects and can create objects that extend the features of existing objects.

For more information
For more information on using ColdFusion components, see “Building and Using ColdFusion Components” on page 158

Using custom CFML tags

Custom tags written in CFML behave like ColdFusion tags. They can do all of the following:
• Take arguments.
• Have tag bodies with beginning and ending tags.
• Do specific processing when ColdFusion encounters the beginning tag.
• Do processing that is different from the beginning tag processing when ColdFusion encounters the ending tag.
• Have any valid ColdFusion page content in their bodies, including both ColdFusion built-in tags and custom tags (referred to as nested tags), or even JSP tags or JavaScript.
• Be called recursively; that is, a custom tag can, if designed properly, call itself in the tag body.
• Return values to the calling page in a common scope or the calling page’s Variables scope, but custom tags do not return values directly, the way functions do.

Although a custom tag and a ColdFusion page that you include using the cfinclude tag are both ColdFusion pages, they differ in how they are processed. When a page calls a custom tag, it hands processing off to the custom tag page and waits until the custom tag page completes. When the custom tag finishes, it returns processing (and possibly data) to the calling page; the calling page can then complete its processing. The following image shows how this works. The arrows indicate the flow of ColdFusion processing the pages.

Calling custom CFML tags

Unlike built-in tags, you can invoke custom CFML tags in the following three ways:
• Call a tag directly.
• Call a tag using the cfmodule tag.
• Use the cfimport tag to import a custom tag library directory.

To call a CFML custom tag directly, precede the filename with cf_, omit the .cfm extension, and put the name in angle brackets (<>). For example, use the following line to call the custom tag defined by the file mytag.cfm:

```cf_myTag>
```

If your tag takes a body, end it with the same tag name preceded with a forward slash (/), as follows:

```</cf_myTag>
```

For information on using the cfmodule and cfimport tags to call custom CFML tags, see “Creating and Using Custom CFML Tags” on page 190.

**Recommended uses**

ColdFusion custom tags let you abstract complex code and programming logic into simple units. These tags let you maintain a CFML-like design scheme for your code. You can easily distribute your custom tags and share tags with others. For example, the ColdFusion Developer’s Exchange includes a library of custom tags that perform a wide variety of often-complex jobs; see http://www.adobe.com/cfusion/exchange/index.cfm?view=sn130.

Consider using CFML custom tags in the following circumstances:

• You need a tag-like structure, which has a body and an end tag, with the body contents changing from invocation to invocation.
• You want to associate specific processing with the beginning tag, the ending tag, or both tags.
• To use a logical structure in which the tag body uses “child” tags or subtags. This structure is similar to the cfform tag, which uses subtags for the individual form fields.
• You do not need a function format in which the calling code uses a direct return value.
• Your code must be recursive.
• Your functionality is complex.
• To distribute your code in a convenient form to others.

If you can create either a UDF or a custom CFML tag for a purpose, first consider creating a UDF because invoking it requires less system overhead than using a custom tag.

**For more information**

For more information on custom CFML tags, see “Creating and Using Custom CFML Tags” on page 190.

**Using CFX tags**

ColdFusion Extension (CFX) tags are custom tags that you write in Java or C++. Generally, you create a CFX tag to do something that is not possible in CFML. CFX tags also let you use existing Java or C++ code in your ColdFusion application. Unlike CFML custom tags, CFX tags cannot have bodies or ending tags.

CFX tags can return information to the calling page in a page variable or by writing text to the calling page. CFX tags can do the following:
• Have any number of custom attributes.
• Create and manipulate ColdFusion queries.
• Dynamically generate HTML to be returned to the client.
• Set variables within the ColdFusion page from which they are called.
• Throw exceptions that result in standard ColdFusion error messages.

Calling CFX tags
To use a CFX tag, precede the class name with cfx_ and put the name in angle brackets. For example, use the following line to call the CFX tag defined by the MyCFXClass class and pass it one attribute.

\(<\text{cfx\_MyCFXClass myArgument}\text{"arg1"}>\)

Recommended uses
CFX tags provide one way of using C++ or Java code. However, you can also create Java classes and COM objects and access them using the cfobject tag. CFX tags, however, provide some built-in features that the cfobject tag does not have:

• CFX tags are easier to call in CFML code. You use CFX tags directly in CFML code as you would any other tag, and you can pass arguments using a standard tag format.
• ColdFusion provides predefined classes for use in your Java or C++ code that facilitate CFX tag development. These classes include support for request handling, error reporting, and query management.

You should consider using CFX tags in the following circumstances:

• You already have existing application functionality written in C++ or Java that you want to incorporate into your ColdFusion application.
• You cannot build the functionality you need using ColdFusion elements.
• You want to provide the new functionality in a tag format, as opposed to using the cfobject tag to import native Java or COM objects.
• You want use the Java and C++ classes provided by ColdFusion for developing your CFX code.

For more information
For more information on CFX tags, see “Building Custom CFXAPI Tags” on page 205.

Selecting among ColdFusion code reuse methods

The following table lists common reasons to employ code reuse methods and indicates the techniques to consider for each purpose. The letter P indicates that the method is preferred. (There can be more than one preferred method.) The letter A means that the method provides an alternative that might be useful in some circumstances.

This table does not include CFX tags. You use CFX tags only when you should code your functionality in C++ or Java. For more information about using CFX tags, see “Using CFX tags” on page 131.
<table>
<thead>
<tr>
<th>Purpose</th>
<th>cfinclude tag</th>
<th>Custom tag</th>
<th>UDF</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide code, including CFML, HTML, and static text, that must be used in multiple pages.</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deploy headers and footers.</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Include one page in another page.</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divide pages into smaller units.</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use variables from a calling page.</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td>A</td>
</tr>
<tr>
<td>Implement code that uses recursion.</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Distribute your code to others.</td>
<td>P</td>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Operate on a body of HTML or CFML text.</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use subtags.</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide a computation, data manipulation, or other procedure.</td>
<td>A</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide a single functional element that takes any number of input values and returns a (possibly complex) result.</td>
<td>A</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use variables, whose variable names might change from use to use.</td>
<td>A</td>
<td>P</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Provide accessibility from Flash clients.</td>
<td>A</td>
<td>A</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Use built-in user security features.</td>
<td>A</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Encapsulate multiple related functions and properties.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create web services.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement object-oriented coding methodologies.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 9: Writing and Calling User-Defined Functions

Creating custom functions for algorithms or procedures that you call frequently lets you organize and reuse the functions in your ColdFusion application pages.

Contents

About user-defined functions ................................................................. 134
Creating user-defined functions .......................................................... 135
Calling user-defined functions ............................................................. 139
Working with arguments and variables in functions ............................ 140
Handling errors in UDFs ................................................................. 147
A user-defined function example ....................................................... 152
Using UDFs effectively ................................................................. 153

About user-defined functions

You can create your own custom functions, known as user-defined functions, or UDFs. You then use them in your application pages the same way you use standard ColdFusion functions. You can also organize functions you create by grouping related functions into ColdFusion components. For more information, see “Building and Using ColdFusion Components” on page 158.

When you create a function for an algorithm or procedure that you use frequently, you can then use the function wherever you require the procedure. If you must change the procedure, you change only one piece of code. You can use your function anywhere that you can use a ColdFusion expression: in tag attributes, between number (#) signs in output, and in CFScript code. Typical uses of UDFs include, but are not limited to the following:

- Data manipulation routines, such as a function to reverse an array
- String and date/time routines, such as a function to determine whether a string is a valid IP address
- Mathematical calculation routines, including standard trigonometric and statistical operations or calculating loan amortization
- Routines that call functions externally, for example using COM or CORBA, including routines to determine the space available on a Windows file system drive

For information about selecting among user-defined functions, ColdFusion components, and custom tags, see “Creating ColdFusion Elements” on page 126.

Note: The Common Function Library Project at www.cflib.org is an open source collection of CFML user-defined functions.
Creating user-defined functions

Before you create a UDF, you must determine where you want to define it, and whether you want to use CFML or CFScript to create it.

Determining where to create a user-defined function

You can define a function in the following places:

- In a ColdFusion component. If you organize your functions in ColdFusion components, you use the functions as described in “Using ColdFusion components” on page 170.

- On the page where it is called. You can even define it below the place on the page where it is called, but this poor coding practice can result in confusing code.

- On a page that you include using a `cfinclude` tag. The `cfinclude` tag must be executed before the function gets called. For example, you can define all your application's functions on a single page and place a `cfinclude` tag at the top of pages that use the functions.

- On any page that puts the function name in a scope common with the page on which you call the function. For more information on UDF scoping, see “Specifying the scope of a function” on page 153.

- On the Application.cfc or Application.cfm page. For more information, see “Designing and Optimizing a ColdFusion Application” on page 218.

For recommendations on selecting where you define functions, see the sections “Using Application.cfm and function include files” on page 153 and “Specifying the scope of a function” on page 153.

About creating functions using CFScript

You use the `function` statement to define the function in CFScript. CFScript function definitions have the following features and limitations:

- The function definition syntax is familiar to anyone who uses JavaScript or most programming languages.

- CFScript is efficient for writing business logic, such as expressions and conditional operations.

- CFScript function definitions cannot include CFML tags.

The following is a CFScript definition for a function that returns a power of 2:

```cfscript
function twoPower(exponent) {
    return 2^exponent;
}
</cfscript>
```

For more information on how to use CFScript to define a function, see “Defining functions in CFScript” on page 135.

Defining functions in CFScript

You define functions using CFScript in a manner similar to defining JavaScript functions. You can define multiple functions in a single CFScript block.

Note: For more information on using CFScript, see “Extending ColdFusion Pages with CFML Scripting” on page 92.

CFScript function definition syntax

A CFScript function definition has the following syntax:
function functionName( [argName1[, argName2...]] )
{
    CFScript Statements
}

The following table describes the function variables:

<table>
<thead>
<tr>
<th>Function variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>functionName</td>
<td>The name of the function. You cannot use the name of a standard ColdFusion function or any name that starts with “cf”. You cannot use the same name for two different function definitions. Function names cannot include periods.</td>
</tr>
<tr>
<td>argName1...</td>
<td>Names of the arguments required by the function. The number of arguments passed into the function must equal or exceed the number of arguments in the parentheses at the start of the function definition. If the calling page omits any of the required arguments, ColdFusion generates a mismatched argument count error.</td>
</tr>
</tbody>
</table>

The body of the function definition must be in curly braces, even if it is a empty.

The following two statements are allowed only in function definitions:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>var variableName = expression;</td>
<td>Creates and initializes a variable that is local to the function (function variable). This variable has meaning only inside the function and is not saved between calls to the function. It has precedence in the function body over any variables with the same name that exist in any other scopes. You never prefix a function variable with a scope identifier, and the name cannot include periods. The initial value of the variable is the result of evaluating the expression. The expression can be any valid ColdFusion expression, including a constant or even another UDF. All var statements must be at the top of the function declaration, before any other statements. You must initialize all variables when you declare them. You cannot use the same name for a function variable and an argument. Each var statement can initialize only one variable. You should use the var statement to initialize all function-only variables, including loop counters and temporary variables.</td>
</tr>
<tr>
<td>return expression;</td>
<td>Evaluates expression (which can be a variable), returns its value to the page that called the function, and exits the function. You can return any ColdFusion variable type.</td>
</tr>
</tbody>
</table>

A simple CFScript example
The following example function adds the two arguments and returns the result:

```cfs
<cfscript>
function Sum(a,b) {
    var sum = a + b;
    return sum;
}
</cfscript>
```

In this example, a single line declares the function variable and uses an expression to set it to the value to be returned. This function can be simplified so that it does not use a function variable, as follows:

```cfs
function MySum(a,b) { Return a + b; }
```

You must always use curly braces around the function definition body, even if it is a single statement.
**About creating functions by using tags**

You use the `cffunction` tag to define a UDF in CFML. The `cffunction` tag syntax has the following features and limitations:

- Developers who have a background in CFML or HTML, but no scripting or programming experience will be more familiar with the syntax.
- You can include any ColdFusion tag in your function definition. Therefore, you can create a function, for example, that accesses a database.
- You can embed CFScript code inside the function definition.
- The `cffunction` tag provides attributes that enable you to easily limit the execution of the tag to authorized users or specify how the function can be accessed.

The following code uses the `cffunction` tag to define the exponentiation function:

```cfml
<cffunction name="twoPower" output=True>
    <cfargument name="exponent">
    <cfreturn 2^exponent>
</cffunction>
```

For more information on how to use the `cffunction` tag to define a function, see “Defining functions by using the `cffunction` tag” on page 137.

**Defining functions by using the `cffunction` tag**

The `cffunction` and `cfargument` tags let you define functions in CFML without using CFScript.

For information on ColdFusion components, see “Building and Using ColdFusion Components” on page 158. For more information on the `cffunction` tag, see the [CFML Reference](#).

**The `cffunction` tag function definition format**

A `cffunction` tag function definition has the following format:

```cfml
<cffunction name="functionName" [returnType="type" roles="roleList" access="accessType" output="Boolean"]>
    <cfargument name="argumentName" [Type="type" required="Boolean" default="defaultValue"]>
    <!--- Function body code goes here. --->
    <cfreturn expression>
</cffunction>
```

where square brackets ([ ]) indicate optional arguments. You can have any number of `cfargument` tags.

The `cffunction` tag specifies the name you use when you call the function. You can optionally specify other function characteristics, as the following table describes:
You must use `cfargument` tags for required function arguments. All `cfargument` tags must precede any other CFML code in a `cffunction` tag body. Therefore, put the `cfargument` tags immediately following the `cffunction` opening tag. The `cfargument` tag takes the following attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>The argument name.</td>
</tr>
<tr>
<td>type</td>
<td>(Optional) The data type of the argument. The type of data that is passed to the function. The valid standard type names are: any, array, binary, boolean, date, guid, numeric, query, string, struct, uuid, and variableName. If you specify any other name, ColdFusion requires the argument to be a ColdFusion component with that name. ColdFusion throws an error if you specify this attribute and the function is called with data of a type that ColdFusion cannot automatically convert to the one you specified. For example, if the argument type attribute is numeric, you cannot call the function with an array.</td>
</tr>
<tr>
<td>required</td>
<td>(Optional) A Boolean value that specifies whether the argument is required. If set to <code>true</code> and the argument is omitted from the function call, ColdFusion throws an error. The default value is <code>false</code>. The required attribute is not required if you specify a default attribute. Because you do not identify arguments when you call a function, all <code>cfargument</code> tags that specify required arguments must precede any <code>cfargument</code> tags that specify optional arguments in the <code>cffunction</code> definition.</td>
</tr>
<tr>
<td>default</td>
<td>(Optional) The default value for an optional argument if no argument value is passed. If you specify this attribute, ColdFusion ignores the <code>required</code> attribute.</td>
</tr>
</tbody>
</table>

**Note:** The `cfargument` tag is not required for optional arguments. This feature is useful if a function can take an indeterminate number of arguments. If you do not use the `cfargument` tag for an optional argument, reference it by using its position in the Arguments scope array. For more information see “Using the Arguments scope as an array” on page 143.
Using a CFML tag in a user-defined function

The most important advantage of using the `cffunction` tag over defining a function in CFScript is that you can include CFML tags in the function. Thus, UDFs can encapsulate activities, such as database lookups, that require ColdFusion tags. Also, you can use the `cfoutput` tag to display output on the calling page with minimal coding.

**Note:** To improve performance, avoid using the `cfparam` tag in ColdFusion functions. Instead, use the `cfset` tag.

The following example function looks up and returns an employee's department ID. It takes one argument, the employee ID, and looks up the corresponding department ID in the cfdocexamples Employee table:

```cfdml
<cffunction name="getDeptID" >
  <cfargument name="empID" required="true" type="numeric"/>
  <cfset var cfdocexamples="">
  <cfquery dataSource="cfdocexamples" name="deptID">
    SELECT Dept_ID
    FROM Employee
    WHERE Emp_ID = #empID#
  </cfquery>
  <cfreturn deptID.Dept_ID>
</cffunction>
```

**Rules for function definitions**

The following rules apply to functions that you define using CFScript or the `cffunction` tag:

- The function name must be unique. It must be different from any existing variable, UDF, or built-in function name, except you can use the ColdFusion advanced security function names.
- The function name must not start with the letters `cf` in any form. (For example, CF_MyFunction, cfmyFunction, and cfxMyFunction are not valid UDF names.)
- You cannot redefine or overload a function. If a function definition is active, ColdFusion generates an error if you define a second function with the same name.
- You cannot nest function definitions; that is, you cannot define one function inside another function definition.
- The function can be recursive, that is, the function definition body can call the function.
- The function does not have to return a value.

You can use tags or CFScript to create a UDF. Each technique has advantages and disadvantages.

**Calling user-defined functions**

You can call a function anywhere that you can use an expression, including in number signs (#) in a `cfoutput` tag, in a CFScript, or in a tag attribute value. One function can call another function, and you can use a function as an argument to another function.

You can call a UDF in two ways:

- With unnamed, positional arguments, as you would call a built-in function
- With named arguments, as you would use attributes in a tag

You can use either technique for any function. However, if you use named arguments, you must use the same argument names to call the function as you use to define the function. You cannot call a function with a mixture of named and unnamed arguments.
One example of a user-defined function is a TotalInterest function that calculates loan payments based on a principal amount, annual percentage, and loan duration in months. (For this function's definition, see "A user-defined function example" on page 152). You might call the function without argument names on a form's action page, as follows:

```cfoutput>
  Interest: #TotalInterest(Form.Principal, Form.Percent, Form.Months)#
</cfoutput>
```

You might call the function with argument names, as follows:

```cfoutput>
Interest: #TotalInterest(principal=Form.Principal, annualPercent=Form.Percent, months=Form.Months)#
</cfoutput>
```

## Working with arguments and variables in functions

### Good argument naming practice

An argument's name should represent its use. For example, the following code is unlikely to result in confusion:

```cfscript>
  function SumN(Addend1, Addend2)
    { return Addend1 + Addend2; }
</cfscript>
<cfset x = 10>
<cfset y = 12>
<cfoutput>#SumN(x,y)#</cfoutput>
```

The following, similar code is more likely to result in programming errors:

```cfscript>
  function SumN(x, y)
    { return x + y; }
</cfscript>
<cfset x = 10>
<cfset y = 12>
<cfoutput>#SumN(x, y)#</cfoutput>
```

### Passing arguments

ColdFusion passes the following data types to the function by value:

- Integers
- Real numbers
- Strings (including lists)
- Date-time objects
- Arrays

As a result, any changes that you make in the function to these arguments do not affect the variable that was used to call the function, even if the calling code is on the same ColdFusion page as the function definition.

ColdFusion passes queries, structures, and external objects such as COM objects into the function by reference. As a result, any changes to these arguments in the function also change the value of the variable in the calling code.
For an example of the effects of passing arguments, see "Passing complex data" on page 141.

**Passing complex data**

Structures, queries, and complex objects such as COM objects are passed to UDFs by reference, so the function uses the same copy of the data as the caller. Arrays are passed to user-defined functions by value, so the function gets a new copy of the array data and the array in the calling page is unchanged by the function. As a result, you must handle arrays differently from all other complex data types.

**Passing structures, queries, and objects**

For your function to modify the caller's copy of a structure, query, or object, you must pass the variable as an argument. Because the function gets a reference to the caller's structure, the caller variable reflects all changes in the function. You do not have to return the structure to the caller. After the function returns, the calling page accesses the changed data by using the structure variable that it passed to the function.

If you do not want a function to modify the caller's copy of a structure, query, or object, use the `Duplicate` function to make a copy and pass the copy to the function.

**Passing arrays**

If you want your function to modify the caller's copy of the array, the simplest solution is to pass the array to the function and return the changed array to the caller in the function `return` statement. In the caller, use the same variable name in the function argument and return variable.

The following example shows how to directly pass and return arrays. In this example, the `doubleOneDArray` function doubles the value of each element in a one-dimensional array.

```cfscript
//Initialize some variables
//This creates a simple array.
a=ArrayNew(1);
a[1]=2;
a[2]=22;
//Define the function.
function doubleOneDArray(OneDArray) {
    var i = 0;
    for ( i = 1; i LE arrayLen(OneDArray); i = i + 1)
    { OneDArray[i] = OneDArray[i] * 2; }
    return OneDArray;
}
//Call the function.
a = doubleOneDArray(a);
</cfscript>
<cfdump var="#a#">

This solution is simple, but it is not always optimal:

- This technique requires ColdFusion to copy the entire array twice, once when you call the function and once when the function returns. This is inefficient for large arrays and can reduce performance, particularly if the function is called frequently.
- You can use the return value for other purposes, such as a status variable.

If you do not use the `return` statement to return the array to the caller, you can pass the array as an element in a structure and change the array values inside the structure. Then the calling page can access the changed data by using the structure variable it passed to the UDF.
The following code shows how to rewrite the previous example using an array in a structure. It returns True as a status indicator to the calling page and uses the structure to pass the array data back to the calling page.

```cfscript
<cfscript>
//Initialize some variables.
//This creates an simple array as an element in a structure.
arrayStruct=StructNew();
arrayStruct.Array=ArrayNew(1);
arrayStruct.Array[1]=2;
//Define the function.
function doubleOneDArrayS(OneDArrayStruct) {
    var i = 0;
    for ( i = 1; i LE arrayLen(OneDArrayStruct.Array); i = i + 1)
    { OneDArrayStruct.Array[i] = OneDArrayStruct.Array[i] * 2; }
    return True;
}
//Call the function.
Status = doubleOneDArrayS(arrayStruct);
WriteOutput("Status: " & Status);
</cfscript>
</br>
<cfdump var="#arrayStruct#">
You must use the same structure element name for the array (in this case Array) in the calling page and the function.

### About the Arguments scope

All function arguments exist in their own scope, the Arguments scope.

The Arguments scope exists for the life of a function call. When the function returns, the scope and its variables are destroyed.

However, destroying the Argument scope does not destroy variables, such as structures or query objects, that ColdFusion passes to the function by reference. The variables on the calling page that you use as function arguments continue to exist; if the function changes the argument value, the variable in the calling page reflects the changed value.

The Arguments scope is special, in that you can treat the scope as either an array or a structure. This dual nature of the Arguments scope is useful because it makes it easy to use arguments in any of the following circumstances:

- You define the function using CFCScript.
- You define the function using the `cffunction` tag.
- You pass arguments using argument name=value format.
- You pass arguments as values only.
- The function takes optional, undeclared arguments.

The following sections describe the general rules for using the Arguments scope as an array and a structure. For more information on using the Arguments scope in functions defined using CFCScript, see "Using the Arguments scope in CFCScript" on page 145. For more information on using the Arguments scope in functions defined using the `cffunction` tag, see "Using the Arguments scope in cffunction definitions" on page 145.

### The contents of the Arguments scope

The following rules apply to the Arguments scope and its contents:

- The scope contains all the arguments passed into a function.
- If you use `cffunction` to define the function, the scope always contains an entry “slot” for each declared argument, even if you do not pass the argument to the function when you call it. If you do not pass a declared (optional) argument, the `scope` entry for that argument is empty.

  When you call a function that you defined using CFScript, you must pass the function a value for each argument declared in the function definition. Therefore, the Arguments scope for a CFScript call does not have empty slots.

The following example shows these rules. Assume that you have a function declared, as follows:

```html
<cffunction name="TestFunction">
  <cfargument name="Arg1">
  <cfargument name="Arg2">
</cffunction>
```

You can call this function with a single argument, as in the following line:

```html
<cfset TestFunction(1)>
```

The resulting Arguments scope looks like the following:

<table>
<thead>
<tr>
<th>As an array</th>
<th>As a structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry</td>
<td>Value</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>undefined</td>
</tr>
</tbody>
</table>

In this example, the following functions return the value 2 because there are two defined arguments:

- `ArrayLen(Arguments)`
- `StructCount(Arguments)`

However, the following tests return the value `false`, because the contents of the second element in the Arguments scope is undefined.

- `IsDefined("Arguments.Arg2")`
- `testArg2 = Arguments[2]`
- `IsDefined("testArg2")`

**Note:** The `IsDefined` function does not test the existence of array elements. Instead, put any code that might try to access an undefined array element in a try block and use a catch block to handle exceptions that arise if elements do not exist.

**Using the Arguments scope as an array**

The following rules apply to referencing Arguments scope as an array:

- If you call the function using unnamed arguments, the array index is the position of the argument in the function call.
- If you use names to pass the arguments, the array indexes correspond to the order in which the arguments are declared in the function definition.
- If you use names to pass arguments, and do not pass all the arguments defined in the function, the Arguments array has an empty entry at the index corresponding to the argument that was not passed. This rule applies only to functions created using the `cffunction` tag.
- If you use a name to pass an optional argument that is not declared in the function definition, the array index of the argument is the sum of the following:
a. The number of arguments defined with names in the function.

b. The position of the optional argument among the arguments passed in that do not have names defined in the function.

However, using argument names in this manner is not good programming practice because you cannot ensure that you always use the same optional argument names when calling the function.

To demonstrate these rules, define a simple function that displays the contents of its Arguments array and call the function with various argument combinations, as the following example shows:

```cfml
cffunction name="TestFunction" >
    <cfargument name="Arg1">
    <cfargument name="Arg2">
    <cfloop index="i" from="1" to="#ArrayLen(Arguments)#">
        <cfoutput>Argument #i#: #Arguments[i]#<br></cfoutput>
    </cfloop>
</cffunction>

<strong>One Unnamed argument</strong><br>
cfset TestFunction(1)>
<strong>Two Unnamed arguments</strong><br>
cfset TestFunction(1, 2)>
<strong>Three Unnamed arguments</strong><br>
cfset TestFunction(1, 2, 3)>
<strong>Arg1:</strong><br>
cfset TestFunction(Arg1=8)>
<strong>Arg2:</strong><br>
cfset TestFunction(Arg2=9)>
<strong>Arg1=8, Arg2=9:</strong><br>
cfset TestFunction(Arg1=8, Arg2=9)>
<strong>Arg2=6, Arg1=7:</strong><br>
cfset TestFunction(Arg2=6, Arg1=7)>
<strong>Arg1=8, Arg2=9, Arg3=10:</strong><br>
cfset TestFunction(Arg1=8, Arg2=9, Arg3=10)>
<strong>Arg2=6, Arg3=99, Arg1=7:</strong><br>
cfset TestFunction(Arg2=6, Arg3=99, Arg1=7)>
<note>
Although you can use the Arguments scope as an array, the <i>IsArray(Arguments)</i> function always returns false and the cfdump tag displays the scope as a structure.
</note>

Using the Arguments scope as a structure
The following rule applies when referencing Arguments scope as a structure:

- Use the argument names as structure keys. For example, if your function definition includes a Principal argument, refer to the argument as Arguments.Principal.

The following rules are also true, but avoid writing code that uses them. To ensure program clarity, only use the Arguments structure for arguments that you name in the function definition. Use the Arguments scope as an array for optional arguments that you do not declare in the function definition.

- If the function can take unnamed optional arguments, use array notation to reference the unnamed arguments. For example, if the function declaration includes two named arguments and you call the function with three arguments, refer to the third argument as Arguments[3]. To determine if an unnamed optional argument exists, use the StructKeyExists function; for example, structKeyExists(Arguments,"3").
• If you do not name an optional argument in the function definition, but do use a name for it in the function call, use the name specified in the function call. For example, if you have an unnamed optional argument and call the function using the name myOptArg for the argument, you can refer to the argument as Arguments.myOptArg in the function body. This usage, however, is poor programming practice, as it makes the function definition contents depend on variable names in the code that calls the function.

Using the Arguments scope in CFScript

A function can have optional arguments that you do not have to specify when you call the function. To determine the number of arguments passed to the function, use the following function:

\[
\text{ArrayLen(Arguments)}
\]

When you define a function using CFScript, the function must use the Arguments scope to retrieve the optional arguments. For example, the following SumN function adds two or more numbers together. It requires two arguments and supports any number of additional optional arguments. You can refer to the first two, required, arguments as Arg1 and Arg2 or as Arguments[1] and Arguments[2]. You must refer to the third, fourth, and any additional optional arguments as Arguments[3], Arguments[4], and so on.

\[
\text{function SumN(Arg1,Arg2) }
\]

\[
\text{var arg_count = ArrayLen(Arguments);} \\
\text{var sum = 0;} \\
\text{var i = 0;} \\
\text{for( i = 1 ; i LTE arg_count; i = i + 1 ) } \\
\{ \\
\quad \text{sum = sum + Arguments[i]; } \\
\} \\
\text{return sum; }
\]

With this function, any of the following function calls are valid:

\[
\text{SumN(Value1, Value2)} \\
\text{SumN(Value1, Value2, Value3)} \\
\text{SumN(Value1, Value2, Value3, Value4)} \\
\]

and so on.

The code never uses the Arg1 and Arg2 argument variables directly, because their values are always the first two elements in the Arguments array and it is simpler to step through the array. Specifying Arg1 and Arg2 in the function definition ensures that ColdFusion generates an error if you pass the function one or no arguments.

\textbf{Note:} Avoid referring to a required argument in the body of a function by both the argument name and its place in the Arguments scope array or structure, as this can be confusing and makes it easier to introduce errors.

For more information on the Arguments scope, see "About the Arguments scope" on page 142.

Using the Arguments scope in cffunction definitions

When you define a function using the cffunction tag, you generally refer to the arguments directly by name if all arguments are named in the cfargument tags. If you do use the Arguments scope identifier, follow the rules listed in "About the Arguments scope" on page 142.

Function-only variables

In addition to the Arguments scope, each function can have a number of variables that exist only inside the function, and are not saved between times the function gets called. As soon as the function exits, all the variables in this scope are removed.
In CFScript, you create function-only variables with the `var` statement. Unlike other variables, you never prefix function-only variables with a scope name.

**Using function-only variables**

Make sure to use the `var` statement in CFScript UDFs to declare all function-specific variables, such as loop indexes and temporary variables that are required only for the duration of the function call. Doing this ensures that these variables are available inside the function only, and makes sure that the variable names do not conflict with the names of variables in other scopes. If the calling page has variables of the same name, the two variables are independent and do not affect each other.

For example, if a ColdFusion page has a `cfloop` tag with an index variable `i`, and the tag body calls a CFScript UDF that also has a loop with a function-only index variable `i`, the UDF does not change the value of the calling page loop index, and the calling page does not change the UDF index. So you can safely call the function inside the `cfloop` tag body.

In general, use the `var` statement to declare all UDF variables, other than the function arguments or shared-scope variables, that you use only inside CFScript functions. Use another scope, however, if the value of the variable must persist between function calls; for example, for a counter that the function increments each time it is called.

**Referencing caller variables**

A function can use and change any variable that is available in the calling page, including variables in the caller's Variables (local) scope, as if the function was part of the calling page. For example, if you know that the calling page has a local variable called `Customer_name` (and there is no function scope variable named `Customer_name`) the function can read and change the variable by referring to it as `Customer_name` or (using better coding practice) `Variables.Customer_name`. Similarly, you can create a local variable inside a function and then refer to it anywhere in the calling page after the function call. You cannot refer to the variable before you call the function.

However, you should generally avoid using the caller's variables directly inside a function. Using the caller's variables creates a dependency on the caller. You must always ensure that the code outside the function uses the same variable names as the function. This can become difficult if you call the function from many pages.

You can avoid these problems by using only the function arguments and the return value to pass data between the caller and the function. Do not reference calling page variables directly in the function. As a result, you can use the function anywhere in an application (or even in multiple applications), without concern for the calling code's variables.

As with many programming practice, there are valid exceptions to this recommendation. For example you might do any of the following:

- Use a shared scope variable, such as an Application or Session scope counter variable.
- Use the Request scope to store variables used in the function. For more information, see "Using the Request scope for static variables and constants" on page 154.
- Create context-specific functions that work directly with caller data if you always synchronize variable names.

*Note:* If your function must directly change a simple variable in the caller (one that is not passed to the function by reference), you can place the variable inside a structure argument.

**Using arguments**

Function arguments can have the same names, but different values, as variables in the caller. Avoid such uses for clarity, however.
The following rules apply to argument persistence:

- Because simple variable and array arguments are passed by value, their names and values exist only while the function executes.
- Because structures, queries, and objects such as COM objects are passed by reference, the argument name exists only while the function executes, but the underlying data persists after the function returns and can be accessed by using the caller's variable name. The caller's variable name and the argument name can, and should, be different.

**Note:** If a function must use a variable from another scope that has the same name as a function-only variable, prefix the external variable with its scope identifier, such as Variables or Form. (However, remember that using variables from other scopes directly in your code is often poor practice.)

### Handling errors in UDFs

This section discusses the following topics:

- Displaying error messages directly in the function
- Returning function status information to the calling page
- Using try/catch or cftry/cfcatch blocks and the cfthrow and cfrethrow tags to handle and generate exceptions

The technique you use depends on the circumstances of your function and application and on your preferred programming style. However, most functions should use the second or third technique, or a combination of the two. The following sections discuss the uses, advantages, and disadvantages of each technique, and provide examples of their use.

#### Displaying error messages

Your function can test for errors and use the WriteOutput function to display an error message directly to the user. This method is particularly useful for providing immediate feedback to users for simple input errors. You can use it independently or in conjunction with either of the other two error-handling methods.

For example, the following variation on a “Hello world” function displays an error message if you do not enter a name in the form:

```cfc
<cfform method="POST" action="#CGI.script_name#">
    <p>Enter your Name:&nbsp;</p>
    <input name="name" type="text" hspace="30" maxlength="30">
    <input type="Submit" name="submit" value="OK">
</cfform>
<cfscript>
    function HelloFriend(Name) {
        if (Name is "") WriteOutput("You forgot your name!");
        else WriteOutput("Hello " & name &"!");
        return "";
    }
    if (IsDefined("Form.submit")) HelloFriend(Form.name);
</cfscript>
```

**Reviewing the code**

The following table describes the code:
Providing status information

In some cases, such as those where the function cannot provide a corrective action, the function cannot, or should not, handle the error directly. In these cases, your function can return information to the calling page. The calling page must handle the error information and act appropriately.

Consider the following mechanisms for providing status information:

• Use the return value to indicate the function status only. The return value can be a Boolean success/failure indicator. The return value can also be a status code, for example where 1 indicates success, and various failure types are assigned known numbers. With this method, the function must set a variable in the caller to the value of a successful result.

• Set a status variable that is available to the caller (not the return variable) to indicate success or failure and any information about the failure. With this method, the function can return the result directly to the caller. In this method, the function should use only the return value and structure arguments to pass the status back to the caller.

Each of these methods can have variants, and each has advantages and disadvantages. The technique that you use should depend on the type of function, the application in which you use it, and your coding style.

The following example, which modifies the function used in “A user-defined function example” on page 152, uses one version of the status variable method. It provides two forms of error information:

• It returns -1, instead of an interest value, if it encounters an error. This value can serve as an error indicator because you never pay negative interest on a loan.

• It also writes an error message to a structure that contains an error description variable. Because the message is in a structure, it is available to both the calling page and the function.

The TotalInterest function

After changes to handle errors, the TotalInterest function looks like the following. Code that is changed from the example in “A user-defined function example” on page 152 is in bold.

<cfscript>
function TotalInterest(principal, annualPercent, months, status) {
  Var years = 0;
  Var interestRate = 0;
</cfscript>
Var totalInterest = 0;
principal = trim(principal);
principal = REReplace(principal,"[\$,.\"]","","ALL");
annualPercent = Replace(annualPercent, ":%", "","ALL");
if ((principal LE 0) OR (annualPercent LE 0) OR (months LE 0)) {
    Status.errorMsg = "All values must be greater than 0";
    Return -1;
}
interestRate = annualPercent / 100;
years = months / 12;
totalInterest = principal*(((1 + interestRate)^years)-1);
Return DollarFormat(totalInterest);
</cfscript>

Reviewing the code
The following table describes the code that has been changed or added to the previous version of this example. For a description of the initial code, see “A user-defined function example” on page 152.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>function TotalInterest(principal, annualPercent, months, status)</td>
<td>The function now takes an additional argument, a status structure. Uses a structure for the status variable so that changes that the function makes affect the status structure in the caller.</td>
</tr>
<tr>
<td>if ((principal LE 0) OR (annualPercent LE 0) OR (months LE 0)) {</td>
<td>Checks to make sure the principal, percent rate, and duration are all greater than zero. If any is not, sets the errorMsg key (the only key) in the Status structure to a descriptive string. Also, returns -1 to the caller and exits the function without processing further.</td>
</tr>
<tr>
<td>Status.errorMsg = &quot;All values must be greater than 0&quot;;</td>
<td></td>
</tr>
<tr>
<td>Return -1;</td>
<td></td>
</tr>
</tbody>
</table>

Calling the function
The code that calls the function now looks like the following. Code that is changed from the example in “A user-defined function example” on page 152 is in bold.

```cfscript
<cfset status = StructNew()>
<cfset myInterest = TotalInterest(Form.Principal,
    Form.AnnualPercent, Form.Months, status)>
<cfif myInterest EQ -1>
  <cfoutput>
    ERROR: #status.errorMsg#<br>
  </cfoutput>
<cfelse>
  <cfoutput>
    Loan amount: #Form.Principal#<br>
    Annual percentage rate: #Form.AnnualPercent#<br>
    Loan duration: #Form.Months# months<br>
    TOTAL INTEREST: #myInterest#<br>
  </cfoutput>
</cfif>
</cfoutput>
```

Reviewing the code
The following table describes the code that has been changed or added:
Using exceptions

UDFs written in CFScript can handle exceptions using the try and catch statements. UDFs written using the cffunction tag can use the cftry, cfcatch, cfthrow, and cfrethrow tags. Using exceptions corresponds to the way many functions in other programming languages handle errors, and can be an effective way to handle errors. In particular, it separates the functional code from the error-handling code, and it can be more efficient than other methods at runtime, because it does not require testing and branching.

Exceptions in UDFs have the following two dimensions:

- Handling exceptions generated by running the UDF code
- Generating exceptions when the UDF identifies invalid data or other conditions that would cause errors if processing continued

Handling exceptions in UDFs

A UDF should use try/catch blocks to handle exceptions in the same conditions that any other ColdFusion application uses try/catch blocks. These are typically circumstances where the function uses an external resource, such as a Java, COM, or CORBA object, a database, or a file. When possible, your application should prevent, rather than catch, exceptions caused by invalid application data. For example, the application should prevent users from entering a zero value for a form field that is used to divide another number, rather than handling exceptions generated by dividing by zero.

When ColdFusion catches an exception, the function can use any of the following methods to handle the exception:

- If the error is recoverable (for example, if the problem is a database time-out where a retry might resolve the issue), try to recover from the problem.
- Display a message, as described in “Displaying error messages” on page 147.
- Return an error status, as described in “Providing status information” on page 148.
- If the UDF is defined using the cffunction tag, throw a custom exception, or rethrow the exception so that it will be caught by the calling ColdFusion page. For more information on throwing and rethrowing exceptions, see “Handling runtime exceptions with ColdFusion tags” on page 258.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfset status = StructNew()&gt;</code></td>
<td>Creates a structure to hold the function status.</td>
</tr>
<tr>
<td><code>&lt;cfset myInterest = TotalInterest (Form.Principal, Form.AnnualPercent, Form.Months, status)&gt;</code></td>
<td>Calls the function. This time, the function requires four arguments, including the status variable.</td>
</tr>
<tr>
<td><code>&lt;cfif myInterest EQ -1&gt; &lt;cfoutput&gt; ERROR: #status.errorMsg#&lt;br&gt; &lt;/cfoutput&gt;</code></td>
<td>If the function returns -1, there must be an error. Displays the message that the function placed in the status.errorMsg structure key.</td>
</tr>
<tr>
<td><code>&lt;cfelse&gt; &lt;cfoutput&gt; Loan amount: #Form.Principal#&lt;br&gt; Annual percentage rate: #Form.AnnualPercent#&lt;br&gt; Loan duration: #Form.Months# months&lt;br&gt; TOTAL INTEREST: #myInterest#&lt;br&gt; &lt;/cfoutput&gt; &lt;/cfif&gt;</code></td>
<td>If the function does not return -1, it returns an interest value. Displays the input values and the function return value.</td>
</tr>
</tbody>
</table>
Generating exceptions in UDFs

If you define your function using the `cffunction` tag, you can use the `cfthrow` and `cfrethrow` tags to throw errors to the page that called the function. You can use this technique whenever your UDF identifies an error, instead of displaying a message or returning an error status. For example, the following code rewrites the example from "Providing status information" on page 148 to use the `cffunction` tag and CFML, and to throw and handle an exception if any of the form values are not positive numbers.

The lines that identify invalid data and throw the exception are in bold. The remaining lines are equivalent to the CFScript code in the previous example. However, the code that removes unwanted characters must precede the error checking code.

```cfml
<cffunction name="TotalInterest">
   <cfargument name="principal" required="Yes">
   <cfargument name="annualPercent" required="Yes">
   <cfargument name="months" required="Yes">
   <cfset var years = 0>
   <cfset var interestRate = 0>
   <cfset var totalInterest = 0>

   <cfset principal = trim(principal)>
   <cfset principal = REReplace(principal, "$", "", "ALL")>
   <cfset annualPercent = Replace(annualPercent, ",", ",ALL")>

   <cfif ((principal LE 0) OR (annualPercent LE 0) OR (months LE 0))>
      <cfthrow type="InvalidData" message="All values must be greater than 0.">
   </cfif>

   <cfset interestRate = annualPercent / 100>
   <cfset years = months / 12>
   <cfset totalInterest = principal * ((1 + interestRate)^years - 1)>
   <cfreturn DollarFormat(totalInterest)>
</cffunction>
```

The code that calls the function and handles the exception looks like the following. The changed lines are in bold.

```cfml
<cftry>
   <cfset status = StructNew()>
   <cfset myInterest = TotalInterest(Form.Principal, Form.AnnualPercent, Form.Months, status)>
   <cfoutput>
      Loan amount: #Form.Principal#<br>
      Annual percentage rate: #Form.AnnualPercent#<br>
      Loan duration: #Form.Months# months<br>
      TOTAL INTEREST: #myInterest#
   </cfoutput>
</cftry>
```

```cfml
<cfcatch type="InvalidData">
   <cfoutput>
      #cfcatch.message#<br>
   </cfoutput>
</cfcatch>
```

</cftry>
A user-defined function example

The following simple function takes a principal amount, an annual percentage rate, and a loan duration in months and returns the total amount of interest to be paid over the period. You can optionally use the percent sign for the percentage rate, and include the dollar sign and comma separators for the principal amount.

You could use the TotalInterest function in a cfoutput tag of a form's action page, as follows:

```cfoutput>
    Loan amount: #Form.Principal#<br>
    Annual percentage rate: #Form.AnnualPercent#<br>
    Loan duration: #Form.Months# months<br>
    TOTAL INTEREST: #TotalInterest(Form.Principal, Form.AnnualPercent, Form.Months)#<br>
</cfoutput>
```

Defining the function using CFScript

```cfscript>
function TotalInterest(principal, annualPercent, months) {
    Var years = 0;
    Var interestRate = 0;
    Var totalInterest = 0;
    principal = trim(principal);
    principal = REReplace(principal,"\[\$,\]","","ALL");
    annualPercent = Replace(annualPercent,"\%","","ALL");
    interestRate = annualPercent / 100;
    years = months / 12;
    totalInterest = principal*(((1 + interestRate)^years)-1);
    Return DollarFormat(totalInterest);
}
</cfscript>
```

Reviewing the code

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>function TotalInterest(principal, annualPercent, months) {</td>
<td>Starts the TotalInterest function definition. Requires three variables: the principal amount, the annual percentage rate, and the loan duration in months.</td>
</tr>
<tr>
<td>Var years = 0;</td>
<td>Declares intermediate variables used in the function and initializes them to 0. All var statements must precede the rest of the function code.</td>
</tr>
<tr>
<td>Var interestRate = 0;</td>
<td></td>
</tr>
<tr>
<td>Var totalInterest = 0;</td>
<td></td>
</tr>
<tr>
<td>principal = trim(principal);</td>
<td>Removes any leading or trailing spaces from the principal argument.</td>
</tr>
<tr>
<td>principal = REReplace(principal,&quot;[$,]&quot;,&quot;&quot;,&quot;ALL&quot;);</td>
<td>Removes any dollar sign ($) and comma (,) characters from the principal argument to get a numeric value.</td>
</tr>
<tr>
<td>annualPercent = Replace(annualPercent,&quot;%&quot;,&quot;&quot;,&quot;ALL&quot;);</td>
<td>Removes any percent (%) character from the annualPercent argument to get a numeric value, then divides the percentage value by 100 to get the interest rate.</td>
</tr>
<tr>
<td>interestRate = annualPercent / 100;</td>
<td>Converts the loan from months to years.</td>
</tr>
<tr>
<td>years = months / 12;</td>
<td></td>
</tr>
<tr>
<td>totalInterest = principal*(((1 + interestRate)^years)-1);</td>
<td>Calculates the total amount of interest due. It is possible to calculate the value in the Return statement, but this example uses an intermediate totalInterest variable to make the code easier to read.</td>
</tr>
<tr>
<td>Return DollarFormat(totalInterest);</td>
<td>Returns the result formatted as a US currency string.</td>
</tr>
<tr>
<td>}</td>
<td>Ends the function definition.</td>
</tr>
</tbody>
</table>
Defining the function using the `cffunction` tag

The following code replaces CFScript statements with their equivalent CFML tags.

```
<cffunction name="TotalInterest">
  <cfargument name="principal" required="Yes">
  <cfargument name="annualPercent" required="Yes">
  <cfargument name="months" required="Yes">
  <cfset var years = 0>
  <cfset var interestRate = 0>
  <cfset var totalInterest = 0>
  <cfset principal = trim(principal)>
  <cfset principal = REReplace(principal, "\[\$,\],","ALL")>
  <cfset annualPercent = Replace(annualPercent, "%","ALL")>
  <cfset interestRate = annualPercent / 100>
  <cfset years = months / 12>
  <cfset totalInterest = principal*
     (((1+ interestRate)^years)-1)>  
  <cfreturn DollarFormat(totalInterest)>
</cffunction>
```

Using UDFs effectively

This section provides information that will help you use user-defined functions more effectively.

Using functions in ColdFusion component

In many cases, the most effective use of UDFs is within a CFC. For more information on CFCs, see “Building and Using ColdFusion Components” on page 158.

Using Application.cfm and function include files

Consider the following techniques for making your functions available to your ColdFusion pages:

- If you consistently call a small number of UDFs, consider putting their definitions on the Application.cfm page.
- If you call UDFs in only a few of your application pages, do not include their definitions in Application.cfm.
- If you use many UDFs, put their definitions on one or more ColdFusion pages that contain only UDFs. You can include the UDF definition page in any page that calls the UDFs.

The next section describes other techniques for making UDFs available to your ColdFusion pages.

Specifying the scope of a function

User-defined function names are essentially ColdFusion variables. ColdFusion variables are names for data. Function names are names (references) for segments of CFML code. Therefore, like variables, functions belong to scopes.

About functions and scopes

Like ColdFusion variables, UDFs exist in a scope:

- When you define a UDF, ColdFusion puts it in the Variables scope.
- You can assign a UDF to a scope the same way you assign a variable to a scope, by assigning the function to a name in the new scope. For example, the following line assigns the MyFunc UDF to the Request scope:
<cfset Request.MyFunc = Variables.MyFunc>
You can now use the function from any page in the Request scope by calling Request.MyFunc.

Selecting a function scope
The following table describes the advantages and disadvantages of scopes that you might considering using for your functions:

<table>
<thead>
<tr>
<th>Scope</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Makes the function available across all invocations of the application. Access to UDFs in Application scope is multi-threaded and you can execute multiple copies of the UDF at one time.</td>
</tr>
<tr>
<td>Request</td>
<td>Makes the function available for the life of the current HTTP request, including in all custom tags and nested custom tags. This scope is useful if a function is used in a page and in the custom tags it calls, or in nested custom tags.</td>
</tr>
<tr>
<td>Server</td>
<td>Makes the function available to all pages on a single server. In most cases, this scope is not a good choice because in clustered systems, it only makes the function available on a single server, and all code that uses the function must be inside a cflock block.</td>
</tr>
<tr>
<td>Session</td>
<td>Makes the function available to all pages during the current user session. This scope has no significant advantages over the Application scope.</td>
</tr>
</tbody>
</table>

Using the Request scope
You can effectively manage functions that are used in application pages and custom tags by doing the following:

1. Define the functions on a function definitions page.
2. On the functions page, assign the functions to the request scope.
3. Use a cfinclude tag to include the function definition page on the application page, but do not include it on any custom tag pages.
4. Always call the functions using the request scope.

This way you only need to include the functions once per request and they are available throughout the life of the request. For example, create a myFuncs.cfm page that defines your functions and assigns them to the Request scope using syntax such as the following:

```coldfusion
function MyFunc1(Argument1, Argument2)
{ Function definition goes here }
Request.MyFunc1 = MyFunc1
```

The application page includes the myFuncs.cfm page:

```coldfusion
<cfinclude template="myfuncs.cfm">
```

The application page and all custom tags (and nested custom tags) call the functions as follows:

```coldfusion
Request.MyFunc1(Value1, Value2)
```

Using the Request scope for static variables and constants
This section describes how to partially break the rule described in the section “Referencing caller variables” on page 146. Here, the function defines variables in the Request scope. However, it is a specific solution to a specific issue, where the following circumstances exist:

- Your function initializes a large number of variables.
- The variables have either of the following characteristics:
  - They must be static: they are used only in the function, the function can change their values, and their values must persist from one invocation of the function to the next.
• They are named constants; that is the variable value never changes.
• Your application page (and any custom tags) calls the function multiple times.
• You can assure that the variable names are used only by the function.

In these circumstances, you can improve efficiency and save processing time by defining your function’s variables in the Request scope, rather than the Function scope. The function tests for the Request scope variables and initializes them if they do not exist. In subsequent calls, the variables exist and the function does not reset them.

The NumberAsString function, written by Ben Forta and available from www.cflib.org, takes advantage of this technique.

Using function names as function arguments

Because function names are ColdFusion variables, you can pass a function’s name as an argument to another function. This technique allows a function to use another function as a component. For example, a calling page can call a calculation function, and pass it the name of a function that does some subroutine of the overall function.

This way, the calling page could use a single function for different specific calculations, such as calculating different forms of interest. The initial function provides the framework, while the function whose name is passed to it can implement a specific algorithm that is required by the calling page.

The following simple example shows this use. The binop function is a generalized function that takes the name of a function that performs a specific binary operation and two operands. The binop function simply calls the specified function and passes it the operands. This code defines a single operation function, the sum function. A more complete implementation would define multiple binary operations.

<cfscript>
function binop(operation, operand1, operand2) { return (operation(operand1, operand2)); }
function sum(addend1, addend2) { return addend1 + addend2; }
x = binop(sum, 3, 5);
writeoutput(x);
</cfscript>

Handling query results using UDFs

When you call a UDF in the body of a tag that has a query attribute, such as a cfloop query=... tag, any function argument that is a query column name passes a single element of the column, not the entire column. Therefore, the function must manipulate a single query element.

For example, the following code defines a function to combine a single first name and last name to make a full name. It queries the cfdocexamples database to get the first and last names of all employees, and then it uses a cfoutput tag to loop through the query and call the function on each row in the query.

<cfscript>
function FullName(aFirstName, aLastName) { return aFirstName & " " & aLastName; }
</cfscript>
<cfform name="GetEmployees" datasource="cfdocexamples">  
  SELECT FirstName, LastName  
  FROM Employee  
</cfform>
<cfoutput query="GetEmployees">
You generally use functions that manipulate many rows of a query outside tags that loop over queries. Pass the query to the function and loop over it inside the function. For example, the following function changes text in a query column to uppercase. It takes a query name as an argument.

```coldfusion
function UCaseColumn(myquery, colName) {
    var currentRow = 1;
    for (; currentRow lte myquery.RecordCount; currentRow = currentRow + 1)
    {
        myquery[colName][currentRow] = UCase(myquery[colName][currentRow]);
    }
    Return "";
}
```

The following code uses a script that calls the `UCaseColumn` function to convert all the last names in the `GetEmployees` query to uppercase. It then uses `cfoutput` to loop over the query and display the contents of the column.

```coldfusion
<cfscript>
    UCaseColumn(GetEmployees, "LastName");
</cfscript>
<cfoutput query="GetEmployees">
    #LastName#<br>
</cfoutput>
```

### Identifying and checking for UDFs

You can use the `IsCustomFunction` function to determine whether a name represents a UDF. The `IsCustomFunction` function generates an error if its argument does not exist. As a result, you must ensure that the name exists before calling the function, for example, by calling the `IsDefined` function. The following code shows this use:

```coldfusion
<cfscript>
    if(IsDefined("MyFunc"))
    {
        if(IsCustomFunction(MyFunc))
        {
            WriteOutput("MyFunc is a user-defined function");
        }
        else
        {
            WriteOutput("Myfunc is defined but is NOT a user-defined function");
        }
    }
    else
    {
        WriteOutput("MyFunc is not defined");
    }
</cfscript>
```

You do **not** surround the argument to `IsCustomFunction` in quotation marks, so you can use this function to determine if function arguments are themselves functions.

### Using the Evaluate function

If your user-defined function uses the `Evaluate` function on arguments that contain strings, you must make sure that all variable names you use as arguments include the scope identifier. Doing so avoids conflicts with function-only variables.

The following example returns the result of evaluating its argument. It produces the expected results, the value of the argument, if you pass the argument using its fully scoped name, `Variables.myname`. However, the function returns the value of the function local variable if you pass the argument as `myname`, without the `Variables` scope identifier.

```coldfusion
<cfscript>
    myname = "globalName";
    function readname(name) {
```
Using recursion

A recursive function is a function that calls itself. Recursive functions are useful when a problem can be solved by an algorithm that repeats the same operation multiple times using the results of the preceding repetition. Factorial calculation, used in the following example, is one case where recursion is useful. The Towers of Hanoi game is also solved using a recursive algorithm.

A recursive function, like looping code, must have an end condition that always stops the function. Otherwise, the function will continue until a system error occurs or you stop the ColdFusion server.

The following example calculates the factorial of a number, that is, the product of all the integers from 1 through the number; for example, 4 factorial is $4 \times 3 \times 2 \times 1 = 24$.

```coldfusion
function Factorial(factor) {
  If (factor LTE 1)
    return 1;
  else
    return factor * Factorial(factor -1);
}
```

If the function is called with a number greater than 1, it calls itself using an argument one less than it received. It multiplies that result by the original argument, and returns the result. Therefore, the function keeps calling itself until the factor is reduced to 1. The final recursive call returns 1, and the preceding call returns $2 \times 1$, and so on until all the initial call returns the end result.

**Important:** If a recursive function calls itself too many times, it causes a stack overflow. Always test any recursive functions under conditions that are likely to cause the maximum number of recursions to ensure that they do not cause a stack overflow.
Chapter 10: Building and Using ColdFusion Components

A ColdFusion component (CFC) file contains data and functions that you define in related, multiple methods. You use CFC pages to organize related actions in one file, which provide can simplify your programming. For more information on creating applications that use CFCs, see the Adobe website: www.adobe.com.

About ColdFusion components

A ColdFusion component (CFC) is a file saved with the extension .cfc. A CFC can contain data and functions. Within a CFC, data is referred to as properties. Although you use the \texttt{cffunction} tag to define functions within a CFC, they are typically referred to as methods instead of functions.

The page on which you define a CFC is also known as a component page. Component pages use the same tags and functions that regular CFML pages do, plus a small number of special tags (in particular, the \texttt{cfcomponent} tag) and tag attributes.

You define related methods in a CFC. Unlike ColdFusion custom tags, a single CFC can perform many related actions, defined in multiple methods. The methods may share a data context, such as metadata and scoping, or manage a particular database or set of tables. For example, you can define the methods to insert, update, delete, and retrieve records from a particular database or table in one CFC.

CFCs and object-oriented programming

CFCs are building blocks that let you develop ColdFusion code in an object-oriented manner, although CFCs do not require you to do object-oriented programming. Some of the object-oriented features of CFCs include encapsulation, inheritance, and introspection. CFC object-oriented features are similar to the object-oriented elements in other languages, like JavaScript.

The technique of incorporating both code and data into one object such as a CFC is known as encapsulation. Encapsulation lets users pass data to and get a result from your CFC without having to understand the underlying code. When you use encapsulation, you can validate data that is passed to the CFC. CFCs can also enforce data types, check for required parameters, and optionally assign default values.

One CFC can inherit the methods and properties of another CFC. Inheritance lets you build multiple specific components without rewriting the code for the basic building blocks of the components. For more information, see “Using the Super keyword” on page 183.
CFCs support introspection; that is, they can provide information about themselves. If you display a component page directly in an HTML browser, inspect it in the ColdFusion and Adobe Dreamweaver CS3 component browsers, or use the CFML `GetMetadata` function, you see information about the component. This information includes its path, property, methods, and additional information that you can specify using special documentation attributes and tags. For more information, see "Using introspection to get information about components" on page 186.

When you use a ColdFusion component, you can simply invoke a method in the CFC. However, typically, you create an instance of the CFC, and then invoke methods and refer to properties of the CFC.

**When to use CFCs**

You can use CFCs in the following ways:

- Developing structured, reusable code
- Creating web services
- Creating Flash Remoting elements
- Using asynchronous CFCs

**Developing structured, reusable code**

CFCs provide an excellent method for developing structured applications that separate display elements from logical elements and encapsulate database queries. You can use CFCs to create application functionality that you (and others) can reuse wherever needed, similar to user-defined functions (UDFs) and custom tags. If you want to modify, add, or remove component functionality, you make changes in only one component file.

CFCs have several advantages over UDFs and custom tags. These advantages, which CFCs automatically provide, include all of the following:

- The ability to group related methods into a single component, and to group related components into a package
- Properties that multiple methods can share
- The This scope, a component-specific scope
- Inheritance of component methods and properties from a base component, including the use of the Super keyword
- Access control
- Introspection for CFC methods, properties, and metadata

CFCs have one characteristic that prevents them from being the automatic choice for all code reuse. It takes relatively more processing time to instantiate a CFC than to process a custom tag. In turn, it takes substantially more time to process a custom tag than to execute a user-defined function (UDF). However, after a CFC is instantiated, calling a CFC method has about the same processing overhead as an equivalent UDF. As a result, you should not use CFCs in place of independent, single-purpose custom tags or UDFs. Instead, you should use CFCs to create bodies of related methods, particularly methods that share properties.

For more information about UDFs, custom tags, and other ColdFusion code reuse techniques, see "Creating ColdFusion Elements" on page 126.

**Creating web services**

ColdFusion can automatically publish CFC methods as web services. To publish a CFC method as a web service, you specify the `access="remote"` attribute in the method's `cffunction` tag. ColdFusion generates all the required Web Services Description Language (WSDL) code and exports the CFC methods. For more information on creating web services in ColdFusion, see "Using Web Services" on page 900.
Creating Flash Remoting elements
Adobe® Flash® applications that use Flash Remoting can easily take advantage of ColdFusion components for business logic. In a CFC, the cffunction tag names the function and contains the application logic, and the cfreturn tag returns the result to Flash.

**Note:** For ColdFusion component methods to communicate with Flash applications, you must set the access attribute of the cffunction tag to remote.

For more information on creating CFCs for Flash Remoting, see “Using Flash with CFCs” on page 684.

Using asynchronous CFCs
ColdFusion provides an event gateway that lets you send a message to a CFC asynchronously. This gateway lets you initialize processing by a CFC without waiting for the CFC to complete or return a value. You can use asynchronous CFCs that use this gateway for the following:

- Reindexing a Verity collection
- Logging information
- Running batch processes

For more information on using asynchronous CFCs, see “About event gateways” on page 1060.

Creating ColdFusion components

When you create CFCs, you create methods, which are ColdFusion user-defined functions, in the component page. You pass data to a method by using parameters. The method then performs the function and, if specified in the cfreturn tag, returns data.

You can also define variables in a CFC. Within a CFC, these variables are known as properties.

Tags for creating CFCs

You use the following tags to create a CFC. You include these tags on the CFML page that defines the CFC.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfcomponent</td>
<td>Contains a component definition; includes attributes for introspection. For more information, see “Building ColdFusion components” on page 161.</td>
</tr>
<tr>
<td>cffunction</td>
<td>Defines a component method (function); includes attributes for introspection. For more information, see “Defining component methods” on page 161.</td>
</tr>
<tr>
<td>cfargument</td>
<td>Defines a parameter (argument) to a method; includes attributes for introspection. For more information, see “Defining and using method parameters” on page 164.</td>
</tr>
<tr>
<td>cfproperty</td>
<td>Defines variables for CFCs that provide web services; also use to document component properties. For more information, see “The cfproperty tag” on page 169.</td>
</tr>
</tbody>
</table>

Elements of a CFC

A CFC has the following characteristics:

- It is a single CFML page with a .cfc filename extension. The component name is the same as the filename. For example, if the file is myComponent.cfc, the component name is myComponent.
• The page is surrounded by a `cfcomponent` tag. No code can be outside this tag.
• The component page defines methods (functions), properties (data), or both. Most CFCs have methods, or methods and properties, but you can also have a CFC that contains only properties.
• You use the `cffunction` tag to define CFC methods. The CFScript `function` statement can create simple methods, but it does not provide options to control access to the method, provide metadata, specify a return type, or control generated output.
• You can write code on the component page that is outside of `cffunction` definitions. This code executes when the CFC is instantiated or whenever you invoke a method of the CFC.

Building ColdFusion components

You use the `cfcomponent` and `cffunction` tags to create ColdFusion components. By itself, the `cffunction` tag does not provide functionality. The `cfcomponent` tag provides an envelope that describes the functionality that you build in CFML and enclose in `cffunction` tags. The following example shows the skeleton of a component with two methods:

```cfcomponent>
  <cffunction name="firstMethod">
    <!--- CFML code for this method goes here. --->
  </cffunction>
  <cffunction name="secondMethod">
    <!--- CFML code for this method goes here. --->
  </cffunction>
</cfcomponent>
```

Defining component methods

You define component methods using `cffunction` tags. The following example defines a CFC that contains two methods, `getall` and `getsalary`:

```cfcomponent>
  <cffunction name="getall" output="false" returntype="query">
    <cfset var queryall="">
    <cfquery name="queryall" datasource="cfdocexamples">
      SELECT * FROM EMPLOYEE
    </cfquery>
    <cfreturn queryall>
  </cffunction>
  <cffunction name="getsalary" output="false">
    <cfset var getNamesandSalary="">
    <cfquery name="getNamesandSalary" datasource="cfdocexamples">
      SELECT FirstName, LastName, Salary FROM EMPLOYEE
    </cfquery>
    <cfreturn getNamesandSalary>
  </cffunction>
</cfcomponent>
```

Because component methods are ColdFusion functions, most of their features and coding techniques are identical to those of user-defined functions. For more information on using the `cffunction` tag to create functions, see “Writing and Calling User-Defined Functions” on page 134. Like other ColdFusion functions, CFC methods can display information directly by generating output, or can return a value to the code or client that invoked the method.

You use the following `cffunction` tag attributes only for CFCs:
• The `displayname` and `hint` attributes, which document the CFC; for more information, see “Documenting CFCs” on page 168.

• The `access` attribute, which controls access to the CFC; for more information, see “Using access security” on page 185.

For detailed reference information on the `cffunction` tag, see the CFML Reference.

**Defining CFCs with related methods**

When defining CFCs, it is good programming practice to organize related methods in one CFC. For example, you could put all methods that perform operations related to a user, such as `addUser`, `editUser`, and `storeUserPreferences`, in one CFC. You can group related mathematical functions into one CFC. A CFC can also contain all the methods and properties necessary for a shopping cart. The following CFC contains two `cffunction` tags that define two component methods, `getEmp` and `getDept`. When invoked, the component methods query the ExampleApps database. The `cfreturn` tag returns the query results to the client, or page, where the method was invoked.

```cfcomponent>
<cffunction name="getEmp">
    <cfset var empQuery="">
    <cfquery name="empQuery" datasource="cfdocexamples" dbtype="ODBC">
        SELECT FIRSTNAME, LASTNAME, EMAIL
        FROM tblEmployees
    </cfquery>
    <cfreturn empQuery>
</cffunction>
<cffunction name="getDept">
    <cfset var deptQuery="">
    <cfquery name="deptQuery" datasource="cfdocexamples" dbtype="ODBC">
        SELECT *
        FROM tblDepartments
    </cfquery>
    <cfreturn deptQuery>
</cffunction>
</cfcomponent>
```

**Putting executable code in a separate file**

You can put executable code in a separate file from the main component definition page. By placing the method execution code in a separate file, you can separate property initialization code, meta information, and the method definition shell from the executable method definition code. This technique lets you modularize your code and helps prevent CFML pages from getting too long and complex.

To separate the component method code, use a `cfinclude` tag on the component definition page to call the page that contains the component method code.

**Note:** If your method takes arguments or returns data to the page that invokes it, the `cfargument` tag and the `cfreturn` tag must be on the component definition page, not on the included page.

**Create a component method by using the cfinCLUDE tag**

1. Create a `tellTime.cfc` file with the following code:

   ```cfcomponent>
   <cffunction name="getUTCTime">
       <cfinclude template="getUTCTime.cfm">
       <cfreturn utcStruct.Hour & ":" & utcStruct.Minute>
   </cffunction>
   ```
2 Create a ColdFusion page with the following code, and save it as getUTCTime.cfm in the same directory as tellTime.cfc:

```cfscript
serverTime=now();
utcTime=GetTimeZoneInfo();
utcStruct=structNew();
utcStruct.Hour=DatePart("h", serverTime);
utcStruct.Minute=DatePart("n", serverTime);
utcStruct.Hour=utcStruct.Hour + utcTime.utcHourOffSet;
utcStruct.Minute=utcStruct.Minute + utcTime.utcMinuteOffSet;
if (utcStruct.Minute LT 10) utcStruct.Minute = "0" & utcStruct.Minute;
```

In the example, the getUTCTime method definition calls the getUTCTime.cfm file with the cfinclude tag. The getUTCTime.cfm code calculates the UTC time representation of the current time and populates a structure with hour and minute values. The method in tellTime.cfc then uses the information in the structure to return the current UTC time as a string to the calling page. The included page must not include a cfreturn statement.

**Initializing instance data**

Some components have instance data, which is data that persists as long as the component instance exists. For example, a shopping cart component might have instance data that includes the IDs and quantities of items that the user puts in the shopping cart. Instance data is often shared by several methods that can create, delete, or modify the data.

You can refer to instance data of a CFC only if you create an instance of the CFC. From inside the CFC, you refer to instance data of the CFC using the this prefix, for example this.firstvariable. From the calling page, you refer to instance data using dot notation, including the name of the instance of the component and the name of the instance data, as in objectname.ivarname. Components whose methods you invoke without first instantiating the component do not typically have instance data.

You initialize instance data at the top of the component definition, before the method definitions. ColdFusion executes this code when it instantiates the component; for example, when a cfobject tag creates the component instance. Because this code executes only when the instance is created and it typically "constructs" properties of the component, instance data initialization code is sometimes called constructor code.

You can use any CFML tag or function in constructor code, and the code can perform any ColdFusion processing, such as querying a database or data validation and manipulation. If one component extends another, the parent component's constructor code executes before the child component's constructor code.

**Note:** ColdFusion does not require you to put the initialization code at the top of the component definition; however, it is good programming practice to do so.

The following example shows constructor code for a shopping cart CFC:

```cfcomponent
<!--- Initialize the array for the cart item IDs and quantities. --->
<cfset This.CartData = ArrayNew(2)>
<!--- The following variable has the ID of the "Special Deal" product for this session. --->
<cfset This.Special_ID = RandRange(1, 999)>
```

For information on scopes, see “The This scope” on page 179 and “The Variables scope” on page 179.
A useful technique is to define a method named `init()`, which initializes an instance of a CFC, acting as a constructor. The `init()` method can initialize constants and return an instance of the component to the calling page. The following code illustrates an example of an `init()` method:

```cfcomponent displayname="shoppingCart">
  <cffunction name="init" access="public" output="no" returntype="shoppingCart">
    <cfargument name="shoppingCartID" type="UUID" required="yes">
    <cfset variables.shoppingCartID = arguments.shoppingCartID>
    <cfreturn this>
  </cffunction>
  <!--- Additional methods go here. --->
</cfcomponent>
```

In this example, the `init()` method uses the variables scope to make the shopping cart ID available anywhere in the CFC. For more information about scope, see "CFC variables and scope" on page 179.

### Defining and using method parameters

You pass data to a method by using parameters. To define a component method parameter, use the `cfargument` tag in the `cffunction` tag body. To define multiple parameters, use multiple `cfargument` tags. The tag names a parameter and lets you specify the following:

- Whether the parameter is required
- The type of data that is required
- A default argument value
- Display name and hint metadata for CFC introspection

**Note:** You can create CFC methods that do not use `cfargument` tags, for example, if you use positional parameters in your methods. However, most CFC methods use the `cfargument` tag.

**Example: convertTemp.cfc**

The `convertTemp.cfc` file consists of the following:

```cfcomponent>
  <!--- Celsius to Fahrenheit conversion method. --->
  <cffunction name="ctof" output="false">
    <cfargument name="temp" required="yes" type="numeric">
    <cfreturn ((temp*9)/5)+32>
  </cffunction>

  <!--- Fahrenheit to Celsius conversion method. --->
  <cffunction name="ftoc" output="false">
    <cfargument name="temp" required="yes" type="numeric">
    <cfreturn ((temp-32)*5/9)>
  </cffunction>
</cfcomponent>
```

### Reviewing the code

The `convertTemp` CFC contains two methods that convert temperature. The following table describes the code and its function:
Example: tempConversion.cfm
The ColdFusion page tempConversion.cfm is an HTML form in which the user enters the temperature to convert, and selects the type of conversion to perform. When the user clicks the Submit button, ColdFusion performs the actions on the processForm.cfm page. The file tempConversion.cfm, which should be in the same directory as convertTemp.cfc, consists of the following:

```html
<cfform action="processForm.cfm" method="POST">
    Enter the temperature:<br>
    <input name="temperature" type="text"><br>
    Select the type of conversion:<br>
    <select name="conversionType">
        <option value="CtoF">Celsius to Farenheit</option>
        <option value="FtoC">Farenheit to Celsius</option>
    </select><br>
    <input name="submitform" type="submit" value="Submit">
</cfform>
```

Example: processForm.cfm
The ColdFusion page processForm.cfm calls the appropriate component method, based on what the user entered in the form on the tempConversion.cfm page. It should be in the same directory as convertTemp.cfc.

```cfm
<cfif #form.conversionType# is "CtoF">
    <cfinvoke component="convertTemp" method="ctof" returnvariable="newtemp" temp=#form.temperature#>
    <cfoutput>#form.temperature# degrees Celsius is #newtemp# degrees Farenheit.</cfoutput>
</cfif>
<cfelseif #form.conversionType# is "FtoC">
    <cfinvoke component="convertTemp" method="ftoc" returnvariable="newtemp" temp=#form.temperature#>
    <cfoutput>#form.temperature# degrees Fahrenheit is #newtemp# degrees Celsius.</cfoutput>
</cfelseif>
```
Reviewing the code
The file processForm.cfm invokes the appropriate component method. The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfif form.conversionType is &quot;CtoF&quot;&gt;</code></td>
<td>Executes the code in the <code>cfif</code> block if the user selected Celsius to Fahrenheit as the conversion type in the form on the tempConversion.cfm page.</td>
</tr>
<tr>
<td><code>&lt;cfinvoke component=&quot;convertTemp&quot; method=&quot;ctof&quot; returnvariable=&quot;newtemp&quot; arguments.temp=&quot;#form.temperature#&quot;&gt;</code></td>
<td>Invokes the <code>ctof</code> method of the <code>convertTemp</code> component, without creating an instance of the <code>convertTemp</code> component. Specifies <code>newtemp</code> as the result variable for the method. Assigns the temperature value that the user entered in the form to the variable <code>temp</code>, which is specified in the <code>cfargument</code> tag of the <code>ctof</code> method. When invoking the <code>ctof</code> method, the <code>temp</code> variable is assigned to the Arguments scope. For more information about variables and scope, see &quot;CFC variables and scope&quot; on page 179.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;#form.temperature# degrees Celsius is #newtemp# degrees Fahrenheit.&lt;/cfoutput&gt;</code></td>
<td>Displays the temperature that the user entered in the form, the text &quot;degrees Celsius is,&quot; the new temperature value that results from the <code>ctof</code> method, and the text &quot;degrees Fahrenheit.&quot;</td>
</tr>
<tr>
<td><code>&lt;cfelseif #form.conversionType# is &quot;FtoC&quot;&gt;</code></td>
<td>Executes the code in the <code>cfelseif</code> block if the user selected Fahrenheit to Celsius as the conversion type in the form on the tempConversion.cfm page.</td>
</tr>
<tr>
<td><code>&lt;cfinvoke component=&quot;convertTemp&quot; method=&quot;ftoc&quot; returnvariable=&quot;newtemp&quot; temp=#form.temperature#&gt;</code></td>
<td>Invokes the <code>ftoc</code> method of the <code>convertTemp</code> component, without creating an instance of the <code>convertTemp</code> component. Specifies <code>newtemp</code> as the result variable for the method. Assigns the temperature value that the user entered in the form to the variable <code>temp</code>, which is specified in the <code>cfargument</code> tag of the <code>ftoc</code> method. When invoking the <code>ftoc</code> method, the <code>temp</code> variable is assigned to the Arguments scope. For more information about variables and scope, see &quot;CFC variables and scope&quot; on page 179.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;#form.temperature# degrees Fahrenheit is #newtemp# degrees Celsius.&lt;/cfoutput&gt;</code></td>
<td>Displays the temperature that the user entered in the form, the text &quot;degrees Fahrenheit is,&quot; the new temperature value that results from the <code>ftoc</code> method, and the text &quot;degrees Celsius.&quot;</td>
</tr>
<tr>
<td><code>&lt;/cfif&gt;</code></td>
<td>Closes the <code>cfif</code> block.</td>
</tr>
</tbody>
</table>

To run the example, display the tempConversion.cfm page in your browser. When you enter a value in the text box of the form, the value is stored in the `form.temperature` variable. Processing is then performed on the `processForm.cfm` page, which refers to the value as `form.temperature`. When you invoke either method, the `cfinvoke` tag assigns the value `form.temperature` to `temp`; `temp` is the argument specified in the `cfargument` tag of the appropriate method. The appropriate method in the `convertTemp` component performs the necessary calculations and returns the new value as `newtemp`.

For detailed reference information on the `cfargument` tag, see the `CFML Reference`. 

To access the parameter values in the component method definition, use structure- or array-like notation with the Arguments scope. The following example refers to the lastName argument as Arguments.lastName; it could also refer to it as Arguments[1]. In addition, you can access arguments directly using number (#) signs, such as #lastName#; however, it is better programming practice to identify the scope (for example, #Arguments.lastName#). Also, you can use Array- or structure-like notation, which lets you loop over multiple parameters.

For more information on the Arguments scope, see “The Arguments scope” on page 181.

Define parameters in the component method definition

1. Create a new component with the following contents, and save it as corpQuery.cfc in a directory under your web root directory:

```coldfusion
<cfcomponent>
  <cffunction name="getEmp" hint="Employee last name">
    <cfset var empQuery="">
    <cfquery name="empQuery" datasource="cfdocexamples">
      SELECT LASTNAME, FIRSTNAME, EMAIL
      FROM tblEmployees
      WHERE LASTNAME LIKE '#Arguments.lastName#'
    </cfquery>

    <!--- Use cfdump for debugging purposes. --->
    <cfdump var=#empQuery#>
  </cffunction>

  <cffunction name="getCat" hint="Get items below specified cost">
    <cfset var catQuery="">
    <cfquery name="catQuery" datasource="cfdocexamples">
      SELECT ItemName, ItemDescription, ItemCost
      FROM tblItems
      WHERE ItemCost <= #Arguments.cost#'
    </cfquery>

    <!--- Use cfdump for debugging purposes. --->
    <cfdump var=#catQuery#>
  </cffunction>
</cfcomponent>
```

In the example, the cfargument attributes specify the following:

- The name attributes define the parameter names.
- The type attribute for the lastName argument specifies that the parameter must be a text string. The type attribute for the cost argument specifies that the parameter must be a numeric value. These attributes validate the data before it is submitted to the database.
- The required attributes indicate that the parameters are required or an exception will be thrown.
- The Arguments scope provides access to the parameter values.

Providing results

ColdFusion components can provide information in the following ways:

- They can generate output that is displayed on the calling page.
- They can return a variable.
You can use either technique, or a combination of both, in your applications. The technique that you use should depend on your application's needs and your coding methodologies. For example, many CFC methods that perform business logic return the results as a variable, and many CFC methods that display output directly are designed as modular units for generating output, and do not do business logic.

**Displaying output**

If you do not specifically suppress output, any text, HTML code, or output that CFML tags generate inside your method gets returned as generated output to the client that calls the component method. If the client is a web browser, it displays these results. For example, the following `getLocalTime1` component method shows the local time directly on the page that invokes the method:

```cfcomponent>
    <cffunction name="getLocalTime1">
        <cfoutput>#TimeFormat(now())#</cfoutput>
    </cffunction>
</cfcomponent>
```

Component methods that are called by using Flash Remoting or as web services cannot use this method to provide results.

**Returning a results variable**

In the component method definition, you use the `cfreturn` tag to return the results to the client as variable data. For example, the following `getLocalTime2` component method returns the local time as a variable to the ColdFusion page or other client that invokes the method:

```cfcomponent>
    <cffunction name="getLocalTime">
        <cfreturn TimeFormat(now())>
    </cffunction>
</cfcomponent>
```

The ColdFusion page or other client, such as a Flash application, that receives the result then uses the variable data as appropriate.

**Note:** If a CFC is invoked using a URL or by submitting a form, ColdFusion returns the variable as a WDDX packet. A CFC that is invoked by Flash Remoting, or any other instance of a CFC, must not return the This scope. You can return values of all data types, including strings, integers, arrays, structures, and instances of CFCs. The `cfreturn` tag returns a single variable, as does the `return` CFScript statement. Therefore, if you want to return more than one result value at a time, use a structure. If you do not want to display output in a method, use `output="false"` in the `cffunction` tag.

For more information on using the `cfreturn` tag, see the CFML Reference.

**Documenting CFCs**

ColdFusion provides several ways to include documentation about your CFCs in your component definitions. The documentation is available when you use introspection to display information about the CFC or call the `GetMetadata` or `GetComponentMetadata` function to get the component's metadata. You can use the following tools for documenting CFCs:

- The `displayname` and `hint` attributes
- User-defined metadata attributes
- The `cfproperty` tag
The following sections describe these tools. For information on displaying the information, see “Using introspection to get information about components” on page 186.

**The displayname and hint attributes**
The `cfcomponent`, `cffunction`, `cfargument`, and `cfproperty` tags have `displayname` and `hint` attributes.

The `displayname` attribute lets you provide a more descriptive name for a component, attribute, method, or property. When you use introspection, this attribute appears in parentheses next to the component or method name, or on the parameter information line.

You use the `hint` attribute for longer descriptions of the component, method, or argument. In the introspection display, this attribute appears on a separate line or on several lines of the component or method description, and at the end of the argument description.

**Metadata attributes**
You can include arbitrary metadata information as attributes of the `cfcomponent`, `cffunction`, `cfargument`, and `cfproperty` tags. To create a metadata attribute, specify the metadata attribute name and its value. For example, in the following `cfcomponent` tag, the `Author` attribute is a metadata attribute. This attribute is not used as a function parameter; instead, it indicates who wrote this CFC.

```html
<cfcomponent name="makeForm" Author="Bean Lapin">
```

Metadata attributes are not used by ColdFusion for processing; they also do not appear in standard ColdFusion introspection displays; however, you can access and display them by using the `GetMetaData` or `GetComponentMetaData` function to get the metadata. Each attribute name is a key in the metadata structure of the CFC element.

Metadata attributes are used for more than documentation. Your application can use the `GetMetaData` function to get the metadata attributes for a component instance, or the `GetComponentMetaData` function to get the metadata for an interface or component that you have not yet instantiated. You can then act based on the values. For example, a `mathCFC` component might have the following `cfcomponent` tag:

```html
<cfcomponent displayname="Math Functions" MetaType="Float">
```

In this case, a ColdFusion page with the following code sets the `MetaTypeInfo` variable to `Float`:

```html
<cfobject component="mathCFC" name="MathFuncs">
<cfset MetaTypeInfo=GetMetadata(MathFuncs).MetaType>
```

**Note:** All metadata values are replaced by strings in the metadata structure returned from the `GetMetaData` function. Because of this, you should not use expressions in custom metadata attributes.

**The `cfproperty` tag**
The `cfproperty` tag is used to create complex data types with WSDL descriptors and for component property documentation, as follows:

- It can create complex data types with WSDL descriptions for ColdFusion web services. For more information, see “Using ColdFusion components to define data types for web services” on page 915.
- It can provide documentation of component properties in the ColdFusion introspection output. The introspection information includes the values of the standard `cfproperty` tag attributes.

**Note:** The `cfproperty` tag does not create a variable or assign it a value. It is used for information purposes only. You use a `cfset` tag, or CFScript assignment statement, to create the property and set its value.
Saving and naming ColdFusion components

The following table lists the locations in which you can save component files and how they can be accessed from each location:

<table>
<thead>
<tr>
<th></th>
<th>URL</th>
<th>Form</th>
<th>Flash Remoting</th>
<th>Web services</th>
<th>ColdFusion page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current directory</td>
<td>N/A</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>Web root</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ColdFusion mappings</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Custom tag roots</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: ColdFusion mappings and custom tag roots can exist within the web root. If so, they are accessible to remote requests, including URL, form, Flash Remoting, and web services invocation.

When you store components in the same directory, they are members of a component package. You can group related CFCs into packages. Your application can refer to any component in a directory specifically by using a qualified component name that starts with a subdirectory of one of the accessible directories and uses a period to delimit each directory in the path to the directory that contains the component. For example, the following example is a qualified name of a component named price:

catalog.product.price

In this example, the price.cfc file must be in the catalog\product subdirectory of a directory that ColdFusion searches for components, as listed in the preceding table. When you refer to a component using the qualified name, ColdFusion looks for the component in the order described in “Specifying the CFC location” on page 176.

Establishing a descriptive naming convention is a good practice, especially if you plan to install the components as part of a packaged application.

Using ColdFusion components

There are two ways to use a CFC:

1. You can instantiate a CFC object, which creates a CFC instance. You then invoke the methods of the instance. You can access the CFC methods and data as instance elements. You can also use the instance in the cfinvoke tag to invoke the CFC methods. When you instantiate a CFC, data in the CFC is preserved as long as the CFC instance exists, and ColdFusion does not incur the overhead of creating the instance each time you call a method.

   Instantiate CFCs to preserve data in the CFC. To ensure processing efficiency if you use the CFC more than once on a page, instantiate the CFC before you invoke its methods.

   Methods that are executed remotely through Flash Remoting and web services always create a new instance of the CFC before executing the method.

2. You can invoke (call) a method of the CFC without creating an instance of the CFC, which is referred to as transiently invoking a method. In this case, ColdFusion creates an instance of the CFC that exists only from the time you invoke the method until the method returns a result. No data is preserved between invocations and there is no instance of the CFC that you can reuse elsewhere in your CFML. It is considered a best practice to create an instance of a CFC before invoking any of its methods, unless your CFML request uses the CFC only once. If you transiently invoke a method frequently, consider creating a user-defined function to replace the CFC method.
You can create persistent CFCs by assigning the CFC instance to a persistent scope, such as the Session or Application scope. This way, you can create CFCs for objects, such as shopping carts or logged-in users, that must persist for sessions. You can also create CFCs that provide application-specific data and methods.

**Tags for using CFCs**

The following table lists the tags that you use to instantiate or invoke a CFC. You use these tags on the CFML page on which you instantiate or invoke the CFC.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfinvoke</td>
<td>Invokes a method of a CFC.</td>
</tr>
<tr>
<td>cfinvokeargument</td>
<td>Passes the name and value of a parameter to a component method.</td>
</tr>
<tr>
<td>cfobject</td>
<td>Creates a CFC instance.</td>
</tr>
<tr>
<td>CreateObject</td>
<td>Creates a CFC instance.</td>
</tr>
</tbody>
</table>

**CFC invocation techniques**

ColdFusion provides many ways to instantiate CFCs and invoke CFC methods. The following table lists the techniques, including the ColdFusion tags and functions that you use:

<table>
<thead>
<tr>
<th>Invocation</th>
<th>Description</th>
<th>For more information</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfinvoke tag</td>
<td>Invokes a component method. Can invoke methods of a CFC instance or invoke the methods transiently.</td>
<td>See “Invoking CFC methods with the cfinvoke tag” on page 172.</td>
</tr>
<tr>
<td>cfset tag and assign-</td>
<td>Invoke methods and access properties of a component instance.</td>
<td>See “Using components directly in CFScript and CFML” on page 174.</td>
</tr>
<tr>
<td>ments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>URL (HTTP GET)</td>
<td>Transiently invokes a component method by specifying the component and method names in the URL string.</td>
<td>See “Invoking component methods by using a URL” on page 175.</td>
</tr>
<tr>
<td>Form control(HTTP POST)</td>
<td>Transiently invokes a component method using the HTML form and input tags and their attributes.</td>
<td>See “Invoking component methods by using a form” on page 175.</td>
</tr>
<tr>
<td>Flash Remoting</td>
<td>ActionScript can transiently invoke component methods.</td>
<td>See “Using the Flash Remoting Service” on page 674.</td>
</tr>
<tr>
<td>Web services</td>
<td>The cfinvoke tag and CFScript consume web services in Coldfusion. External applications can also consume CFC methods as web services.</td>
<td>See “Using Web Services” on page 900.</td>
</tr>
</tbody>
</table>

**Instantiating CFCs**

If you use a CFC multiple times in a ColdFusion request, or if you use a CFC with persistent properties, use the `cfobject` tag or `CreateObject` function to instantiate the CFC before you call its methods.

The following example uses the `cfobject` tag to create an instance of the `tellTime` CFC.

```cfml
<cfobject component="tellTime" name="tellTimeObj">
```

The following example uses the `CreateObject` function to instantiate the same component in CFScript:

```cfml
tellTimeObj = CreateObject("component", "tellTime");
```
Invoking CFC methods with the cfinvoke tag

The cfinvoke tag can invoke methods on a CFC instance or invoke CFC methods transiently. You can also use the cfinvoke tag to invoke CFC methods from within a CFC.

Invoking methods of a CFC instance

To invoke a component method of a CFC instance, use the cfinvoke tag and specify the following:

- The CFC instance name, enclosed in number signs (#), in the component attribute.
- The method name, in the method attribute.
- Any parameters. For information on passing parameters, see "Passing parameters to methods by using the cfinvoke tag" on page 177.
- If the component method returns a result, the name of the variable that will contain the result in the returnVariable attribute.

1 Create a file named tellTime2.cfc with the following code:

```cfcomponent>
<cffunction name="getLocalTime" access="remote">
<cfreturn TimeFormat(now())>
</cffunction>
<cffunction name="getUTCTime" access="remote">
<cfscript>
serverTime=now();
utcTime=GetTimeZoneInfo();
utcStruct=structNew();
utcStruct.Hour=DatePart("h", serverTime);
utcStruct.Minute=DatePart("n", serverTime);
utcStruct.Hour=utcStruct.Hour + utcTime.utcHourOffSet;
utcStruct.Minute=utcStruct.Minute + utcTime.utcMinuteOffSet;
if (utcStruct.Minute LT 10) utcStruct.Minute = "0" & utcStruct.Minute;
<cfreturn utcStruct.Hour & ":" & utcStruct.Minute>
</cfscript>
<cfreturn utcStruct.Hour & ";" & utcStruct.Minute>
</cffunction>
</cfcomponent>
```

The example defines two component methods: getLocalTime and getUTCTime.

2 Create a ColdFusion page, with the following code and save it in the same directory as the tellTime component:

```cfobject component="tellTime2" name="tellTimeObj">
<cfinvoke component="#tellTimeObj#" method="getLocalTime" returnvariable="localTime">
<cfinvoke component="#tellTimeObj#" method="getUTCTime" returnvariable="UTCTime">
</cfobject>
```

This example uses the cfinvoke tag to create an instance of the tellTime component and the cfinvoke tag to invoke the instance's getLocalTime and getUTCTime methods. In this example, the CFC contains the functional logic in the methods, which return a result to the calling page, and the calling page displays the results. This structure separates the logic from the display functions, which usually results in more reusable code.
**Invoking component methods transiently**

In ColdFusion pages or components, the `cfinvoke` tag can invoke component methods without creating a persistent CFC instance.

To invoke a component method transiently, use the `cfinvoke` tag and specify the following:

- The name or path of the component, in the `component` attribute.
- The method name, in the `method` attribute.
- Any parameters. For information on passing parameters, see “Passing parameters to methods by using the `cfinvoke` tag” on page 177.
- If the component method returns a result, the name of the variable that contains the result, in the `returnVariable` attribute.

1. Create the following component and save it as `tellTime.cfc`:

   ```cfcomponent>
   <cffunction name="getLocalTime">
   <cfoutput>#TimeFormat(now())#</cfoutput>
   </cffunction>
   </cfcomponent>
   
   The example defines a component with one method, `getLocalTime`, that displays the current time.

2. Create a ColdFusion page, with the following code, and save it in the same directory as the `tellTime` component:

   ```html
   <h3>Time Display Page</h3>
   <b>Server's Local Time:</b>
   <cfinvoke component="tellTime" method="getLocalTime">
   Using the `cfinvoke` tag, the example invokes the `getLocalTime` component method without creating a persistent CFC instance.
   ```

**Using the `cfinvoke` tag within the CFC definition**

You can use the `cfinvoke` tag to invoke a component method within the component definition; for example, to call a utility method that provides a service to other methods in the component. To use the `cfinvoke` tag in this instance, do not create an instance or specify the component name in the `cfinvoke` tag, as the following example shows:

```cfcomponent>
   <cffunction name="servicemethod" access="public">
   <cfoutput>At your service...<br></cfoutput>
   </cffunction>
   <cffunction name="mymethod" access="public">
   <cfoutput>We're in mymethod.<br></cfoutput>
   <!--- Invoke a method in this CFC. --->
   <cfinvoke method="servicemethod">
   </cffunction>
   </cfcomponent>
   
   Note: When you invoke a method from within the component definition in which you define the method, do not use the `This` scope, because this resets the access privileges.

**Invoking methods by using dynamic method names**

The `cfinvoke` tag is the only way to efficiently invoke different component methods based on variable data (for example, form input). In this case, you use a variable name, such as `Form.method`, as the value of the `method` attribute. In the following example, the user selects a report from a form:

```html
   <select name="whichreport">
```
The `cfinvoke` tag then invokes the appropriate method, based on what the user selected:

```coldfusion
<cfinvoke component="getdata" method="#form.whichreport#" returnvariable="queryall">
```

### Using components directly in CFScript and CFML

You can invoke methods of a component instance directly using CFScript or in CFML tags. To invoke component methods directly, use the `CreateObject` function or `cfobject` tag to instantiate the component. Thereafter, use the instance name followed by a period and the method that you are calling to invoke an instance of the method. You must always use parentheses after the method name, even if the method does not take any parameters.

You can use this syntax anywhere that you can use a ColdFusion function, such as in `cfset` tags or surrounded by number signs in the body of a `cfoutput` tag.

#### Invoking component methods in CFScript

The following example shows how to invoke component methods in CFScript:

```coldfusion
<!--- Instantiate once and reuse the instance.--->
<cfscript>
    tellTimeObj=CreateObject("component","tellTime");
    WriteOutput("Server's Local Time: 
        & tellTimeObj.getLocalTime();
    WriteOutput("<br> Calculated UTC Time: 
        & tellTimeObj.getUTCTime();
</cfscript>
```

In the example, the three CFScript statements do the following:

1. The `CreateObject` function instantiates the `tellTime` CFC as `tellTimeObj`.
2. The first `WriteOutput` function displays text followed by the results returned by the `getLocalTime` method of the `tellTimeObj` instance.
3. The second `WriteOutput` function displays text followed by the results returned by the `getUTCTime` method of the `tellTimeObj` instance.

In CFScript, you use the method name in standard function syntax, such as `methodName()`.

#### Invoking component methods in CFML

The following example uses CFML tags to produce the same results as the CFScript example:

```cfml
<cfobject name="tellTimeObj" component="tellTime">
    <cfoutput>
        Server's Local Time: #tellTimeObj.getLocalTime()#<br>
        Calculated UTC Time: #tellTimeObj.getUTCTime()#
    </cfoutput>
</cfobject>
```

#### Accessing component data directly

You can access data in the component's `This` scope directly in CFScript and `cfset` assignment statements. For example, if a user data CFC has a `This.lastUpdated` property, you could have code such as the following:

```cfml
<cfobject name="userDataCFC" component="userData">
    <cfif DateDiff("d", userCFC.lastUpdated, Now()) GT 30>
        <!--- Code to deal with older data goes here. --->
    </cfif>
</cfobject>
```

For more information, see “The `This` scope” on page 179.
Invoking CFC methods with forms and URLs

You can invoke CFC methods directly by specifying the CFC in a URL, or by using HTML and CFML form tags. Because all HTTP requests are transient, these methods only let you transiently invoke methods. They do not let you create persistent CFC instances.

Invoking component methods by using a URL

To invoke a component method by using a URL, you must append the method name to the URL in standard URL query-string, name-value syntax. You can invoke only one component method per URL request, for example:

http://localhost:8500/tellTime.cfc?method=getLocalTime

Note: To use URL invocation, you must set the access attribute of the cffunction tag to remote.

To pass parameters to component methods using a URL, append the parameters to the URL in standard URL query-string, name-value pair syntax; for example:

http://localhost:8500/corpQuery.cfc?method=getEmp&lastName=camden

To pass multiple parameters within a URL, use the ampersand character (&) to delimit the name-value pairs; for example:


Note: To ensure data security, Adobe strongly recommends that you not pass sensitive information over the web using URL strings. Potentially sensitive information includes all personal user information, including passwords, addresses, telephone numbers, and so on.

If a CFC method that you access using the URL displays output directly, the user’s browser shows the output. You can suppress output by specifying output="No" in the cffunction tag. If the CFC returns a result using the cfreturn tag, ColdFusion converts the text to HTML edit format (with special characters replaced by their HTML escape sequences), puts the result in a WDDX packet, and includes the packet in the HTML that it returns to the client.

Invoking component methods by using a form

To invoke a method by using a ColdFusion or HTML form, the following must be true:

• The form or cfform tag action attribute must specify the CFC filename or path followed by ?method=methodname, where methodname is the name of the method, for example:


• The form must have an input tag for each component method parameter. The name attribute of the tag must be the method parameter name and the field value is the parameter value.

• The cffunction tag that defines the CFC method being invoked must specify the access="remote" attribute.

If the CFC method that you invoke from the form displays output directly, the user’s browser shows the output. (You can use the cffunction output attribute to disable displaying output.) If the CFC returns a result using the cfreturn tag, ColdFusion converts the text to HTML edit format, puts it in a WDDX packet, and includes the packet in the HTML that it returns to the client.

1 Create a corpFind.cfm file with the following contents:

```html
<h2>Find People</h2>
<form action="/components/corpQuery.cfc?method=getEmp" method="post">
  <p>Enter employee's last Name:</p>
  <input type="Text" name="lastName">
  <input type="Hidden" name="method" value="getEmp">
</form>
```
<input type="Submit" title="Submit Query"><br>
</form>

In the example, the form tag's action attribute points to the corpQuery component and invokes the getEmp method.

2. Create a corpQuery.cfc file, specifying access="remote" for each cffunction tag, as the following example shows:

```coldfusion
<cfcomponent>
  <cffunction name="getEmp" access="remote">
    <cfargument name="lastName" required="true">
    <cfset var empQuery="">
    <cfquery name="empQuery" datasource="cfdocexamples">
      SELECT LASTNAME, FIRSTNAME, EMAIL
      FROM tblEmployees
      WHERE LASTNAME LIKE '#arguments.lastName#'
    </cfquery>
    <cfoutput>Results filtered by #arguments.lastName#:</cfoutput><br>
    <cfdump var=#empQuery#>
  </cffunction>
</cfcomponent>
```

3. Open a web browser and enter the following URL:

```text
http://localhost/corpFind.cfm
```

ColdFusion displays the search form. After you enter values and click the Submit Query button, the browser displays the results.

**Accessing CFCs from outside ColdFusion and basic HTML**

Flash applications that use Flash Remoting can easily take advantage of ColdFusion components for business logic. Similarly, you can export CFCs so that any application can access CFC methods as web services.

For ColdFusion component methods to communicate with Flash Remoting applications, you must set the access attribute of the cffunction tag to remote.

For more information on creating CFCs for Flash Remoting, see "Using the Flash Remoting Service" on page 674

Any application, whether it is a ColdFusion application, a Java application, JSP page, or a .Net application, can access well-formed ColdFusion components as web services by referencing the WSDL file that ColdFusion automatically generates.

To see a component's WSDL definition, specify the component web address in a URL, followed by ?wsdl; for example:

```text
http://localhost:8500/MyComponents/arithCFC.cfc?wsdl
```

For more information on using CFCs as web services, see “Using Web Services” on page 900

**Specifying the CFC location**

When you instantiate or invoke a component, you can specify the component name only, or you can specify a qualified path. To specify a qualified path, separate the directory names with periods, not backslashes. For example, myApp\cfcs\myComponent specifies the component defined in myApp\cfcs\myComponent.cfc. For additional information, see "Saving and naming ColdFusion components" on page 170.

ColdFusion uses the following rules to find the specified CFC:
• If you use a `cfinvoke` or `cfobject` tag, or the `CreateObject` function, to access the CFC from a CFML page, ColdFusion searches directories in the following order:
  a. Local directory of the calling CFML page
  b. Web root
  c. Directories specified on the Custom Tag Paths page of ColdFusion Administrator
• If you specify only a component name, ColdFusion searches each of these directories, in turn, for the component.
• If you specify a qualified path, such as `myApp.cfc.myComponent`, ColdFusion looks for a directory matching the first element of the path in each of these directories (in this example, `myApp`). If ColdFusion finds a matching directory, it looks for a file in the specified path beneath that directory, such as `myApp\cfc\myComponent.cfc`, relative to each of these directories.

**Note:** If ColdFusion finds a directory that matches the first path element, but does not find a CFC under that directory, ColdFusion returns a not found error and does not search for another directory.

• If you invoke a CFC method remotely, using a specific URL, a form field, Flash Remoting, or a web service invocation, ColdFusion looks in the specified path relative to the web root. For form fields and URLs that are specified directly on local web pages, ColdFusion also searches relative to the page directory.

**Note:** On UNIX and Linux systems, ColdFusion attempts to match a CFC name or custom tag name with a filename, as follows: First, it attempts to find a file with the name that is all lowercase. If it fails, it tries to find a file whose case matches the CFML case. For example, if you specify `<cfobject name="myObject" component="myComponent">`, ColdFusion first looks for `mycomponent.cfc` and, if it doesn't find it, ColdFusion looks for `myComponent.cfc`.

### Passing parameters to methods

You pass parameters to a method in a CFC by using the `cfinvoke` tag, direct method invocations, or by passing parameters in a URL.

#### Passing parameters to methods by using the `cfinvoke` tag

When you use the `cfinvoke` tag, ColdFusion provides several methods for passing parameters to CFC methods:

• As `cfinvoke` tag attributes, in `name="value"` format
• In the `cfinvoke` tag `argumentcollection` attribute
• In the `cfinvoke` tag body, using the `cfinvokeargument` tag

You can use any combination of these methods in a single invocation. If you use the same name in two or three of these methods, ColdFusion uses the value based on the following order of precedence:

1. `cfinvokeargument` tags
2. `cfinvoke` attribute name-value pairs
3. `argumentcollection` arguments

#### Passing parameters by using attribute format

You can pass parameters in the `cfinvoke` tag as tag attribute name-value pairs, as the following example shows:

```
<cfinvoke component="authQuery" method="getAuthSecure"
   lastName="#session.username#" pwd="#url.password#">
```
In the example, the parameters are passed as the lastName and pwd attributes.

Note: The cfinvoke tag attribute names are reserved and cannot be used for parameter names. The reserved attribute names are: component, method, argumentCollection, and returnVariable. For more information, see the CFML Reference.

Passing parameters in the argumentCollection attribute
If you save attributes to a structure, you can pass the structure directly using the cfinvoke tag’s argumentCollection attribute. This technique is useful if an existing structure or scope (such as the Forms scope) contains values that you want to pass to a CFC as parameters, and for using conditional or looping code to create parameters.

When you pass an argumentCollection structure, each structure key is the name of a parameter inside the structure.

The following example passes the Form scope to the addUser method of the UserDataCFC component. In the method, each form field name is a parameter name; the method can use the contents of the form fields to add a user to a database.

```
<cfinvoke component="UserDataCFC" method="addUser" argumentCollection="#Form#">
```

Passing parameters by using the cfinvokeargument tag
To pass parameters in the cfinvoke tag body, use the cfinvokeargument tag. Using the cfinvokeargument tag, for example, you can build conditional processing that passes a different parameter based on user input.

The following example invokes the corpQuery component:

```
<cfinvoke component="corpQuery" method="getEmp">
  <cfinvokeargument name="lastName" value="Wilder">
  </cfinvoke>
</cfinvoke>
```

The cfinvokeargument tag passes the lastName parameter to the component method.

In the following example, a form already lets the user select the report to generate. After instantiating the getdata and reports components, the action page invokes the doquery component instance, which returns the query results in queryall. The action page then invokes the doreport component instance and uses the cfinvokeargument tag to pass the query results to the doreport instance, where the output is generated.

```
<cfobject component="getdata" name="doquery">
<cfobject component="reports" name="doreport">
  <cfinvoke component="#doquery#" method="#form.whichreport#" returnvariable="queryall">
    <cfinvoke component="#doreport#" method="#form.whichreport#">
      <cfinvokeargument name="queryall" value="#queryall#">
      </cfinvoke>
    </cfinvoke>
  </cfinvoke>
</cfobject>
```

Passing parameters in direct method invocations
ColdFusion provides three methods for passing parameters to CFC methods in direct method invocations:

1. You can pass the parameters the form of comma-separated name=value entries, as in the following CFScript example:
   ```
   authorized = securityCFC.getAuth(name="Almonzo", Password="LauRa123");
   ```

2. You can pass the parameters in an argumentCollection structure. The following code is equivalent to the previous example:
   ```
   argsColl = structNew();
   argsColl.username = "Almonzo";
   argsColl.password = "LauRa123";
   ```
authorized = securityCFC.getAuth(argumentCollection = argsColl);

3 You can pass positional parameters to a method by separating them with commas. The following example calls the `getAuth` method, and passes the name and password as positional parameters:

authorized = securityCFC.getAuth("Almonzo", "LauRal23");

**Note:** For more information on using positional parameters and component methods in ColdFusion functions, see “Creating user-defined functions” on page 135.

### Passing parameters in a URL

ColdFusion lets you pass parameters to CFC methods in a URL. To do so, you append the URL in standard URL query-string, name-value pair syntax; for example:

http://localhost:8500/CompanyQuery.cfc?method=getEmp&lastName=Adams

---

### CFC variables and scope

CFCs interact with ColdFusion scopes and use local variables.

**Note:** Components also have a Super keyword that is sometimes called a scope. For information on the Super keyword, see “Using the Super keyword” on page 183.

#### The This scope

The This scope is available within the CFC and is shared by all CFC methods. It is also available in the base component (if the CFC is a child component), on the page that instantiates the CFC, and all CFML pages included by the CFC.

Inside the CFC, you define and access This scope variables by using the prefix This, as in the following line:

```
<cfset This.color="green">
```

In the calling page, you can define and access CFC This scope variables by using the CFC instance name as the prefix. For example, if you create a CFC instance named `car` and, within the `car` CFC specify `<cfset This.color="green">`, a ColdFusion page that instantiates the CFC could refer to the component's color property as `#car.color#`.

Variable values in the This scope last as long as the CFC instance exists and, therefore, can persist between calls to methods of a CFC instance.

**Note:** The This scope identifier works like the This keyword in JavaScript and ActionScript. CFCs do not follow the Java class model, and the This keyword behaves differently in ColdFusion than in Java. In Java, This is a private scope, whereas in ColdFusion, it is a public scope.

#### The Variables scope

The Variables scope in a CFC is private to the CFC. It includes variables defined in the CFC body (initialization or constructor code) and in the CFC methods. When you set Variables scope variables in the CFC, they cannot be seen by pages that invoke the CFC.

The CFC Variables scope does not include any of the Variables scope variables that are declared or available in the page that instantiates or invokes the CFC. However, you can make the Variables scope of the page that invokes a CFC accessible to the CFC by passing Variables as an argument to the CFC method.
You set a Variables scope variable by assigning a value to a name that has the Variables prefix or no prefix. Values in the Variables scope last as long as the CFC instance exists, and therefore can last between calls to CFC instance methods.

The Variables scope is available to included pages, and Variables scope variables that are declared in the included page are available in the component page.

**Note:** The Variables scope is not the same as the var keyword, which makes variables private within a function. You should always define function-local variables using the var keyword.

**Example: sharing the Variables scope**

The following example shows how to make the Variables scope of the page that invokes a CFC accessible to the CFC by passing Variables as an argument to the CFC method. It also illustrates that the Variables scope is private to the CFC.

The following code is for the callGreetMe.cfm page:

```cfm
<cfsset Variables.MyName="Wilson">
<cfoobject component="greetMe" name="myGreetings">
<cfooutput>
    Before invoking the CFC, Variables.Myname is: #Variables.MyName#. <br>
    Passing Variables scope to hello method. It returns: #myGreetings.hello(Variables.MyName)#. <br>
    After invoking the CFC, Variables.Myname is: #Variables.MyName#. <br>
</cfooutput>
<cfinvoke component="greetMe" method="VarScopeInCfc">
    The following code is for the greetMe CFC:

    <cfsset Variables.MyName="Tuckerman">
    <cffunction name="hello">
        <cfargument name="Name" Required=true>
        <cfset Variables.MyName="Hello " & Arguments.Name>
        <cfreturn Variables.MyName>
    </cffunction>
    <cffunction name="VarScopeInCfc">
        <cfoutput>Within the VarScopeInCfc method, Variables.MyName is: #variables.MyName#<br>
</cfoutput>
    </cffunction>
</cfscomponent>

In this example, the callGreetMe.cfm page does the following:

1. Sets the MyName variable in its Variables scope to Wilson.
2. Displays the Variables.MyName value.
3. Calls the greetMe CFC and passes its Variables scope as a parameter.
4. Displays the value returned by the greetMe CFC.
5. Displays the Variables.MyName value.
6. Invokes the VarScopeInCfc method, which displays the value of Variables.MyName within the CFC.

When you browse the callGreetMe.cfm page, the following appears:

Before invoking the CFC, Variables.Myname is: Wilson.
Passing Variables scope to hello method. It returns: Hello Wilson.
After invoking the CFC, Variables.Myname is: Wilson.
Within the VarScopeInCfc method, Variables.MyName is: Tuckerman.
The Arguments scope

The Arguments scope exists only in a method, and is not available outside the method. The scope contains the variables that you passed into the method, including variables that you passed in the following ways:

- As named attributes to the `cfinvoke` tag
- In the `cfargumentcollection` attribute of the `cfinvoke` tag
- In `cfinvokeargument` tags
- As attributes or parameters passed into the method when the method is invoked as a web service, by Flash Remoting, as a direct URL, or by submitting a form

You can access variables in the Arguments scope using structure notation (`Arguments.variablename`), or array notation (`Arguments[1]` or `Arguments["variablename"]`).

The Arguments scope does not persist between calls to CFC methods.

Variables in the Arguments scope are available to pages included by the method.

Other variable scopes

A CFC shares the Form, URL, Request, CGI, Cookie, Client, Session, Application, Server, and Flash scopes with the calling page. Variables in these scopes are also available to all pages that are included by a CFC. These variables do not have any behavior that is specific to CFCs.

Function local variables

Variables that you declare with the Var keyword inside a `cffunction` tag or CFScript function definition are available only in the method in which they are defined, and only last from the time the method is invoked until it returns the result. You cannot use the Var keyword outside of function definitions.

**Note:** You should always use the Var keyword on variables that are only used inside of the function in which they are declared.

You must define all function local variables at the top of the function definition, before any other CFML code; for example:

```cfc
cffunction ...
  <cfset Var testVariable = "this is a local variable">
  <!--- Function code goes here. --->
  <cfreturn myresult>
</cffunction>
```

Any arguments declared with the `cfargument` tag must appear before any variables defined with the `cfset` tag. You can also put any `cfscript` tag first and define variables that you declare with the Var keyword in the script.

Use function local variables if you put the CFC in a persistent scope such as the Session scope, and the function has data that must be freed when the function exits.

Local variables do not persist between calls to CFC methods.

Local variables are available to pages included by the method.
Using CFCs effectively

Several techniques let you effectively use CFCs in your applications:

- Structure and reuse code
- Build secure CFCs
- Use introspection to get information about components

Structuring and reusing code

Component inheritance and the Super keyword are two important tools for creating structured, object-oriented ColdFusion components.

Component inheritance: Lets you create a single base component and reuse this code in multiple subclasses that are derived from the base component. Typically a base component is more general, and subcomponents are typically more specific. Each subclass does not have to redefine the code in the base component, but can override it if necessary.

The Super keyword: Lets a component that overrides a base component method execute the original base component method. This technique lets your subclassed component override a method without losing the ability to call the original version of the method.

Using component inheritance

Component inheritance lets you import component methods and properties from one component to another component. Inherited components share any component methods or properties that they inherit from other components, and ColdFusion initializes instance data in the parent CFC when you instantiate the CFC that extends it.

When using component inheritance, inheritance should define an is a relationship between components. For example, a component named president.cfc inherits its methods and properties from manager.cfc, which inherits its methods and properties from employee.cfc. In other words, president.cfc is a manager.cfc; manager.cfc is an employee.cfc; and president.cfc is an employee.cfc.

In this example, employee.cfc is the base component; it's the component upon which the others are based. The manager component extends the employee component; it has all the methods and properties of the employee component, and some additional ones. The president component extends the manager component. The president component is called a subcomponent or child component of the manager component, which, in turn, is a child component of the employee component.

1. Create the employee.cfc file with the following content:

```
<cfcomponent>
  <cfset This.basesalary=40*20>
</cfcomponent>
```

2. Create the manager.cfc file with the following content:

```
<cfcomponent extends="employee">
  <cfset This.mgrBonus=40*10>
</cfcomponent>
```

In the example, the `cfcomponent` tag's `extends` attribute points to the `employee` component.

3. Create the president.cfc file with the following content:

```
<cfcomponent extends="manager">
  <cfset This.prezBonus=40*20>
```
In the example, the `cfcomponent` tag's `extends` attribute points to the `manager` component.

4. Create the `inherit.cfm` file with the following content, and save it in the same directory as the components you created in the previous steps:

```cfm
<cfobject name="empObj" component="employee">
<cfobject name="mgrObj" component="manager">
<cfobject name="prezObj" component="president">
<cfoutput>
An employee's salary is #empObj.basesalary# per week.<br>
A manager's salary is #mgrObj.basesalary + mgrObj.mgrBonus# per week.<br>
A president's salary is #prezObj.basesalary + prezObj.mgrBonus + prezObj.PrezBonus# per week.
</cfoutput>
</cfobject>
</cfcomponent>
```

When you browse the ` inherit.cfm` file, the `manager` component refers to the `basesalary` defined in `employee.cfc`, which is the base component; the `president` component refers to both the `basesalary` defined in the `employee` component, and the `mgrBonus` defined in the `manager` component. The `manager` component is the parent class of the `president` component.

**Using the component.cfc file**

All CFCs automatically extend the ColdFusion WEB-INF/cftags/component.cfc component. (The WEB-INF directory is in the `cf_root/wwwroot` directory on ColdFusion configured with an embedded J2EE server. It is in the `cf_root` directory when you deploy ColdFusion on a J2EE server.) This CFC is distributed as a zero-length file. You can use it for any core methods or properties that you want all CFCs in your ColdFusion application server instance to inherit.

**Note:** When you install a newer version of ColdFusion, the installation procedure replaces the existing `component.cfc` file with a new version. Therefore, before upgrading, you should save any code that you have added to the `component.cfc` file, and then copy the code into the new `component.cfc` file.

**Using the Super keyword**

You use the `Super` keyword only on CFCs that use the `Extends` attribute to extend another CFC. Unlike ColdFusion scopes, the `Super` keyword is not used for variables; it is only used for CFC methods, and it is not available on ColdFusion pages that invoke CFCs.

The `Super` keyword lets you refer to versions of methods that are defined in the CFC that the current component extends. For example, the `employee`, `manager`, and `president` CFCs each contain a `getPaid` method. The `manager` CFC extends the `employee` CFC. Therefore, the `manager` CFC can use the original versions of the overridden `getPaid` method, as defined in the `employee` CFC, by prefixing the method name with `Super`.

1. Create the `employee.cfc` file with the following content:

```cfm
<cfcomponent>
  <cffunction name="getPaid" returntype="numeric">
    <cfset var salary=40*20>
    <cfreturn salary>
  </cffunction>
</cfcomponent>
```

2. Create the `manager.cfc` file with the following content:

```cfm
<cfcomponent extends="employee">
  <cffunction name="getPaid" returntype="numeric">
    <cfset var salary=1.5 * Super.getPaid()>
    <cfreturn salary>
  </cffunction>
</cfcomponent>
```
3 Create the president.cfc file with the following content:

```<cfcomponent extends="manager">
<cffunction name="getPaid" returntype="numeric">
<cfset var salary = 1.5 * Super.getPaid()>
<cfreturn salary>
</cffunction>
</cfcomponent>
```

4 Create the payday.cfm file with the following content, and save it in the same directory as the components that you created in the previous steps:

```<cfobject name="empObj" component="employee"/>
<cfobject name="mgrObj" component="manager"/>
<cfobject name="prezObj" component="president"/>
<cfoutput>
    An employee earns #empObj.getPaid()#.\n    A manager earns #mgrObj.getPaid()#.\n    The president earns #prezObj.getPaid()#.\n</cfoutput>
```

In this example, each `getPaid` method in a child component invoked the `getPaid` method of its parent component. The child's `getPaid` method then used the salary returned by the parent's `getPaid` method to calculate the appropriate amount.

Included pages can use the Super keyword.

*Note:* The Super keyword supports only one level of inheritance. If you use multiple levels of inheritance, you can only use the Super keyword to access the current component's immediate parent. The example in this section illustrates handling this limitation by invoking methods in a chain.

**Using component packages**

Components stored in the same directory are members of a component package. Component packages help prevent naming conflicts, and facilitate easy component deployment; for example:

- ColdFusion searches the current directory first for a CFC. If you put two components in a single directory as a package, and one component refers to the other with only the component name, not a qualified path, ColdFusion always searches the package directory first for the component. As a result, if you structure each application's components into a package, your applications can use the same component names without sharing the component code.

- If you use the `access="package"` attribute in a method's `cffunction` tag, access to the method is limited to components in the same package. Components in other packages cannot use this method, even if they specify it with a fully qualified component name. For more information on access security, see “Using access security” on page 185.

**Invoke a packaged component method with the cfinvoke tag**

1 In your web root directory, create a directory named `appResources`.

2 In the `appResources` directory, create a directory named `components`.

3 Copy the `tellTime2.cfc` file you created in “Invoking methods of a CFC instance” on page 172 and the `getUTCTime.cfm` file that you created in “Putting executable code in a separate file” on page 162 to the components directory.

4 Create the `timeDisplay.cfm` file with the following content and save it in your web root directory:

```<!--- Create the component instance. --->
```
<cfobject component="appResources.components.tellTime2" name="tellTimeObj">

<!--- Invoke the methods. --->
<cfinvoke component="#tellTimeObj#" method="getLocalTime"
    returnvariable="#localTime#" >
<cfinvoke component="#tellTimeObj#" method="getUTCTime"
    returnvariable="#UTCTime#" >

<!--- Display the results. --->
<h3>Time Display Page</h3>
<cfoutput>
    Server's Local Time: #localTime#
    Calculated UTC Time: #UTCTime#
</cfoutput>

You use dot syntax to navigate directory structures. Place the directory name before the component name.

5   Browse the timeDisplay.cfm file in your browser.

The following example shows a CFScript invocation:

<cfscript>
helloCFC = createObject("component", "appResources.components.catQuery");
helloCFC.getSaleItems();
</cfscript>

The following example shows a URL invocation:

http://localhost/appResources/components/catQuery.cfc?method=getSalesItems

Using CFCs in persistent scopes

You can put a CFC instance in the Session or Application scope. This way, the component properties continue to
exist while the scope persists. For example, you might want to use a CFC for a shopping cart application, where the
shopping cart contents must persist for the length of the user's session. If you put the shopping cart CFC in the
Session scope, you can use component properties to store the cart contents. For example, the following line creates
an instance of the shoppingCart component in the Session scope:

<cfobject name="Session.myShoppingCart" component="shoppingCart">

Code that manipulates persistent scope CFC properties must be locked, just as all other code that manipulates
persistent scope properties must be locked. Therefore, you must lock both of the following types of application code:

- Code that directly manipulates properties of a persistent scope CFC instance
- Code that calls methods of a persistent scope CFC instance that manipulate properties of the instance

If you put multiple CFC instances in a single persistent scope, you can create a named lock for each CFC instance.
For more information on locking, see "Using Persistent Data and Locking" on page 272.

Note: Session scope CFCs cannot be serialized, so you cannot use them with clustered sessions; for example, if you want
to support session failover among servers.

Building secure ColdFusion components

To restrict access to component methods, ColdFusion components use access, role-based, or programmatic security.

Using access security

CFC access security lets you limit the code that can access the components. You specify the access to a CFC method
by specifying the cffunction access attribute, as follows:
Using role-based security

If you specify a `roles` attribute in a `cffunction` tag, only users who are logged in with one of the specified roles can execute the method. When a user tries to invoke a method that he or she is not authorized to invoke, an exception is returned.

The following example creates a component method that deletes files:

```coldfusion
<cfcomponent>
  <cffunction name="deleteFile" access="remote" roles="admin,manager" output="no">
    <cfargument name="filepath" required="yes">
    <cffile action="DELETE" file=#arguments.filepath#>
  </cffunction>
</cfcomponent>
```

In the example, the `cffunction` tag includes the `roles` attribute to specify the user roles allowed to access it. In this example, only users in the role `admin` and `manager` can access the function. Notice that multiple roles are delimited by a comma.

For information on ColdFusion security, including the `cflogin` tag and role-based security in ColdFusion, see “Securing Applications” on page 311.

Using programmatic security

You can implement your own security within a method to protect resources. For example you can use the ColdFusion function `IsUserInAnyRole` to determine if a user is in particular role, as the following example shows:

```coldfusion
<cffunction name="foo">
  <cfif IsUserInRole("admin")>
    do stuff allowed for admin
  <cfelseif IsUserInRole("user")>
    do stuff allowed for user
  <cfelse>
    <cfoutput>unauthorized access</cfoutput>
    <cfabort>
  </cfif>
</cffunction>
```

Using introspection to get information about components

ColdFusion provides several ways for you to get information about components:

- Request a component page from the browser
- Use the ColdFusion component browser
- Use the Adobe® Dreamweaver® Components panel

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>private</td>
<td>Available only to the component that declares the method and any components that extend the component in which it is defined. This usage is similar to the Java protected keyword, not the Java private keyword.</td>
</tr>
<tr>
<td>package</td>
<td>Available only to the component that declares the method, components that extend the component, or any other components in the package. A package consists of all components defined in a single directory. For more information on packages, see “Using component packages” on page 184.</td>
</tr>
<tr>
<td>public</td>
<td>Available to any locally executing ColdFusion page or component method.</td>
</tr>
<tr>
<td>remote</td>
<td>Available to a locally or remotely executing ColdFusion page or component method, or to a local or remote client through a URL, form submission, Flash Remoting, or as a web service.</td>
</tr>
</tbody>
</table>
• Use the GetMetaData function

Development teams can use the information about components as up-to-date API reference information.

**Note:** For information about how to include documentation in CFCs for display by using introspection, see "Documenting CFCs" on page 168.

**Requesting a component page from the browser**

When you access a CFC directly with a web browser without specifying a component method, the following chain of events occurs:

1. The request is redirected to the cfcexplorer.cfc file, which is located in the `cf_root/wwwroot/CFIDE/componentutils` directory.
2. The cfcexplorer component prompts users for the ColdFusion RDS or Administrator password, if necessary.
3. The cfcexplorer component renders an HTML description and returns it to the browser.

**Using the ColdFusion component browser**

You can also browse the components available in ColdFusion using the component browser, which is located at `cf_root/wwwroot/CFIDE/componentutils/componentdoc.cfm`.

The browser has three panes:

- The upper-left pane lists all CFC packages that ColdFusion can access, and has all components and refresh links.
- The lower-left pane lists CFC component names. When the browser first appears, or when you click the all components link in the upper pane, the lower pane lists all available components. If you click a package name in the upper left pane, the lower pane lists only the components in the package.
- The right pane initially lists the paths of all components. When you click a component name in the lower-left pane, the right pane shows the ColdFusion introspection page, as described in "Requesting a component page from the browser" on page 187.

**Note:** When RDS user names are enabled, the component browser accepts the root administrator user (admin) with either the administrator or RDS single password.

**Using the Dreamweaver Components panel**

The Dreamweaver Components panel lists all available components, including their methods, method parameters, and properties. The panel's context menu includes options to create a new component, edit the selected component, insert code to invoke the component, or show detailed information on the component or component element. The Get description option shows the ColdFusion introspection page, as described in "Requesting a component page from the browser" on page 187. For more information on viewing and editing CFCs in Dreamweaver, see the Dreamweaver online Help.

**Using the GetMetaData function**

The CFML GetMetaData function returns a structure that contains all the metadata of a CFC instance. This structure contains substantially more data about the CFC than the `cfdump` tag shows, and includes the following information:

- All attributes to the component tag, including any metadata-only attributes, plus the component path.
- An array of structures that contains complete information on each method (function) in the component. This information describes all attributes, including metadata-only function and parameter attributes.
• Within each function structure, a Parameters element that contains an array of parameters specified by cfargument tags. Information on each parameter includes any metadata-only attributes.
• Information about any properties that are specified using the cfproperty tag.

Display metadata for a CFC
1 Create the tellAboutCfcs.cfm file in the same directory as the telltime.cfc file, with the following code:

```coldfusion
<!--- Create an instance of the component. --->
<cfobject component="tellTime" name="tellTimeObj">
<!--- Create a new structure. --->
<cfset aboutcfc=structNew()>
<!--- Populate the structure with the metadata for the tellTimeObj instance of the tellTime CFC. --->
<cfset aboutcfc=GetMetaData(tellTimeObj)>
<cfdump var="aboutcfc">
```

2 View the tellAboutCfcs.cfm file in a browser.

For information on how to specify CFC metadata, including how to use component tags and how to specify metadata-only attributes, see “Documenting CFCs” on page 168.

ColdFusion component example

A number of code examples in the ColdFusion Developer's Guide reuse code, particularly queries. To illustrate the advantages of CFCs, these examples invoke the appropriate method in the CFC that appears in the following example. Although Adobe recommends using CFCs to create structured, reusable code, some code examples in this manual contain queries within a CFML page, rather than invoking a CFC, in order to clearly illustrate a particular element of ColdFusion.

```coldfusion
<cffunction>
  <cfset var getNames="">
  <cfquery name="getNames" datasource="cfdocexamples">
    SELECT * FROM Employee
  </cfquery>
</cffunction>

<cffunction>
  <cfset var EmpList="">
  <cfquery name="EmpList" datasource="cfdocexamples">
    SELECT Firstname, Lastname, Salary, Contract FROM Employee
  </cfquery>
</cffunction>

<cffunction>
  <cfset var engquery="">
  <cfquery name="engquery" datasource="cfdocexamples">
    SELECT FirstName || ' ' || LastName AS FullName FROM Employee
  </cfquery>
</cffunction>
```
<cffunction name="bydept" access="public" output="false" returntype="query">
  <cfset var deptquery="">
  <cfquery name="deptquery" datasource="cfdocexamples">
    SELECT Dept_ID, FirstName || ' ' || LastName
    AS FullName
    FROM Employee
    ORDER BY Dept_ID
  </cfquery>
</cffunction>

<cffunction name="employeebyURLID" access="public" output="false" returntype="query">
  <cfset var GetRecordtoUpdate="">
  <cfquery name="GetRecordtoUpdate" datasource="cfdocexamples">
    SELECT * FROM Employee
    WHERE Emp_ID = #URL.Emp_ID#
  </cfquery>
</cffunction>

<cffunction name="deleteemployee" access="public" output="false" returntype="void">
  <cfset var DeleteEmployee="">
  <cfquery name="DeleteEmployee" datasource="cfdocexamples">
    DELETE FROM Employee
    WHERE Emp_ID = #Form.Emp_ID#
  </cfquery>
</cffunction>

<cffunction name="distinctlocs" access="public" output="false" returntype="void">
  <cfset var GetDepartments="">
  <cfquery name="GetDepartments" datasource="cfdocexamples">
    SELECT DISTINCT Location
    FROM Departmt
  </cfquery>
</cffunction>
</cfcomponent>
Chapter 11: Creating and Using Custom CFML Tags

You can extend CFML by creating and using custom CFML tags that encapsulate common code.

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Creating custom tags

Custom tags let you extend CFML by adding your own tags to the ones supplied with ColdFusion. After you define a custom tag, you can use it on a ColdFusion page just as you would any of the standard CFML tags, such as `cfquery` and `cfoutput`.

You use custom tags to encapsulate your application logic so that it can be referenced from any ColdFusion page. Custom tags allow for rapid application development and code reuse while offering off-the-shelf solutions for many programming chores.

For example, you might create a custom tag, named `cf_happybirthday`, to generate a birthday message. You could then use that tag in a ColdFusion page, as follows:

```cf_happybirthday name="Ted Cantor" birthDate="December 5, 1987">
```

When ColdFusion processes the page containing this tag, it could output the message:

December 5, 1987 is Ted Cantor’s Birthday.
Please wish him well.

A custom tag can also have a body and end tag, for example:

```<cf_happybirthdayMessage name="Ellen Smith" birthDate="June 8, 1993">
<p> Happy Birthday Ellen!</p>
<p> May you have many more!</p>
</cf_happybirthdayMessage>
```

This tag could output the message:

June 8, 1993 is Ellen Smith’s Birthday.
Happy Birthday Ellen!
May you have many more!

For more information about using end tags, see “Handling end tags” on page 198.
Creating and calling custom tags

You implement a custom tag with a single ColdFusion page. You then call the custom tag from a ColdFusion page by inserting the prefix cf_ before the page's filename. The page that references the custom tag is referred to as the calling page.

1. Create a ColdFusion page, the custom tag page, that shows the current date:
   ```cfml
   <cfoutput>#DateFormat(Now())#</cfoutput>
   ```

2. Save the file as date.cfm.

3. Create a ColdFusion page, the calling page, with the following content:
   ```cfml
   <html>
   <head>
   <title>Date Custom Tag</title>
   </head>
   <body>
   <!--- Call the custom tag defined in date.cfm --->
   <cf_date>
   </cf_date>
   </body>
   </html>
   ```

4. Save the file as callingdate.cfm.

5. View callingdate.cfm in your browser.

   This custom tag returns the current date in the format DD-MMM-YY.

As you can see from this example, creating a custom tag in CFML is no different from writing any ColdFusion page. You can use all CFML constructs, as well as HTML. You are free to use any naming convention that fits your development practice. Unique descriptive names make it easy for you and others to find the right tag.

**Note:** Although tag names in ColdFusion pages are case-insensitive, custom tag filenames must be lowercase on UNIX.

Storing custom tag pages

You must store custom tag pages in any one of the following:

- The same directory as the calling page
- The cfusion\CustomTags directory
- A subdirectory of the cfusion\CustomTags directory
- A directory that you specify in the ColdFusion Administrator

To share a custom tag among applications in multiple directories, place it in the cfusion\CustomTags directory. You can create subdirectories to organize custom tags. ColdFusion searches recursively for the Custom Tags directory, stepping down through any existing subdirectories until the custom tag is found.

You might have a situation where you have multiple custom tags with the same name. To guarantee which tag ColdFusion calls, copy it to the same directory as the calling page. Or, use the cfmodule tag with the template attribute to specify the absolute path to the custom tag. For more information on cfmodule, see the next section.

Calling custom tags with the cfmodule tag

You can also use the cfmodule tag to call custom tags if you want to specify the location of the custom tag page. The cfmodule tag is useful if you are concerned about possible name conflicts when invoking a custom tag, or if the application must use a variable to dynamically call a custom tag at runtime.
You must use either a `template` or `name` attribute in the tag, but you cannot use both. The following table describes the basic `cfmodule` attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
</table>
| `template` | Required if the `name` attribute is not used. Same as the `template` attribute in `cfinclude`. This attribute:  
• Specifies a path relative to the directory of the calling page.  
• If the path value is prefixed with "/", ColdFusion searches directories explicitly mapped in the ColdFusion Administrator for the included file.  
Example: `<cfmodule template="/MyTag.cfm">` identifies a custom tag file in the parent directory. |
| `name` | Required if the `template` attribute is not used. Use period-separated names to uniquely identify a subdirectory under the CustomTags root directory.  
Example: `<cfmodule name="MyApp.GetUserOptions">` identifies the file GetUserOptions.cfm in the CustomTags\MyApp directory under the ColdFusion root directory. |
| `attributes` | The custom tag's attributes. |

For example, the following code specifies to execute the custom tag defined by the mytag.cfm page in the parent directory of the calling page:

```cfmodule template="/./mytag.cfm">
```

For more information on using the `cfmodule` tag, see the CFML Reference.

**Calling custom tags with the `cfimport` tag**

You can use the `cfimport` tag to import custom tags from a directory as a tag library. The following example imports the tags from the directory myCustomTags:

```cfimport prefix="mytags" taglib="myCustomTags">
```

Once imported, you call the custom tags using the prefix that you set when importing, as the following example shows:

```mytags:customTagName>
```

where `customTagName` corresponds to a ColdFusion application page named `customTagName.cfm`. If the tag takes attributes, you include them in the call:

```mytags:custom_tag_name attribute1=val_1 attribute2=val_2>
```

You can also include end tags when calling your custom tags, as the following example shows:

```mytags:custom_tag_name attribute1=val_1 attribute2=val_2>
   ...
</mytags:custom_tag_name>
```

ColdFusion calls the custom tag page twice for a tag that includes an end tag: once for the start tag and once for the end tag. For more information on how ColdFusion handles end tags, and how to write your custom tags to handle them, see “Handling end tags” on page 198.

One of the advantages to using the `cfimport` tag is that you can define a directory structure for your custom tags to organize them by category. For example, you can put all security tags in one directory, and all interface tags in another. You then import the tags from each directory and give them a different prefix:

```cfimport prefix="security" taglib="securityTags">
<cfimport prefix="ui" taglib="uiTags">
   ...
<security:validateUser name="Bob">
```
Reading your code becomes easier because you can identify the location of your custom tags from the prefix.

**Securing custom tags**

The ColdFusion security framework enables you to selectively restrict access to individual tag files and tag directories. This can be an important safeguard in team development. For details, see *Configuring and Administering ColdFusion*.

**Accessing existing custom tags**

Before creating a custom tag in CFML, you should review the free and commercial custom tags available on the Adobe developer’s exchange (www.adobe.com/devnet/coldfusion/index.html). You might find a tag that does what you want.

Tags are grouped in several broad categories and are downloadable as freeware, shareware, or commercial software. You can view each tag’s syntax and usage information. The gallery contains a wealth of background information on custom tags and an online discussion forum for tag topics.

Tag names with the `cf_` preface are CFML custom tags; those with the `cfx_` preface are ColdFusion extensions written in C++. For more information about the CFX tags, see “Building Custom CFXAPI Tags” on page 205.

If you do not find a tag that meets your specific needs, you can create your own custom tags in CFML.

**Passing data to custom tags**

To make your custom tags flexible, you often pass data to them for processing. To do this, you write custom tags that take tag attributes and other data as input from a calling page.

**Passing values to and from custom tags**

Because custom tags are individual ColdFusion pages, variables and other data are not automatically shared between a custom tag and the calling page. To pass data from the calling page to the custom tag, you can specify attribute name-value pairs in the custom tag, just as you do for normal HTML and CFML tags.

For example, to pass the value of the `NameYouEntered` variable to the `cf_getmd` tag, you can call the custom tag as follows:

```cfml
<cf_getmd Name=#NameYouEntered#>
```

To pass multiple attributes to a custom tag, separate them with a space in the tag as follows:

```cfml
<cf_mytag Firstname="Thadeus" Lastname="Jones">
```

In the custom tag, you use the `Attributes` scope to access attributes passed to the tag. Therefore, in the getmd.cfm page, you refer to the passed attribute as `Attributes.Name`. The mytag.cfm custom tag page refers to the passed attributes as `Attributes.Firstname` and `Attributes.Lastname`. 
The custom tag page can also access variables set in the calling page by prefixing the calling page’s local variable with Caller. However, this is not the best way to pass information to a custom tag, because each calling page would be required to create variables with the names required by the custom tag. You can create more flexible custom tags by passing parameters using attributes.

Variables created within a custom tag are deleted when the processing of the tag terminates. Therefore, if you want to pass information back to the calling page, you must write that information back to the Caller scope of the calling page. You cannot access the custom tag’s variables outside the custom tag itself.

For example, use the following code in the getmd.cfm page to set the variable Doctor on the calling page:

```
<cfset Caller.Doctor="Doctor " & Attributes.Name>
```

If the variable Doctor does not exist in the calling page, this statement creates it. If the variable exists, the custom tag overwrites it.

The following image shows the relationship between the variables on the calling page and the custom tag:

One common technique used by custom tags is for the custom tag to take as input an attribute that contains the name of the variable to use to pass back results. For example, the calling page passes returnHere as the name of the variable to use to pass back results:

```
<cf_mytag resultName="returnHere">
```

In mytag.cfm, the custom tag passes back its results using the following code:

```
<cfset "Caller.#Attributes.resultName# = result>
```

Be careful not to overwrite variables in the calling page from the custom tag. You should adopt a naming convention to minimize the chance of overwriting variables. For example, prefix the returned variable with customtagname_, where customtagname is the name of the custom tag.

Note: Data that pertains to the HTTP request or to the current application is visible in the custom tag page. This includes the variables in the Form, Url, Cgi, Request, Cookies, Server, Application, Session, and Client scopes.

Using tag attributes summary

Custom tag attribute values are passed from the calling page to the custom tag page as name-value pairs. CFML custom tags support required and optional attributes. Custom tag attributes conform to the following CFML coding standards:

- ColdFusion passes any attributes in the Attributes scope.
- Use the `Attributes.attribute_name` syntax when referring to passed attributes to distinguish them from custom tag page local variables.
- Attributes are case-insensitive.
- Attributes can be listed in any order within a tag.
- Attribute name-value pairs for a tag must be separated by a space in the tag invocation.
Passed values that contain spaces must be enclosed in double-quotation marks.

Use the `cfparam` tag with a `default` attribute at the top of a custom tag to test for and assign defaults for optional attributes that are passed from a calling page. For example:

```cfml
<!--- The value of the variable Attributes.Name comes from the calling page. If
the calling page does not set it, make it "Who". --->
<cfparam name=" Attributes.Name" default="Who">
```

1 Use the `cfparam` tag or a `cfif` tag with an `IsDefined` function at the top of a custom tag to test for required attributes that must be passed from a calling page; for example, the following code issues an abort if the user does not specify the `Name` attribute to the custom tag:

```cfml
<cfif not IsDefined("Attributes.Name")>
  <cfabort showError="The Name attribute is required.">
</cfif>
```

**Custom tag example with attributes**

The following example creates a custom tag that uses an attribute that is passed to it to set the value of a variable called `Doctor` on the calling page.

1 Create a ColdFusion page (the calling page) with the following content:

```cfml
<html>
<head>
  <title>Enter Name</title>
</head>
<body>
  <!--- Enter a name, which could also be done in a form. --->
  <!--- This example simply uses a cfset. --->
  <cfset NameYouEntered="Smith">
  <!--- Display the current name. --->
  <cfoutput>
    Before you leave this page, you're #Variables.NameYouEntered#.\n  </cfoutput>
  <!--- Go to the custom tag. --->
  <cf_getmd Name="#NameYouEntered#">
  <!--- Come back from the Custom tag --->
  <!--- Display the results of the custom tag. --->
  <cfoutput>
    You are now #Variables.Doctor#.\n  </cfoutput>
</body>
</html>
```

2 Save the page as `callingpage.cfm`.

3 Create another page (the custom tag) with the following content:

```cfml
<!--- The value of the variable Attributes.Name comes from the calling page.
If the calling page does not set it, make it "Who". --->
<cfparam name="Attributes.Name" default="Who">

<!--- Create a variable called Doctor, make its value "Doctor 
followed by the value of the variable Attributes.Name.
Make its scope Caller so it is passed back to the calling page. --->
<cfset Caller.Doctor="Doctor " & Attributes.Name>
```
4  Save the page as getmd.cfm.
5  Open the file callingpage.cfm in your browser.

The calling page uses the getmd custom tag and displays the results.

**Reviewing the code**
The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfset NameYouEntered=&quot;Smith&quot;&gt;</code></td>
<td>In the calling page, create a variable <code>NameYouEntered</code> and assign it the value <code>Smith</code>.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt; Before you leave this page, you’re #Variables.NameYouEntered#.br&lt;/cfoutput&gt;</code></td>
<td>In the calling page, display the value of the <code>NameYouEntered</code> variable before calling the custom tag.</td>
</tr>
<tr>
<td><code>&lt;cf_getmd Name=&quot;#NameYouEntered#&quot;&gt;</code></td>
<td>In the calling page, call the getmd custom tag and pass it the <code>Name</code> attribute whose value is the value of the local variable <code>NameYouEntered</code>.</td>
</tr>
<tr>
<td><code>&lt;cfparam name=&quot;Attributes.Name&quot; default=&quot;Who&quot;&gt;</code></td>
<td>The custom tag page normally gets the <code>Name</code> variable in the Attributes scope from the calling page. Assign it the value <code>Who</code> if the calling page did not pass an attribute.</td>
</tr>
<tr>
<td><code>&lt;cfset Caller.Doctor=&quot;Doctor &quot; &amp; Attributes.Name&gt;</code></td>
<td>In the custom tag page, create a variable called <code>Doctor</code> in the Caller scope so it exists in the calling page as a local variable. Set its value to the concatenation of the string <code>&quot;Doctor&quot;</code> and the value of the <code>Attributes.Name</code> variable.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt; You are now #Variables.Doctor#.br&lt;/cfoutput&gt;</code></td>
<td>In the calling page, display the value of the <code>Doctor</code> variable returned by the custom tag page. (This example uses the Variables scope prefix to emphasize the fact that the variable is returned as a local variable.)</td>
</tr>
</tbody>
</table>

**Passing custom tag attributes by using CFML structures**
You can use the reserved attribute `attributeCollection` to pass attributes to custom tags using a structure. The `attributeCollection` attribute must reference a structure containing the attribute names as the keys and the attribute values as the values. You can freely mix `attributeCollection` with other attributes when you call a custom tag.

The key-value pairs in the structure specified by the `attributeCollection` attribute get copied into the custom tag page's Attributes scope. This has the same effect as specifying the `attributeCollection` entries as individual attributes when you call the custom tag. The custom tag page refers to the attributes passed using `attributeCollection` the same way as it does other attributes; for example, as `Attributes.CustomerName` or `Attributes.Department_number`.

**Note:** You can combine tag attributes and the `attributeCollection` attribute when you use a custom tag directly or when you use the `cfmodule` tag to invoke a custom tag. If you pass an attribute with the same name both explicitly and in the `attributeCollection` structure, ColdFusion passes only the tag attribute to the custom tag and ignores the corresponding attribute from the attribute collection. You cannot combine tag attributes and the `attributeCollection` attribute when you use standard (built-in) ColdFusion tags.

Custom tag processing reserves the `attributeCollection` attribute to refer to the structure holding a collection of custom tag attributes. If `attributeCollection` does not refer to such a collection, ColdFusion generates a template exception.
The following example uses an `attributeCollection` attribute to pass two of four attributes:

```cfscript
<cfset zort=StructNew()>
<cfset zort.x = "-X-"=
<cfset zort.y = "-Y-"=
<cf_testtwo a="blab" attributeCollection=#zort# foo="16">

If `testtwo.cfm` contains the following code:

```cfm
---custom tag ---
<cfoutput>#attributes.a# #attributes.x# #attributes.y# #attributes.foo#</cfoutput>
--- end custom tag ---
```

its output is the following statement:

```cfm
---custom tag ---
blab -X- -Y- 16
--- end custom tag ---
```

One use for `attributeCollection` is to pass the entire `Attributes` scope of one custom tag to another. This often happens when you have one custom tag that calls a second custom tag and you want to pass all attributes from the first tag to the second.

For example, you call a custom tag with the following code:

```cfscript
<cf_first attr1="foo" attr2="bar">
```

To pass all the attributes of the first custom tag to the second, you include the following statement in `first.cfm`:

```cfscript
<cf_second attributeCollection="#attributes#"
```

Within the body of `second.cfm`, you reference the parameters passed to it as follows:

```cfoutput
#attributes.attr1#
#attributes.attr2#
```

### Managing custom tags

If you deploy custom tags in a multideveloper environment or distribute your tags publicly, you can use the advanced security and template encoding capabilities of ColdFusion.

The ColdFusion security framework enables you to selectively restrict access to individual tags or to tag directories. This can be an important safeguard in team development. For more information, see “Securing Applications” on page 311.

You can use the command-line utility `cfcompile` to precompile your custom tag files into Java class files or byte code. For more information, see “Using the cfcompile utility” on page 77 in Configuring and Administering ColdFusion.

### Executing custom tags

ColdFusion provides techniques for executing custom tags, including handling end tags and processing body text.
Accessing tag instance data

When a custom tag page executes, ColdFusion keeps data related to the tag instance in the `thisTag` structure. You can access the `thisTag` structure from within your custom tag to control processing of the tag. The behavior is similar to the `File` tag-specific variable (sometimes called the `File scope`).

ColdFusion generates the variables in the following table and writes them to the `thisTag` structure:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExecutionMode</td>
<td>Contains the execution mode of the custom tag. Valid values are 'start', 'end', and 'inactive'.</td>
</tr>
<tr>
<td>HasEndTag</td>
<td>Distinguishes between custom tags that are called with and without end tags. Used for code validation. If the user specifies an end tag, <code>HasEndTag</code> is set to <code>true</code>; otherwise, it is set to <code>false</code>.</td>
</tr>
<tr>
<td>GeneratedContent</td>
<td>Specifies the content that is generated by the tag. This includes anything in the body of the tag, including the results of any active content, such as ColdFusion variables and functions. You can process this content as a variable.</td>
</tr>
<tr>
<td>AssocAttribs</td>
<td>Contains the attributes of all nested tags if you use <code>cfassociate</code> to make them available to the parent tags. For more information, see &quot;High-level data exchange&quot; on page 202.</td>
</tr>
</tbody>
</table>

The following example accesses the `ExecutionMode` variable of the `thisTag` structure from within a custom tag:

```cfif thisTag.ExecutionMode is 'start'>```

Handling end tags

The preceding examples of custom tags in this topic all reference a custom tag by using just a start tag:

```<cf_date>```

In this case, ColdFusion calls the custom tag page `date.cfm` to process the tag.

However, you can create custom tags that have both a start and an end tag. For example, the following tag has both a start and an end tag:

```<cf_date>
...
</cf_date>```

ColdFusion calls the custom tag page `date.cfm` twice for a tag that includes an end tag: once for the start tag and once for the end tag. As part of the `date.cfm` page, you can determine if the call is for the start or end tag, and perform the appropriate processing.

ColdFusion also calls the custom tag page twice if you use the shorthand form of an end tag:

```<cf_date/>```

You can also call a custom tag using the `cfmodule` tag, as shown in the following example:

```<cfmodule ...
...
</cfmodule>```

If you specify an end tag to `cfmodule`, then ColdFusion calls your custom tag as if it had both a start and an end tag.

Determining if an end tag is specified

You can write a custom tag that requires users to include an end tag. If a tag must have an end tag provided, you can use `thisTag.HasEndTag` in the custom tag page to verify that the user included the end tag.

For example, in `date.cfm`, you could include the following code to determine whether the end tag is specified:
Determining the tag execution mode

The variable `thisTag.ExecutionMode` contains the mode of invocation of a custom tag page. The variable has one of the following values:

- **Start**: Mode for processing the start tag.
- **End**: Mode for processing the end tag.
- **Inactive**: Mode when the custom tag uses nested tags. For more information, see “Nesting custom tags” on page 201.

If an end tag is not explicitly provided, ColdFusion invokes the custom tag page only once, in Start mode.

A custom tag page named `bold.cfm` that makes text bold could be written as follows:

```coldfusion
<cfif thisTag.ExecutionMode is 'start'>
  <!--- Start tag processing --->
  <B>
<cfelse>
  <!--- End tag processing --->
</B>
</cfif>
```

You then use this tag to convert the text to bold:

```coldfusion
<cf_bold>This is bold text</cf_bold>
```

You can also use `cfswitch` to determine the execution mode of a custom tag:

```coldfusion
<cfswitch expression=#thisTag.ExecutionMode#>
  <cfcase value= 'start'>
    <!--- Start tag processing --->
  </cfcase>
  <cfcase value='end'>
    <!--- End tag processing --->
  </cfcase>
</cfswitch>
```

Considerations when using end tags

How you code your custom tag to divide processing between the start tag and end tag depends greatly on the function of the tag. However, use the following rules to help you make your decisions:

- Use the start tag to validate input attributes, set default values, and validate the presence of the end tag if it is required by the custom tag.
- Use the end tag to perform the actual processing of the tag, including any body text passed to the tag between the start and end tags. For more information on body text, see “Processing body text” on page 199.
- Perform output in either the start or end tag; do not divide it between the two tags.

Processing body text

Body text is any text that you include between the start and end tags when you call a custom tag, for example:

```coldfusion
<cf_happybirthdayMessage name="Ellen Smith" birthDate="June, 8, 1993">
  <p> Happy Birthday Ellen!</p>
  <p> May you have many more!</p>
</cf_happybirthdayMessage>
```
In this example, the two lines of code after the start tag are the body text.

You can access the body text within the custom tag using the `thisTag.GeneratedContent` variable. The variable contains all body text passed to the tag. You can modify this text during processing of the tag. The contents of the `thisTag.GeneratedContent` variable are returned to the browser as part of the tag's output.

The `thisTag.GeneratedContent` variable is always empty during the processing of a start tag. Any output generated during start tag processing is not considered part of the tag's generated content.

A custom tag can access and modify the generated content of any of its instances using the `thisTag.GeneratedContent` variable. In this context, the term `generated content` means the results of processing the body of a custom tag. This includes all text and HTML code in the body, the results of evaluating ColdFusion variables, expressions, and functions, and the results generated by descendant tags. Any changes to the value of this variable result in changes to the generated content.

As an example, consider a tag that comments out the HTML generated by its descendants. Its implementation could look like this:

```cfif thisTag.ExecutionMode is 'end'>
  <cfset thisTag.GeneratedContent = '<!--#thisTag.GeneratedContent#-->'>
</cfif>
```

### Terminating tag execution

Within a custom tag, you typically perform error checking and parameter validation. As part of those checks, you can choose to abort the tag, using `cfabort`, if a required attribute is not specified or other severe error is detected.

The `cfexit` tag also terminates execution of a custom tag. However, the `cfexit` tag is designed to give you more flexibility when coding custom tags than `cfabort`. The `cfexit` tag's `method` attribute specifies where execution continues. The `cfexit` tag can specify that processing continues from the first child of the tag or continues immediately after the end tag marker.

You can also use the `method` attribute to specify that the tag body executes again. This enables custom tags to act as high-level iterators, emulating `cfloop` behavior.

The following table summarizes `cfexit` behavior:

<table>
<thead>
<tr>
<th>Method attribute value</th>
<th>Location of cfexit call</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExitTag (default)</td>
<td>Base page</td>
<td>Acts like <code>cfabort</code></td>
</tr>
<tr>
<td></td>
<td><code>ExecutionMode=start</code></td>
<td>Continue after end tag</td>
</tr>
<tr>
<td></td>
<td><code>ExecutionMode=end</code></td>
<td>Continue after end tag</td>
</tr>
<tr>
<td>ExitTemplate</td>
<td>Base page</td>
<td>Acts like <code>cfabort</code></td>
</tr>
<tr>
<td></td>
<td><code>ExecutionMode=start</code></td>
<td>Continue from first child in body</td>
</tr>
<tr>
<td></td>
<td><code>ExecutionMode=end</code></td>
<td>Continue after end tag</td>
</tr>
<tr>
<td>Loop</td>
<td>Base page</td>
<td>Error</td>
</tr>
<tr>
<td></td>
<td><code>ExecutionMode=start</code></td>
<td>Error</td>
</tr>
<tr>
<td></td>
<td><code>ExecutionMode=end</code></td>
<td>Continue from first child in body</td>
</tr>
</tbody>
</table>
Nesting custom tags

A custom tag can call other custom tags from within its body text, thereby *nesting* tags. ColdFusion uses nested tags such as `cfgraph` and `cfgraphdata`, `cfhttp` and `cfhttpparam`, and `cftree` and `cftreeitem`. The ability to nest tags allows you to provide similar functionality.

The following example shows a `cftreeitem` tag nested within a `cftree` tag:

```cfml
<cfhttp name="http1" url="www.example.com">
    <cfhttpparam name="user" value="user1" />
    <cfhttpparam name="password" value="password1" />
    <cfhttpparam name="method" value="GET" />
    <cfhttpparam name="file" value="/users" />
</cfhttp>
```

The calling tag is known as an *ancestor*, *parent*, or *base* tag; the tags that ancestor tags call are known as *descendant*, *child*, or *sub* tags. Together, the ancestor and all descendant tags are called *collaborating* tags.

In order to nest tags, the parent tag must have a closing tag.

The following table lists the terms that describe the relationships between nested tags:

<table>
<thead>
<tr>
<th>Calling tag</th>
<th>Tag nested within the calling tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancestor</td>
<td>Descendant</td>
<td>An ancestor is any tag that contains other tags between its start and end tags. A descendant is any tag called by a tag.</td>
</tr>
<tr>
<td>Parent</td>
<td>Child</td>
<td>Parent and child are synonyms for ancestor and descendant.</td>
</tr>
<tr>
<td>Base tag</td>
<td>Sub tag</td>
<td>A base tag is an ancestor that you explicitly associate with a descendant, called a sub tag, with <code>cfassociate</code>.</td>
</tr>
</tbody>
</table>

You can create multiple levels of nested tags. In this case, the sub tag becomes the base tag for its own sub tags. Any tag with an end tag present can be an ancestor to another tag.

Nested custom tags operate through three modes of processing, which are exposed to the base tags through the variable `thisTag.ExecutionMode`.

**Passing data between nested custom tags**

A key custom tag feature is for collaborating custom tags to exchange complex data without user intervention, while encapsulating each tag's implementation so that others cannot see it.

When you use nested tags, you must address the following issues:

- What data should be accessible?
- Which tags can communicate to which tags?
- How are the source and targets of the data exchange identified?
- What CFML mechanism is used for the data exchange?

**What data is accessible?**

To enable developers to obtain maximum productivity in an environment with few restrictions, CFML custom tags can expose all their data to collaborating tags.
When you develop custom tags, you should document all variables that collaborating tags can access and/or modify. When your custom tags collaborate with other custom tags, you should make sure that they do not modify any undocumented data.

To preserve encapsulation, put all tag data access and modification operations into custom tags. For example, rather than documenting that the variable MyQueryResults in a tag's implementation holds a query result and expecting users to manipulate MyQueryResults directly, create a nested custom tag that manipulates MyQueryResult. This protects the users of the custom tag from changes in the tag's implementation.

Variable scopes and special variables

Use the Request scope for variables in nested tags. The Request scope is available to the base page, all pages it includes, all custom tag pages it calls, and all custom tag pages called by the included pages and custom tag pages. Collaborating custom tags that are not nested in a single tag can exchange data using the request structure. The Request scope is represented as a structure named Request.

Where is data accessible?

Two custom tags can be related in a variety of ways in a page. Ancestor and descendant relationships are important because they relate to the order of tag nesting.

A tag's descendants are inactive while the page is executed; that is, the descendent tags have no instance data. A tag, therefore, can only access data from its ancestors, not its descendants. Ancestor data is available from the current page and from the whole runtime tag context stack. The tag context stack is the path from the current tag element up the hierarchy of nested tags, including those in included pages and custom tag references, to the start of the base page for the request. Both cfinclude tags and custom tags appear on the tag context stack.

High-level data exchange

Although the ability to create nested custom tags is a tremendous productivity gain, keeping track of complex nested tag hierarchies can become a chore. The cfassociate tag lets the parent know what the children are up to. By adding this tag to a sub tag, you enable communication of its attributes to the base tag.

In addition, there are many cases in which descendant tags are used only as a means for data validation and exchange with an ancestor tag, such as cfhttp/cfhttpparam and cftree/cfitem. You can use the cfassociate tag to encapsulate this processing.

The cfassociate tag has the following format:

```
<cfassociate baseTag="tagName" dataCollection="collectionName">
```

The baseTag attribute specifies the name of the base tag that gets access to this tag's attributes. The dataCollection attribute specifies the name of the structure in which the base tag stores the sub-tag data. Its default value is AssocAt-tribs. You only need to specify a dataCollection attribute if the base tag can have more than one type of subtag. It is convenient for keeping separate collections of attributes, one per tag type.

Note: If the custom tag requires an end tag, the code processing the structure referenced by the dataCollection attribute must be part of end-tag code.

When cfassociate is encountered in a sub tag, the sub tag's attributes are automatically saved in the base tag. The attributes are in a structure appended to the end of an array whose name is thisTag.collectionName.

The cfassociate tag performs the following operations:

```
<!--- Get base tag instance data --->
  <cfset data = getBaseTagData(baseTag)>
```
<!--- Create a string with the attribute collection name --->
<cfset collection_Name = "data.#dataCollection#" >

<!--- Create the attribute collection, if necessary --->
<cfif not isDefined(collectionName)>
  <cfset #collection_Name# = arrayNew(1)>
</cfif>

<!--- Append the current attributes to the array --->
<cfset temp=arrayAppend(evaluate(collectionName), attributes)>

The code accessing sub-tag attributes in the base tag could look like the following:

<!--- Protect against no sub-tags --->
<cfparam Name='thisTag.assocAttribs' default=#arrayNew(1)#>

<!--- Loop over the attribute sets of all sub tags --->
<cfloop index=i from=1 to=#arrayLen(thisTag.assocAttribs)#>

  <!--- Get the attributes structure --->
  <cfset subAttribs = thisTag.assocAttribs[i]>

  <!--- Perform other operations --->
</cfloop>

Ancestor data access
The ancestor’s data is represented by a structure object that contains all the ancestor’s data.

The following functions provide access to ancestral data:

• GetBaseTagList(): Returns a comma-delimited list of uppercase ancestor tag names, as a string. The first list
  element is the current tag, the next element is the parent tag name if the current tag is a nested tag. If the function is
  called for a top-level tag, it returns an empty string.

• GetBaseTagData(TagName, InstanceNumber=1): Returns an object that contains all the variables (not just the
  local variables) of the nth ancestor with a given name. By default, the closest ancestor is returned. If there is no
  ancestor by the given name, or if the ancestor does not expose any data (such as cfif), an exception is thrown.

Example: ancestor data access
This example creates two custom tags and a simple page that calls each of the custom tags. The first custom tag calls
the second. The second tag reports on its status and provides information about its ancestors.

Create the calling page
1. Create a ColdFusion page (the calling page) with the following content:

    Call cf_nesttag1 which calls cf_nesttag2<br>
    <cf_nesttag1>
    <hr>
    Call cf_nesttag2 directly<br>
    <cf_nesttag2>
    <hr>

2. Save the page as nesttest.cfm.

Create the first custom tag page
1. Create a ColdFusion page with the following content:

    <cf_nesttag2>

2. Save the page as nesttag1.cfm.
Create the second custom tag page

1. Create a ColdFusion page with the following content:

```coldfusion
<cfif thisTag.executionmode is 'start'>
  <!--- Get the tag context stack. The list will look something like
  "MYTAGNAME, CALLINGTAGNAME, ..." --->
  <cfset ancestorlist = getbasetaglist()>

  <!--- Output your own name. You are the first entry in the context stack. --->
  <cfoutput>
    <p>I'm custom tag #ListGetAt(ancestorlist,1)#</p>
  </cfoutput>

  <!--- Output all the contents of the stack a line at a time. --->
  <cfloop index="loopcount" from="1" to="#listlen(ancestorlist)#">
    Ancestor list entry #loopcount# is #ListGetAt(ancestorlist,loopcount)#
  </cfloop>
</cfoutput>

<!--- Determine whether you are nested inside a custom tag. Skip the first
      element of the ancestor list, i.e., the name of the custom tag I'm in. --->
<cfset incustomtag = ''>
<cfloop index="elem" list="#listrest(ancestorlist)#">
  <cfif (left(elem, 3) eq 'cf_')>
    <cfset incustomtag = elem>
    <cfbreak>
  </cfif>
</cfloop>
<cfif incustomtag neq ''>
  <!--- Say you are there. --->
  <cfoutput>
    I'm running in the context of a custom tag named #inCustomTag#. <p>
  </cfoutput>
  <!--- Get the tag instance data. --->
  <cfset tagdata = getbasetagdata(inCustomTag)>
  <!--- Find out the tag's execution mode. --->
  I'm located inside the custom tag code either because it is in its start or end execution mode.
  <cfelse>
    body of the tag
  </cfif>
</cfif>
<p>
<cfelse>
  <!--- Say you are lonely. --->
  I'm not nested inside any custom tags. :'( <p>
</cfif>
</cfoutput>

2. Save the page as nesttag2.cfm.

3. Open the file nesttest.cfm in your browser.
Chapter 12: Building Custom CFXAPI Tags

Sometimes, the best approach to application development is to develop elements of your application by building executables to run with ColdFusion. Perhaps the application requirements go beyond what is currently feasible in CFML. Perhaps you can improve application performance for certain types of processing. Or, you have existing code that already solves an application problem and you want to incorporate it into your ColdFusion application.

To meet these types of requirements, you can use the ColdFusion Extension Application Programming Interface (CFX API) to develop custom ColdFusion tags based on Java or C++.

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Before you begin developing CFX tags in Java ........................................ 206
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ZipBrowser example .................................................................. 210
Approaches to debugging Java CFX tags ............................................ 211
Developing CFX tags in C++ ...................................................... 213

What are CFX tags?

ColdFusion Extension (CFX) tags are custom tags written against the ColdFusion Extension Application Programming Interface. Generally, you create a CFX tag if you want to do something that is not possible in CFML, or if you want to improve the performance of a repetitive task.

One common use of CFX tags is to incorporate existing application functionality into a ColdFusion application. That means if you already have the code available, CFX tags make it easy to use it in your application.

CFX tags can do the following:

• Handle any number of custom attributes.
• Use and manipulate ColdFusion queries for custom formatting.
• Generate ColdFusion queries for interfacing with non-ODBC based information sources.
• Dynamically generate HTML to be returned to the client.
• Set variables within the ColdFusion application page from which they are called.
• Throw exceptions that result in standard ColdFusion error messages.

You can build CFX tags using C++ or Java.

Note: ColdFusion provides several different techniques to create reusable code, including custom tags. For information on all of these techniques, see “Creating ColdFusion Elements” on page 126.
Before you begin developing CFX tags in Java

Before you begin developing CFX tags in Java, you must configure your Java development environment. Also, it might be helpful to review the examples in this topic before you create CFX tags.

Sample Java CFX tags

Before you begin developing a CFX tag in Java, you might want to study sample CFX tags. You can find the Java source files for the examples for Windows in the cfx\java\distrib\examples subdirectory of the main installation directory. In UNIX systems, the files are located in the cfx/java/examples directory. The following table describes the example tags:

<table>
<thead>
<tr>
<th>Example</th>
<th>Action</th>
<th>Demonstrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>HelloColdFusion</td>
<td>Prints a personalized greeting.</td>
<td>The minimal implementation required to create a CFX tag.</td>
</tr>
<tr>
<td>ZipBrowser</td>
<td>Retrieves the contents of a ZIP archive.</td>
<td>How to generate a ColdFusion query and return it to the calling page.</td>
</tr>
<tr>
<td>ServerDateTime</td>
<td>Retrieves the date and time from a network server.</td>
<td>Attribute validation, using numeric attributes, and setting variables within the calling page.</td>
</tr>
<tr>
<td>OutputQuery</td>
<td>Returns a ColdFusion query in an HTML table.</td>
<td>How to handle a ColdFusion query as input, throw exceptions, and generate dynamic output.</td>
</tr>
<tr>
<td>HelloWorldGraphic</td>
<td>Generates a “Hello World!” graphic in JPEG format.</td>
<td>How to dynamically create and return graphics from a Java CFX tag.</td>
</tr>
</tbody>
</table>

Setting up your development environment to develop CFX tags in Java

You can use a wide range of Java development environments, including the Java Development Kit (JDK) from Sun, to build Java CFX tags. You can download the JDK from Sun http://java.sun.com/j2se.

Adobe recommends that you use one of the commercial Java IDEs, so you have an integrated environment for development, debugging, and project management.

Configuring the classpath

To configure your development environment to build Java CFX tags, you must ensure that the supporting classes are visible to your Java compiler. These classes are located in the cfx.jar archive, located in one of the following directories:

Server configuration: cf_root/wwwroot/WEB-INF/lib

J2EE configuration: cf_webapp_root/WEB-INF/lib

Consult your Java development tool documentation to determine how to configure the compiler classpath for your particular environment.

The cfx.jar archive contains the classes in the com.allaire.cfx package, which are required for developing and deploying Java CFX tags.

When you create new Java CFX tags, you should compile them into the WEB-INF/classes directory. Doing this simplifies your development, debugging, and testing processes.

After you finish with development and testing, you can deploy your Java CFX tag anywhere on the classpath visible to ColdFusion.
Customizing and Configuring Java

Use the ColdFusion Administrator > Server Settings > JVM and Java Settings page to customize your Java development environment by customizing the classpath and Java system properties, or by specifying an alternate JVM. For more information, see the ColdFusion Administrator online Help.

Writing a Java CFX Tag

To create a Java CFX tag, create a class that implements the Custom tag interface. This interface contains one method, `processRequest`, which is passed `Request` and `Response` objects that are then used to do the work of the tag.

The example in the following procedure creates a very simple Java CFX tag named `cfx_MyHelloColdFusion` that writes a text string back to the calling page.

1. Create a source file in your editor with the following code:
   ```java
   import com.allaire.cfx.*;
   public class MyHelloColdFusion implements CustomTag {
   public void processRequest( Request request, Response response )
   throws Exception {
   String strName = request.getAttribute( "NAME" );
   response.write( "Hello, " + strName );
   }
   }
   ```

2. Save the file as `MyHelloColdFusion.java` in the WEB-INF/classes directory.

3. Compile the java source file into a class file using the Java compiler. If you are using the command-line tools bundled with the JDK, use the following command line, which you execute from within the classes directory:
   ```bash
   javac -classpath cf_root\WEB-INF\lib\cfx.jar MyHelloColdFusion.java
   ```

   **Note:** The previous command works only if the Java compiler (`javac.exe`) is in your path. If it is not in your path, specify the fully qualified path; for example, `c:\jdk1.3.1_01\bin\javac` in Windows or `/usr/java/bin/javac` in UNIX.

   If you receive errors during compilation, check the source code to make sure you entered it correctly. If no errors occur, you successfully wrote your first Java CFX tag.

Calling the CFX tag from a ColdFusion Page

You call Java CFX tags from within ColdFusion pages by using the name of the CFX tag that is registered on the ColdFusion Administrator CFX Tags page. This name should be the prefix `cfx_` followed by the class name (without the .class extension).

Register a Java CFX Tag in the ColdFusion Administrator

1. In the ColdFusion Administrator, select Extensions > CFX Tags.
2. Click Register Java CFX.
3. Enter the tag name (for example, `cfx_MyHelloColdFusion`).
4. Enter the class name without the .class extension (for example, `MyHelloColdFusion`).
5. (Optional) Enter a description.
6. Click Submit.
You can now call the tag from a ColdFusion page.

**Call a CFX tag from a ColdFusion page**

1. Create a ColdFusion page (.cfm) in your editor with the following content to call the HelloColdFusion custom tag:
   ```html
   <html>
   <body>
   <cfx_MyHelloColdFusion NAME="Les">
   </body>
   </html>
   ```

2. Save the file in a directory configured to serve ColdFusion pages. For example, you can save the file as C:\inetpub\wwwroot\cfdocs\testjavacfx.cfm in Windows or /home/docroot/cfdocs/testjavacfx.cfm in UNIX.

3. If you have not already done so, register the CFX tag in the ColdFusion Administrator (see "Registering CFX tags" on page 215).

4. Request the page from your browser using the appropriate URL; for example:
   ```
   http://localhost/cfdocs/testjavacfx.cfm
   ```
   ColdFusion processes the page and returns a page that displays the text "Hello, Les." If an error is returned instead, check the source code to make sure you entered it correctly.

**Delete a CFX tag in the ColdFusion Administrator**

1. In the ColdFusion Administrator, select Extensions > CFX Tags.

2. For the tag to delete, click the Delete icon in the Controls column of the Registered CFX Tags list.

**Processing requests**

Implementing a Java CFX tag requires interaction with the Request and Response objects passed to the processRequest method. In addition, CFX tags that need to work with ColdFusion queries also interface with the Query object. The `com.allaire.cfx` package, located in the WEB-INF/lib/cfx.jar archive, contains the Request, Response, and Query objects.

For a complete description of these object types, see “ColdFusion Java CFX Reference” on page 1436 in the CFML Reference. For a complete example Java CFX tag that uses Request, Response, and Query objects, see “ZipBrowser example” on page 210.

**Request object**

The Request object is passed to the processRequest method of the CustomTag interface. The following table lists the methods of the Request object for retrieving attributes, including queries, passed to the tag and for reading global tag settings:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attributeExists</td>
<td>Checks whether the attribute was passed to this tag.</td>
</tr>
<tr>
<td>debug</td>
<td>Checks whether the tag contains the debug attribute.</td>
</tr>
<tr>
<td>getAttribute</td>
<td>Retrieves the value of the passed attribute.</td>
</tr>
<tr>
<td>getAttributeList</td>
<td>Retrieves a list of all attributes passed to the tag.</td>
</tr>
</tbody>
</table>
For detailed reference information on each of these interfaces, see the CFML Reference.

Response object

The Response object is passed to the processRequest method of the CustomTag interface. The following table lists the methods of the Response object for writing output, generating queries, and setting variables within the calling page:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>write</td>
<td>Outputs text to the calling page.</td>
</tr>
<tr>
<td>setVariable</td>
<td>Sets a variable in the calling page.</td>
</tr>
<tr>
<td>addQuery</td>
<td>Adds a query to the calling page.</td>
</tr>
<tr>
<td>writeDebug</td>
<td>Outputs text to the debug stream.</td>
</tr>
</tbody>
</table>

For detailed reference information on each of these interfaces, see the CFML Reference.

Query object

The Query object provides an interface for working with ColdFusion queries. The following table lists the methods of the Query object for retrieving name, row count, and column names and methods for getting and setting data elements:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>getName</td>
<td>Retrieves the name of the query.</td>
</tr>
<tr>
<td>getRowCount</td>
<td>Retrieves the number of rows in the query.</td>
</tr>
<tr>
<td>getColumnIndex</td>
<td>Retrieves the index of a query column.</td>
</tr>
<tr>
<td>getColumns</td>
<td>Retrieves the names of the query columns.</td>
</tr>
<tr>
<td>getData</td>
<td>Retrieves a data element from the query.</td>
</tr>
<tr>
<td>addRow</td>
<td>Adds a new row to the query.</td>
</tr>
<tr>
<td>setData</td>
<td>Sets a data element within the query.</td>
</tr>
</tbody>
</table>

For detailed reference information on each of these interfaces, see CFML Reference.

Life cycle of Java CFX tags

A new instance of the Java CFX object is created for each invocation of the Java CFX tag. This means that it is safe to store per-request instance data within the members of your CustomTag object. To store data and/or objects that are accessible to all instances of your CustomTag, use static data members. If you do so, you must ensure that all accesses to the data are thread-safe.
ZipBrowser example

The following example shows the use of the Request, Response, and Query objects. The example uses the java.util.zip package to implement a Java CFX tag called cfx_ZipBrowser, which is a zip file browsing tag.

Note: The Java source file that implements cfx_ZipBrowser, ZipBrowser.java, is included in the cf_root/cfx/java/distrib/examples (server configuration) or cf_webapp_root/WEB-INF/cfusion/cfx/java/distrib/examples (J2EE configuration) directory. Compile ZipBrowser.java to implement the tag.

The tag's archive attribute specifies the fully qualified path of the zip archive to browse. The tag's name attribute must specify the query to return to the calling page. The returned query contains three columns: Name, Size, and Compressed.

For example, to query an archive at the path C:\logfiles.zip for its contents and output the results, you use the following CFML code:

```cfml
<cfx_ZipBrowser
archive="C:\logfiles.zip"
name="LogFiles">
<cfoutput query="LogFiles">
#Name#, #Size#, #Compressed# <BR>
</cfoutput>
</cfx_ZipBrowser>
```

The Java implementation of ZipBrowser is as follows:

```java
import com.allaire.cfx.*;
import java.util.Hashtable;
import java.io.FileInputStream;
import java.util.zip.*;
public class ZipBrowser implements CustomTag {
    public void processRequest( Request request, Response response )
        throws Exception {
        // Validate that required attributes were passed.
        if (!request.attributeExists( "ARCHIVE" ) || !request.attributeExists( "NAME" ) ) {
            throw new Exception("Missing attribute (ARCHIVE and NAME are both " +
                            "required attributes for this tag) ");
        }
        // get attribute values
        String strArchive = request.getAttribute( "ARCHIVE" );
        String strName = request.getAttribute( "NAME" );
        // create a query to use for returning the list of files
        String[] columns = { "Name", "Size", "Compressed" };
        int iName = 1, iSize = 2, iCompressed = 3;
        Query files = response.addQuery( strName, columns );
        // read the zip file and build a query from its contents
        ZipInputStream zin = new ZipInputStream( new FileInputStream(strArchive) );
        ZipEntry entry;
        while ( ( entry = zin.getNextEntry() ) != null ) {
            // Add a row to the results.
            int iRow = files.addRow();
            // populate the row with data
            files.setData( iRow, iName, entry.getName() );
            files.setData( iRow, iSize, String.valueOf(entry.getSize()) );
            files.setData( iRow, iCompressed,
```
String.valueOf(entry.getCompressedSize());

// Finish up with entry.
zin.closeEntry();
}

// Close the archive.
zin.close();
}

### Approaches to debugging Java CFX tags

Java CFX tags are not stand-alone applications that run in their own process, like typical Java applications. Rather, they are created and invoked from an existing process. This makes debugging Java CFX tags more difficult, because you cannot use an interactive debugger to debug Java classes that have been loaded by another process.

To overcome this limitation, you can use one of the following techniques:

- Debug the CFX tag while it is running within ColdFusion by outputting the debug information as needed.
- Debug the CFX tag using a Java IDE (Integrated Development Environment) that supports debugging features, such as setting breakpoints, stepping through your code, and displaying variable values.
- Debug the request in an interactive debugger offline from ColdFusion using the special com.allaire.cfx debugging classes.

### Outputting debugging information

Before using interactive debuggers became the norm, programmers typically debugged their programs by inserting output statements in their programs to indicate information such as variable values and control paths taken. Often, when a new platform emerges, this technique comes back into vogue while programmers wait for more sophisticated debugging technology to develop for the platform.

If you need to debug a Java CFX tag while running against a live production server, this is the technique you must use. In addition to outputting debugging text using the Response.write method, you can also call your Java CFX tag with the debug="On" attribute. This attribute flags the CFX tag that the request is running in debug mode and therefore should output additional extended debugging information. For example, to call the HelloColdFusion CFX tag in debugging mode, use the following CFML code:

```cfml
<cfx_HelloColdFusion name="Robert" debug="On"/>
```

To determine whether a CFX tag is invoked with the debug attribute, use the Request.debug method. To write debugging output in a special debugging block after the tag finishes executing, use the Response.writeDebug method. For information on using these methods, see "ColdFusion Java CFX Reference" on page 1436 in CFML Reference.

### Debugging in a Java IDE

You can use a Java IDE to debug your Java CFX tags. This means you can develop your Java CFX tag and debug it in a single environment.

1. Start your IDE.
In the project properties (or your IDE’s project setting), make sure your CFX class is in the web_root\WEB-INF\classes directory or in the system classpath.

Make sure the libraries cf_root/wwwroot/WEB-INF/lib/cfx.jar (cf_webapp_root/WEB-INF/lib/cfx.jar in the J2EE configuration) and cf_root/runtime/lib/jrun.jar (server configuration only) are included in your classpath.

In your project settings, set your main class to jrunx.kernel.JRun and application parameters to -start default.

Debug your application by setting breakpoints, single stepping, displaying variables, or by performing other debugging actions.

Using the debugging classes
To develop and debug Java CFX tags in isolation from the ColdFusion, you use three special debugging classes that are included in the com.allaire.cfx package. These classes let you simulate a call to the processRequest method of your CFX tag within the context of the interactive debugger of a Java development environment. The three debugging classes are the following:

• DebugRequest: An implementation of the Request interface that lets you initialize the request with custom attributes, settings, and a query.
• DebugResponse: An implementation of the Response interface that lets you print the results of a request once it has completed.
• DebugQuery: An implementation of the Query interface that lets you initialize a query with a name, columns, and a data set.

Implement a main method
1 Create a main method for your Java CFX class.
2 Within the main method, initialize a DebugRequest and DebugResponse, and a DebugQuery. Use the appropriate attributes and data for your test.
3 Create an instance of your Java CFX tag and call its processRequest method, passing in the DebugRequest and DebugResponse objects.
4 Call the DebugResponse.printResults method to output the results of the request, including content generated, variables set, queries created, and so on.

After you implement a main method as described previously, you can debug your Java CFX tag using an interactive, single-step debugger. Specify your Java CFX class as the main class, set breakpoints as appropriate, and begin debugging.

Example: debugging classes
The following example demonstrates how to use the debugging classes:

```java
import java.util.Hashtable;
import com.allaire.cfx.*;

public class OutputQuery implements CustomTag {
    // debugger testbed for OutputQuery
    public static void main(String[] argv) {
        try {
            // initialize attributes
            Hashtable attributes = new Hashtable();
            attributes.put( "HEADER", "Yes" );
            attributes.put( "BORDER", "3" );
```
// initialize query
String[] columns = { "FIRSTNAME", "LASTNAME", "TITLE" };

String[][] data = {
    { "Stephen", "Cheng", "Vice President" },
    { "Joe", "Berrey", "Intern" },
    { "Adam", "Lipinski", "Director" },
    { "Lynne", "Teague", "Developer" } 
};

DebugQuery query = new DebugQuery( "Employees", columns, data ) ;

// create tag, process debugging request, and print results
OutputQuery tag = new OutputQuery();
DebugRequest request = new DebugRequest( attributes, query ) ;
DebugResponse response = new DebugResponse() ;
tag.processRequest( request, response ) ;
response.printResults() ;

} catch( Throwable e ) {
    e.printStackTrace() ;
}

public void processRequest(Request request, Response response) throws Exception {
    // ...code for processing the request...
}

Developing CFX tags in C++

You can develop CFX tags in C++.

Sample C++ CFX tags
Before you begin development of a CFX tag in C++, you might want to study the two CFX tags included with
ColdFusion. These examples will help you get started working with the CFXAPI. The two example tags are as
follows:
• CFX_DIRECTORYLIST: Queries a directory for the list of files it contains.
• CFX_NTUSERDB (Windows only): Lets you add and delete Windows NT users.

In Windows, these tags are located in the cf_root/cfx/examples directory. In UNIX, these tags are in the
cf_root/coldfusion/cfx/examples directory.

Setting up your C++ development environment
The following compliers generate valid CFX code for UNIX platforms:

<table>
<thead>
<tr>
<th>Platform</th>
<th>Compiler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solaris</td>
<td>Sun Workshop C++ compiler, version 5.0 or higher (gcc cannot be used to compile CFX code on Solaris)</td>
</tr>
<tr>
<td>Linux</td>
<td>Gnu C++ compiler - gcc</td>
</tr>
</tbody>
</table>
Before you can use your C++ compiler to build custom tags, you must enable the compiler to locate the CFX API header file, cfx.h. In Windows, you do this by adding the CFX API include directory to your list of global include paths. In Windows, this directory is \cf_root\cfx\include. In UNIX, this directory is \cf_root\cfx\include. In UNIX, you will need -I <includepath> on your compile line (see the Makefile for the directory list example in the cfx/examples directory).

**Compiling C++ CFX tags**

CFX tags built in Windows and in UNIX must be thread-safe. Compile CFX tags for Solaris with the \texttt{-mt} switch on the Sun compiler.

**Locating your C++ library files in UNIX**

In UNIX systems, your C++ library files can be in any directory as long as the directory is included in \texttt{LD_LIBRARY_PATH} or \texttt{SHLIB_PATH} (HP-UX only).

**Implementing C++ CFX tags**

CFX tags built in C++ use the tag request object, represented by the C++ \texttt{CCFXRequest} class. This object represents a request made from an application page to a custom tag. A pointer to an instance of a request object is passed to the main procedure of a custom tag. The methods available from the request object let the custom tag accomplish its work. For information about the CFX API classes and members, see “ColdFusion C++ CFX Reference” on page 1415 in the CFML Reference.

\textit{Note: Calling a nonexistent C++ CFX procedure or entry point causes a JVM crash in UNIX.}

**Debugging C++ CFX tags**

After you configure a debugging session, you run your custom tag from within the debugger, set breakpoints, single-step, and so on.

**Debugging in Windows**

You can debug custom tags within the Visual C++ environment.

1. Build your C++ CFX tag using the debug option.
2. Restart ColdFusion.
4. Select Build > Start Debug > AttachProcess.
5. Select jrunsvc.exe.

Adobe recommends that you shut down all other Java programs.

6. Execute any ColdFusion page that calls the CFX tag.
7. Select File > Open to open a file in VisualDev in which to set a breakpoint.
8. Set a breakpoint in the CFX project.

The best place is to put it in \texttt{ProcessRequest()} . Next time you execute the page you will hit the breakpoint.
**Registering CFX tags**

To use a CFX tag in your ColdFusion applications, first register it in the Extensions, CFX Tags page in the ColdFusion Administrator.

1. In the ColdFusion Administrator, select Extensions > CFX Tags.
2. Click Register C++ CFX.
3. Enter the Tag name (for example, cfx_MyNewTag).
4. If the Server Library .dll field is empty, enter the filepath.
5. Accept the default Procedure entry.
6. Clear the Keep library loaded box while developing the tag.
   - For improved performance, when the tag is ready for production use, you can select this option to keep the DLL in memory.
7. (Optional) Enter a description.
8. Click Submit.

You can now call the tag from a ColdFusion page.

**Delete a CFX tag**

1. In the ColdFusion Administrator, select Extensions > CFX Tags.
2. For the tag to delete, click the Delete icon in the Controls column of the Registered CFX Tags list.
Part 3: Developing CFML Applications

This part contains the following topics:

- Designing and Optimizing a ColdFusion Application ................................................. 218
- Handling Errors ........................................................................................................ 246
- Using Persistent Data and Locking ........................................................................... 272
- Using ColdFusion Threads ...................................................................................... 300
- Securing Applications ............................................................................................. 311
- Developing Globalized Applications ....................................................................... 336
- Debugging and Troubleshooting Applications .......................................................... 351
- Using the ColdFusion Debugger ............................................................................. 370
Chapter 14: Designing and Optimizing a ColdFusion Application

Application elements and how you structure an application on your server make your Adobe ColdFusion pages an effective Internet application. You use the Application.cfc and Application.cfm files and various coding methods to optimize the efficiency of your application.

Contents

About applications ................................................................. 218
Elements of a ColdFusion application ....................................... 219
Structuring an application ....................................................... 222
Defining the application and its event handlers in Application.cfc ....................................................... 224
Migrating from Application.cfm to Application.cfc ................. 235
Using an Application.cfm page ................................................. 235
Optimizing ColdFusion applications ........................................ 238

About applications

The term application can mean many things. An application can be as simple as a guest book or as sophisticated as a full Internet commerce system with catalog pages, shopping carts, and reporting.

An application, however, has a specific meaning in ColdFusion. A ColdFusion application has the following characteristics:

- It consists of one or more ColdFusion pages that work together and share a common set of resources.
- All pages in the application share an application name and configuration settings as specified in an Application.cfc file or the cfapplication tag.
- All pages in the application share variables in the Application scope.
- You can write application-wide event handlers for specific events, such as request start or session end.

What appears to a user to be a single application (for example, a company's website), might consist of multiple ColdFusion applications.

ColdFusion applications are not J2EE applications. However, if you do not specify an application name in your Application.cfc file or the cfapplication tag, the Application scope corresponds to the J2EE application servlet context.

ColdFusion applications end when the application has been inactive for the application time-out period or the server stops. When the application times out, ColdFusion releases all Application scope variables. You must, therefore, select a time-out period that balances the need for clearing Application scope memory and the overhead of recreating the scope. A typical application time-out is two days.

ColdFusion applications and sessions are independent of each other. For example, if an application times out while a user's session is active, the session continues and the session context, including the user's Session scope variables, is unaffected by the application ending and restarting.
Although there are no definite rules about how you represent your web application as a ColdFusion application or applications, the following guidelines are useful:

- Application pages share a common general purpose. For example, a web storefront is typically a single ColdFusion application.
- Many, but not necessarily all, pages in a ColdFusion application share data or common code elements, such as a single login mechanism.
- Application pages share a common look and feel, often enforced by using common code elements, such as the same header and footer pages, and a common error message template.

**Elements of a ColdFusion application**

Before you develop a ColdFusion application, you must determine how to structure the application and how to handle application-wide needs and issues. In particular, you must consider all of the following:

- The overall application framework
- Reusable application elements
- Shared variables
- Application events and the Application.cfc file
- Application-level settings and functions
- Application security and user identification

**The application framework**

The application framework is the overall structure of the application and how your directory structure and application pages reflect that structure. You can use a single application framework to structure multiple ColdFusion applications into a single website or Internet application. You can structure a ColdFusion application by using many methodologies. For example, the Fusebox application development methodology is one popular framework for developing ColdFusion web applications. (For more information on Fusebox, see www.fusebox.org.)

This chapter does not provide information on how to use or develop a specific application framework. However, it does discuss the tools that ColdFusion provides for building your framework, including the Application.cfc file, how an application's directory structure affects the application, and how you can map the directory structure. For more information on mapping the application framework, see “Structuring an application” on page 222.

*Note: For one example of an application framework, see “ColdFusion Methodologies for Content Management,” available at www.adobe.com/devnet/server_archive/articles/cf_methodologies_for_content_mgmt.html.*

**Reusable application elements**

ColdFusion provides a variety of reusable elements that you can use to provide commonly used functionality and extend CFML. These elements include the following:

- User-defined functions (UDFs)
- CFML custom tags
- ColdFusion components (CFCs)
- CFX (ColdFusion Extension) tags
• Pages that you include using the \texttt{cfinclude} tag

For an overview of these elements, and information about how to choose among them, see “Creating ColdFusion Elements” on page 126.

**Shared variables**

The following ColdFusion variable scopes maintain data that lasts beyond the scope of the current HTTP request:

<table>
<thead>
<tr>
<th>Variable scope</th>
<th>Variables available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>To all applications on a server and all clients</td>
</tr>
<tr>
<td>Application</td>
<td>To all pages in an application for all clients</td>
</tr>
<tr>
<td>Client</td>
<td>For a single client browser over multiple browser sessions in one application</td>
</tr>
<tr>
<td>Session</td>
<td>For a single client browser for a single browser session in one application</td>
</tr>
</tbody>
</table>

For more information on using these variables, including how to use locks to ensure that the data they contain remains accurate, see “Using Persistent Data and Locking” on page 272.

**Application events and the Application.cfc file**

Application events are specific occurrences during the life cycle of an application. Each time one of these events occurs, ColdFusion runs the corresponding method in your Application.cfc file (also referred to as the application CFC). The Application.cfc file defines application settings and implements methods to handle the application events.

You can implement application CFC methods to handle the following events:

<table>
<thead>
<tr>
<th>Event</th>
<th>Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application start</td>
<td>ColdFusion starts processing the first request for a page in an application that is not running.</td>
</tr>
<tr>
<td>Application end</td>
<td>An application time-out setting is reached or the server shuts down.</td>
</tr>
<tr>
<td>Session start</td>
<td>A new session is created as a result of a request that is not in an existing session.</td>
</tr>
<tr>
<td>Session end</td>
<td>A session time-out setting is reached.</td>
</tr>
<tr>
<td>Request start</td>
<td>ColdFusion receives a request, including HTTP requests, messages to the event gateway, SOAP requests, or Flash Remoting requests.</td>
</tr>
<tr>
<td>Request end</td>
<td>ColdFusion finishes processing all pages and CFCs for the request.</td>
</tr>
<tr>
<td>Exceptions</td>
<td>ColdFusion finishes processing all pages and CFCs for the request.</td>
</tr>
</tbody>
</table>

The Application.cfc file can also define application-wide settings, including the application name and whether the application supports Session variables.

For more information on using application events and the Application.cfc file, see “Defining the application and its event handlers in Application.cfc” on page 224.
Other application-level settings and functions

This section describes the techniques used prior to ColdFusion MX 7 to define application-level settings, variables, and functions. Adobe recommends that you do not use these techniques in new code that you write; instead, you should use the Application.cfc file and its variables and methods, which provide more features and include logical, hierarchical structure.

If you do not have an Application.cfc file, ColdFusion processes the following two pages, if they are available, every time it processes any page in the application:

- The Application.cfm page is processed before each page in the application.
- The OnRequestEnd.cfm page is processed after each page in the application.

**Note:** UNIX systems are case-sensitive. To ensure that your pages work on UNIX, always capitalize the A in Application.cfm and the O, R, and E in OnRequestEnd.cfm.

The Application.cfm page can define the application. It can contain the `cfapplication` tag that specifies the application name, and code on this page is processed for all pages in the application. This page can define application-level settings, functions, and features.

The OnRequestEnd.cfm page is used in fewer applications than the Application.cfm page. It lets you provide common clean-up code that gets processed after all application pages, or specify dynamic footer pages.

**The OnRequestEnd.cfm page does not execute if the page invokes a cflocation tag.**

For more information on the Application.cfm and OnRequestEnd.cfm pages, see “Using an Application.cfm page” on page 235. For information on placing these pages in the application directory structure, see “Structuring an application” on page 222.

**Note:** You can create a ColdFusion application without using an Application.cfc, Application.cfm, or OnRequestEnd.cfm page. However, it is much easier to use the Application.cfm page than to have each page in the application use a `cfapplication` tag and define common application elements.

Specifying settings per application

You can set the following on a per-application basis:

- Mappings
- Custom tag paths

These settings override the server-side settings in the ColdFusion Administrator for the specified application only. Specifying per application settings does not change the server-wide settings. To set per-application settings, you must first enable per-application settings on the Settings page of the ColdFusion Administrator. You then set the mappings or custom tag paths in the Application.cfc file.

Custom Tags in per-application settings override those defined in the ColdFusion Administrator. For example, if you have two custom tags of the same name and they are in different locations in the Administrator and per-application settings, the one in the per-application settings is taken first.

**Note:** Per-application settings are supported in applications that use an Application.cfc file only, not in applications that use an Application.cfm file. The per-application settings do not work if you have disabled application variables in the Memory Variables page of the Administrator.

Set the mappings per application

1. Check the Enable Per App Settings option on the Settings page of the ColdFusion Administrator.
Include code similar to the following in your Application.cfc file:

```coldfusion
<cfset THIS.mappings["MyMap"]="c:\inetpub\myStuff">

or

```coldfusion
<cfset StructInsert(TTHIS.mappings, "MyMap", "c:\inetpub\myStuff")>
```

Set the custom tag paths per application

1. Check the Enable Per App Settings option on the Settings page of the ColdFusion Administrator.
2. Include code similar to the following in your Application.cfc file:

```coldfusion
<cfset customtagpaths = "c:\mapped1,c:\mapped2">
<cfset customtagpaths = ListAppend(customtagpaths,"c:\mapped3")>
<cfset This.customtagpaths = customtagpaths>
```

Application security and user identification

All applications must ensure that malicious users cannot make improper use of their resources. Additionally, many applications require user identification, typically to control the portions of a site that the user can access, to control the operations that the user can perform, or to provide user-specific content. ColdFusion provides the following forms of application security to address these issues:

Resource (file and directory-based) security: Limits the ColdFusion resources, such as tags, functions, and data sources that application pages in particular directories can access. You must consider the resource security needs of your application when you design the application directory structure.

User (programmatic) security: Provides an authentication (login) mechanism and a role-based authorization mechanism to ensure that users can only access and use selected features of the application. User security also incorporates a user ID, which you can use to customize page content. To implement user security, you include security code, such as the `cflogin` and `cfloginuser` tags, in your application.

For more on implementing security, see “Securing Applications” on page 311.

Structuring an application

When you design a ColdFusion application, you must structure its contents into directories and files, also known as mapping the directory structure. This activity is an important step in designing a ColdFusion application. Before you start building the application, you must establish a root directory for the application. You can store application pages in subdirectories of the root directory.

The following sections describe how ColdFusion uses application-specific pages and how you can organize your application pages in a directory structure.

How ColdFusion finds and process application definition pages

ColdFusion uses the following rules to locate and process the Application.cfc, Application.cfm, and OnRequestEnd.cfm pages that define application-specific elements. The way ColdFusion locates these files helps determine how you structure an application.

Each time ColdFusion processes a page request it does the following:

1. When ColdFusion starts processing the request, it does the following:
• It searches the page’s directory for a file named Application.cfc. If one exists, it creates a new instance of the CFC, processes the initial events, and stops searching. (ColdFusion creates a new instance of the CFC and processes its initialization code for each request.)

• If the requested page’s directory does not have an Application.cfc file, it checks the directory for an Application.cfm file. If one exists, ColdFusion logically includes the Application.cfm page at the beginning of the requested page and stops searching further.

• If the requested page’s directory does not have an Application.cfc or Application.cfm file, ColdFusion searches up the directory tree and checks each directory first for an Application.cfc file and then, if one is not found, for an Application.cfm page, until it reaches the root directory (such as C:). When it finds an Application.cfc or Application.cfm file, it processes the page and stops searching.

2 ColdFusion processes the requested page’s contents.

3 When the request ends, ColdFusion does the following:

• If you have an Application.cfc, ColdFusion processes the CFC’s onRequestEnd method and releases the CFC instance.

• If you do not have an Application.cfc, but do have an Application.cfm page, ColdFusion looks for an OnRequestEnd.cfm in the same directory as the Application.cfm page ColdFusion uses for the current page. ColdFusion does not search beyond that directory, so it does not run an OnRequestEnd.cfm page that resides in another directory. Also, the OnRequestEnd.cfm page does not run if there is an error or an exception on the application page, or if the application page executes the cfabort or cfexit tag.

The following rules determine how ColdFusion processes application pages and settings:

• ColdFusion processes only one Application.cfc or Application.cfm page for each request. If a ColdFusion page has a cfinclude tag pointing to an additional ColdFusion page, ColdFusion does not search for an Application.cfc or Application.cfm page when it includes the additional page.

• If a ColdFusion page has a cfapplication tag, it first processes any Application.cfc or Application.cfm, and then processes the cfapplication tag. The tag can override the settings from the application files, including the application name and the behaviors set by the cfapplication tag attributes.

• You can have multiple Application.cfc files, Application.cfm files, and cfapplication tags that use the same application name. In this case, all pages that have the same name share the same application settings and Application scope and can set and get all the variables in this scope. ColdFusion uses the parameter settings of the cfapplication tag or the most recently processed file, if the settings, such as the session time-out, differ among the files.

Note: If your application runs on a UNIX platform, which is case-sensitive, you must spell Application.cfc, Application.cfm, and OnRequestEnd.cfm with capital letters.

**Defining the directory structure**

Defining an application directory structure with an application-specific root directory has the following advantages:

**Development**: The application is easier to develop and maintain, because the application page files are well-organized.

**Portability**: You can easily move the application to another server or another part of a server without changing any code in the application page files.

**Application-level settings**: Application pages that are under the same directory can share application-level settings and functions.
Security: Application pages that are under the same directory can share web server security settings.

When you put your application in an application-specific directory hierarchy, you can use a single application definition (Application.cfc or Application.cfm) page in the application root directory, or put different application definition pages that govern individual sections of the application in different directories.

You can divide your logical web application into multiple ColdFusion applications by using multiple application definition pages with different application names. Alternatively, you can use multiple application definition pages that specify the same application name, but have different code, for different subsections of your application.

The directory trees in the following image show two approaches to implementing an application framework:

• In the example on the left, a company named Web Wonders, Inc. uses a single Application.cfc file installed in the application root directory to process all application page requests.

• In the example on the right, Bandwidth Associates uses the settings in individual Application.cfc files to create individual ColdFusion applications at the departmental level. Only the Products application pages are processed using the settings in the root Application.cfc file. The Consulting, Marketing, and Sales directories each have their own Application.cfc file.

Defining the application and its event handlers in Application.cfc

The Application.cfc file defines application-wide settings and variables, and application event handlers:

• Application-wide settings and variables include page processing settings, default variables, data sources, style settings, and other application-level constants.
• Application event handlers are CFC methods that ColdFusion automatically executes when specific events occur
during the lifetime of an application: application start and end, session start and end, request start, execution, and
dead, and exceptions.

**Defining application-level settings and variables**

When you create an application, you can set a number of application-wide properties and characteristics, including
the following items:

• Application name
• Application properties, including Client-, Application-, and Session-variable management options
• Page processing options
• Default variables, data sources, style settings, and other application-level constants

This section describes the following topics:

• Naming the application
• Setting application properties
• Setting page processing options

For information on setting default variables, see “Setting application default variables and constants in onApplicationStart” on page 228.

**Naming the application**

Define the application and give it a name by setting the This.name variable in the Application.cfc initialization
section, before the method definitions. By using a specific application name, you define a set of pages as part of the
same logical application.

ColdFusion supports unnamed applications, which are useful for ColdFusion applications that must interoperate
with JSP tags and servlets. Consider creating an unnamed application only if your ColdFusion pages must share
Application or Session scope data with existing JSP pages and servlets. You cannot have more than one unnamed
application on a server instance. For more information on using unnamed applications, see “Sharing data between
ColdFusion pages and JSP pages or servlets” on page 932.

**Setting application properties**

You can specify application properties by setting This scope variables in the Application.cfc initialization code.
(These are the same properties that you can set in the cfapplication tag.) The following table lists the This scope
variable that ColdFusion uses to set application properties and describes their uses.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>applicationTimeout</td>
<td>Administrator</td>
<td>Life span, as a real number of days, of the application, including all Application scope variables. Use the createTimeSpan function to generate this variable.</td>
</tr>
<tr>
<td>clientManagement</td>
<td>False</td>
<td>Whether the application supports Client scope variables.</td>
</tr>
<tr>
<td>clientStorage</td>
<td>Administrator</td>
<td>Where Client variables are stored; can be cookie, registry, or the name of a data source.</td>
</tr>
<tr>
<td>loginStorage</td>
<td>Cookie</td>
<td>Whether to store login information in the Cookie scope or the Session scope.</td>
</tr>
<tr>
<td>scriptProtect</td>
<td>Administrator</td>
<td>Whether to protect variables from cross-site scripting attacks.</td>
</tr>
<tr>
<td>sessionManagement</td>
<td>False</td>
<td>Whether the application supports Session scope variables.</td>
</tr>
</tbody>
</table>
The following example code from the top of an Application.cfc sets the application name and properties:

```coldfusion
<cfcomponent>
<cfset This.name = "TestApplication">
<cfset This.clientmanagement="True">
<cfset This.loginstorage="Session">
<cfset This.sessionmanagement="True">
<cfset This.sessiontimeout="#createtimespan(0,0,10,0)#">
<cfset This.applicationtimeout="#createtimespan(5,0,0,0)#">
</cfscript>
<cfsetting showdebugoutput="No" enablecfoutputonly="No">

For more information on these settings, see `cfapplication` in the CFML Reference.

### Setting page processing options

The `cfsetting` tag lets you specify the following page processing attributes that you might want to apply to all pages in your application:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>showDebugOutput</td>
<td>Specifies whether to show debugging output. This setting cannot enable debugging if it is disabled in the ColdFusion Administrator. However, this option can ensure that debugging output is not displayed, even if the Administrator enables it.</td>
</tr>
<tr>
<td>requestTimeout</td>
<td>Specifies the page request time-out. If ColdFusion cannot complete processing a page within the time-out period, it generates an error. This setting overrides the setting in the ColdFusion Administrator. You can use this setting to increase the page time-out if your application or page frequently accesses external resources that might be particularly slow, such as external LDAP servers or web services providers.</td>
</tr>
<tr>
<td>enableCFOutputOnly</td>
<td>Disables output of text that is not included inside <code>cfoutput</code> tags. This setting can help ensure that extraneous text that might be in your ColdFusion pages does not get displayed.</td>
</tr>
</tbody>
</table>

Often, you use the `cfsetting` tag on individual pages, but you can also use it in your Application.cfc file. For example, you might use it in multi-application environment to override the ColdFusion Administrator settings in one application.

You can put an application-wide `cfsetting` tag in the component initialization code, normally following the `This` scope application property settings, as the following example shows:

```coldfusion
<cfcomponent>
<cfscript>
This.name="MyAppl";
This.clientmanagement="True";
This.loginstorage="Session";
This.sessionmanagement="True";
This.sessiontimeout=CreateTimeSpan(0,0,1,0);
</cfscript>
<cfsetting showdebugoutput="No" enablecfoutputonly="No">

The `cfsetting` tag in this example affects all pages in an application. You can override the application-wide settings in the event methods, such as `onRequestStart`, or on individual ColdFusion pages.
Using application event handlers

The following table briefly describes the application event CFC methods that you can implement, including when they are triggered. The following sections describe how to use these methods in more detail.

<table>
<thead>
<tr>
<th>Method</th>
<th>When run</th>
</tr>
</thead>
<tbody>
<tr>
<td>onApplicationStart</td>
<td>The application first starts: when the first request for a page is processed or the first CFC method is invoked by an event gateway instance, Flash Remoting request, or a web service invocation. This method is useful for setting application-wide (Application scope) variables, such as the names of data sources.</td>
</tr>
<tr>
<td>onApplicationEnd</td>
<td>The application ends: when the application times out or the server shuts down.</td>
</tr>
<tr>
<td>onSessionStart</td>
<td>A new session is created as a result of a request that is not in an existing session, including ColdFusion event gateway sessions. The application must enable sessions for this event to happen.</td>
</tr>
<tr>
<td>onSessionEnd</td>
<td>A session time-out setting is reached. This event is not triggered when the application ends or the server shuts down.</td>
</tr>
<tr>
<td>onRequestStart</td>
<td>ColdFusion receives any of the following: a request, an HTTP request (for example, from a browser), a message to an event gateway, a SOAP request, or a Flash Remoting request.</td>
</tr>
<tr>
<td>onRequest</td>
<td>The onRequestStart event has completed. This method can act as a filter for the requested page content.</td>
</tr>
<tr>
<td>onRequestEnd</td>
<td>All pages and CFCs in the request have been processed: equivalent to the onRequestEnd.cfm page.</td>
</tr>
<tr>
<td>onMissingTemplate</td>
<td>When ColdFusion receives a request for a nonexistent page.</td>
</tr>
<tr>
<td>onError</td>
<td>When an exception occurs that is not caught by a try/catch block.</td>
</tr>
</tbody>
</table>

When ColdFusion receives a request, it instantiates the Application CFC and runs the Application.cfc code in the following order:

- CFC initialization code at the top of the file
- onApplicationStart, if not run before for this application
- onSessionStart, if not run before for this session
- onRequestStart
- onRequest, or the requested page if there is no onRequest method
- onRequestEnd

The following methods are triggered by specific events:

- onApplicationEnd
- onSessionEnd
- onMissingTemplate
- onError

The onApplicationEnd and onSessionEnd methods do not execute in the context of a page request, so they cannot access request variables or display information to the user. The onMissingTemplate method is triggered when a URL specifies a CFML page that does not exist. The onError method does not always execute in the context of a request; you can use its Event argument to determine the context.
Managing the application with Application.cfc

You use the onApplicationStart and onApplicationEnd methods to configure and manage the application; that is, to control resources that are used by multiple pages and requests and must be consistently available to all code in your application. Such resources can include data sources, application counters such as page hit variables, or style information for all pages.

The onApplicationStart method executes when ColdFusion gets the first request for a page in the application after the server starts. The onApplicationEnd method executes when the application server shuts down or if the application is inactive for the application time-out period.

The following sections describe some of the ways you can use these methods. For more information, see entries for onApplicationStart and onApplicationEnd in the CFML Reference.

Defining application utility functions

Functions that you define in Application.cfc and do not put in a shared scope are, by default, available only to other methods in the CFC.

If your Application.cfc implements the onRequest method, any utility functions that you define in Application.cfc are also directly available in to the target page, because Application.cfc and the target page share the Variables scope.

If your application requires utility functions that are used by multiple pages, not just by the methods in Application.cfc, and you do not use an onRequest method, Adobe recommends that you put them in a separate CFC and access them by invoking that CFC. As with other ColdFusion pages, Application.cfc can access any CFC in a directory path that is configured on the ColdFusion Administrator Mappings page. You can, therefore, use this technique to share utility functions across applications.

If your Application.cfc defines utility functions that you want available on request pages and does not use an onRequest method, you must explicitly put the functions in a ColdFusion scope, such as the Request scope, as the following code shows:

```coldfusion
<cffunction name="theFunctionName" returntype="theReturnType">
    <!--- Function definition goes here. --->
</cffunction>
<cffunction name="OnRequestStart">
    <!--- OnRequestStart body goes here --->
    <cfset Request.theFunctionName=This.theFunctionName>
</cffunction>
```

On the request page, you would include the following code:

```coldfusion
<cfset myVar=Request.theFunctionName(Argument1...)>
```

Functions that you define in this manner share the This scope and Variables scope with the Application.cfc file for the request.

Setting application default variables and constants in onApplicationStart

You can set default variables and application-level constants in Application.cfc. For example, you can do the following:

- Specify a data source and ensure that it is available
- Specify domain name
- Set styles, such as fonts or colors
- Set other application-level variables
You do not have to lock Application scope variables when you set them in the Application.cfc onApplicationStart method.

For details on implementing the `onApplicationStart` method, see `onApplicationStart` in the CFML Reference.

**Using the `onApplicationEnd` method**

Use the `onApplicationEnd` method for any clean-up activities that your application requires when it shuts down, such as saving data in memory to a database, or to log the application end. You cannot use this method to display data on a user page, because it is not associated with any request. The application ends, even if this method throws an exception. An application that is used often is unlikely to execute this method, except when the server is shut down.

For details on implementing the `onApplicationEnd` method, see `onApplicationEnd` in the CFML Reference.

**Managing sessions in Application.cfc**

You use the `onSessionStart` and `onSessionEnd` methods to configure and manage user sessions; that is, to control resources that are used by multiple pages while a user is accessing your site from during a single browser session. The session begins when a user first requests a page in your application, and ends when the session times out. For more information on Session scope and Session variables, see “Using Persistent Data and Locking” on page 272.

Session resources include variables that store data that is needed throughout the session, such as account numbers, shopping cart contents, or CFCs that contain methods and data that are used by multiple pages in a session.

*Note:* Do not put the `cflogin` tag or basic login processing in the `onSessionStart` method, as the code executes only at the start of the session; it cannot handle user logouts, and cannot fully ensure security.

The following sections describe some of the ways you can use the `onSessionStart` and `onSessionEnd` methods. For more information, see the `onSessionStart` and `onSessionEnd` entries in the CFML Reference.

**Using the `onSessionStart` method**

This method is useful for initializing session data, such as user settings or shopping cart contents, or for tracking the number of active sessions. You do not need to lock the Session scope when you set session variables in this method.

**Using the `onSessionEnd` method**

Use this method for any clean-up activities when the session ends. (For information on ending sessions, see “Ending a session” on page 286.) You can, for example, save session-related data, such as shopping cart contents or information about whether the user has not completed an order, in a database, or you can log the end of the session to a file. You cannot use this method to display data on a user page, because it is not associated with a request.

*Note:* Sessions do not end, and the `onSessionEnd` method is not called when an application ends. For more information, see the `onSessionEnd` entry in the CFML Reference.

**Managing requests in Application.cfc**

ColdFusion provides three methods for managing requests: `onRequestStart`, `onRequest`, and `onRequestEnd`. ColdFusion processes requests, including these methods, as follows:

1. ColdFusion always processes `onRequestStart` at the start of the request.
2. If you implement an `onRequest` method, ColdFusion processes it; otherwise, it processes the requested page. If you implement an `onRequest` method, you must explicitly call the requested page in your `onRequest` method.
3. ColdFusion always processes `onRequestEnd` at the end of the request.
The following sections explain how you can use each of the Application.cfc request methods to manage requests. For more information, see entries for `onRequestStart`, `onRequest`, and `onRequestEnd` in the CFML Reference.

**Using the `onRequestStart` method**
This method runs at the beginning of the request. It is useful for user authorization (login handling), and for request-specific variable initialization, such as gathering performance statistics.

If you use the `onRequestStart` method and do not use the `onRequest` method, ColdFusion automatically processes the request when it finishes processing the `onRequestStart` code.

**Note:** If you do not include an `onRequest` method in Application.cfc file, the `onRequestStart` method does not share a Variables scope with the requested page, but it does share Request scope variables.

**User authentication**
When an application requires a user to log in, put the authentication code, including the `cflogin` tag or code that calls this tag, in the `onRequestStart` method. Doing so ensures that the user is authenticated at the start of each request. For detailed information on security and creating logins, see "Securing Applications" on page 311 For an example that uses authentication code generated by the Adobe Dreamweaver CF Login Wizard, see `onRequestStart` in the CFML Reference.

**Using the `onRequest` method**
The `onRequest` method differs from the `onRequestStart` method in one major way: the `onRequest` method intercepts the user's request. This difference has two implications:

- ColdFusion does not process the request unless you explicitly call it, for example, by using a `cfinclude` tag. This behavior lets you use the `onRequest` method to filter requested page content or to implement a switch that determines the pages or page contents to be displayed.

- When you use `cfinclude` to process request, the CFC instance shares the Variables scope with the requested page. As a result, any method in the CFC that executes can set the page's Variables scope variables, and the `onRequestEnd` method can access any Variable scope values that the included page has set or changed. Therefore, for example, the `onRequestStart` or `onRequest` method can set variables that are used on the page.

To use this method as a filter, put the `cfinclude` tag inside a `cfsavecontent` tag, as the following example shows:

```cfc
<cffunction name="onRequest">
  <cfargument name = "targetPage" type="String" required=true/>
  <cfsavecontent variable="content">
    <cfinclude template=#Arguments.targetPage#>
  </cfsavecontent>
  <cfoutput>
    #replace(content, "report", "MyCompany Quarterly Report", "all")#
  </cfoutput>
</cffunction>
```

**Using the `onRequestEnd` method**
You use the `onRequestEnd` method for code that should run at the end of each request. (In ColdFusion versions through ColdFusion MX 6.1, you would use the OnRequestEnd.cfm page for such code.) Typical uses include displaying dynamic footer pages. For an example, see `onSessionEnd` in the CFML Reference.

**Note:** If you do not include an `onRequest` method in Application.cfc file, the `onRequestEnd` method does not share a Variables scope with the requested page, but it does share Request scope variables.
Handling errors in Application.cfc

The following sections briefly describe how you can handle errors in Application.cfc. For more information on error pages and error handling, see “Handling Errors” on page 246 For details on implementing the onError method, see onError in the CFML Reference.

Application.cfc error handling techniques

Application.cfc can handle errors in any combination of the following ways:

- You can use try/catch error handling in the event methods, such as onApplicationStart or onRequestStart, to handle exceptions that happen in the event methods.

- You can implement the onError method. This method receives all exceptions that are not directly handled by try/catch handlers in CFML code. The method can use the cfthrow tag to pass any errors it does not handle to ColdFusion for handling.

- You can use cferror tags in the application initialization code following the cfcomponent tag, typically following the code that sets the application's This scope variables. These tags specify error processing if you do not implement an onError method, or if the onError method throws an error. You could implement an application-specific validation error handler, for example, by putting the following tag in the CFC initialization code:

```
<cferror type="VALIDATION" template="validationerrorhandler.cfm">
```

1. The ColdFusion default error mechanisms handle any errors that are not handled by the preceding techniques. These mechanisms include the site-wide error handler that you can specify in the ColdFusion Administrator and the built-in default error pages.

These techniques let you include application-specific information, such as contact information or application or version identifiers, in the error message, and let you display all error messages in the application in a consistent manner. You can use Application.cfc to develop sophisticated application-wide error-handling techniques, including error-handling methods that provide specific messages, or use structured error-handling techniques.

Note: The onError method can catch errors that occur in the onSessionEnd and onApplicationEnd application event methods. It will not display messages to the user, however, because there is no request context. The onError function can log errors that occur when the session or application ends.

Handling server-side validation errors in the onError method

Server-side validation errors are actually ColdFusion exceptions; as a result, if your application uses an onError method, this method gets the error and must handle it or pass it on to ColdFusion for handling.

To identify a server-side validation error, search the Arguments.Exception.StackTrace field for coldfusion.filter.FormValidationException. You can then handle the error directly in your onError routine, or throw the error so that either the ColdFusion default validation error page or a page specified by an cferror tag in your Application.cfc initialization code handles it.

Example: error Handling with the onError method

The following Application.cfc file has an onError method that handles errors as follows:

- If the error is a server-side validation error, the onError method throws the error for handling by ColdFusion, which displays its standard validation error message.

- For any other type of exception, the onError method displays the name of the event method in which the error occurred and dumps the exception information. In this example, because you generate errors on the CFM page only, and not in a Application.cfc method, the event name is always the empty string.

```cfc
<cfcomponent>
<cfset This.name = "BugTestApplication">
```
<cffunction name="onError">
<!--- The onError method gets two arguments:
An exception structure, which is identical to a cfcatch variable.
The name of the Application.cfc method, if any, in which the error
happened. --->
<cfargument name="Except" required=true/>
<cfargument type="String" name = "EventName" required=true/>
<!--- Log all errors in an application-specific log file. --->
<cflog file="#This.Name#" type="error" text="Event Name: #Eventname#">
<cflog file="#This.Name#" type="error" text="Message: #except.message#">
<!--- Throw validation errors to ColdFusion for handling. --->
<cfif Find("coldfusion.filter.FormValidationException",
Arguments.Except.StackTrace)>
<cfthrow object="#except#">
<cfelse>
<!--- You can replace this cfoutput tag with application-specific
error-handling code. --->
<cfoutput>
<p>Error Event: #EventName#</p>
<p>Error details:<br>
<cfdump var=#except#></p>
</cfoutput>
</cfif>
</cffunction>
</cfcomponent>

To test this example, put a CFML page with the following code in the same page as the Application.cfc file, and enter valid and invalid text in the text input field.

<cfform>
This box does Integer validation:
<cfinput name="intinput" type="Text" validate="integer" validateat="onServer"><br>
Check this box to throw an error on the action page:
<cfinput type="Checkbox" name="throwerror"><br>
<cfinput type="submit" name="submitit">
</cfform>
<cfif IsDefined("form.fieldnames")>
<cfif IsDefined("form.throwerror")>
<cfthrow type="ThrownError" message="This error was thrown from the bugTest action page.">
</cfif>
</cfif>

Note: For more information on server-side validation errors, see "Validating Data" on page 553.

Example: a complete Application.cfc
The following example is a simplified Application.cfc file that illustrates the basic use of all application event handlers:

<cfcomponent>
<cfset This.name = "TestApplication">
<cfset This.Sessionmanagement=true>
<cfset This.Sessiontimeout="#createtimespan(0,0,10,0)#">
<cfset This.applicationtimeout="#createtimespan(5,0,0,0)#">
<cffunction name="onApplicationStart">
<cftry>

<!--- Test whether the DB that this application uses is accessible by selecting some data. --->
<cfquery name="testDB" dataSource="cfdocexamples" maxrows="2">
    SELECT Emp_ID FROM employee
</cfquery>
<!--- If we get database error, report it to the user, log the error information, and do not start the application. --->
<cfcatch type="database">
    <cfoutput>
        This application encountered an error.<br>
        Please contact support.
    </cfoutput>
    <cflog file="#This.Name#" type="error"
        text="cfdocexamples DB not available. message: #cfcatch.message#
        Detail: #cfcatch.detail# Native Error: #cfcatch.NativeErrorcode#">
    <cfreturn False>
</cfcatch>
</cftry>
<cflog file="#This.Name#" type="Information" text="Application Started">
<!--- You do not have to lock code in the onApplicationStart method that sets Application scope variables. --->
<cfscript>
    Application.availableResources=0;
    Application.counter1=1;
    Application.sessions=0;
</cfscript>
<!--- You do not need to return True if you don't set the cffunction returntype attribute. --->
</cffunction>
<cffunction name="onApplicationEnd">
    <cfargument name="ApplicationScope" required=true/>
    <cflog file="#This.Name#" type="Information"
        text="Application #ApplicationScope.applicationname# Ended">
</cffunction>
<cffunction name="onRequestStart">
    <!--- Authentication code, generated by the Dreamweaver Login Wizard, makes sure that a user is logged in, and if not displays a login page. --->
    <cfinclude template="mm_wizard_application_include.cfm">
    <!--- If it's time for maintenance, tell users to come back later. --->
    <cfscript>
        if ([Hour(now()) gt 1] and [Hour(now()) lt 3]) {
            WriteOutput("The system is undergoing periodic maintenance.
            Please return after 3:00 AM Eastern time.");
            return false;
        } else {
            this.start=now();
        }
    </cfscript>
</cffunction>
<cffunction name="onRequest">
    <cfargument name = "targetPage" type="String" required=true/>
    <cfsavecontent variable="content">
    <cfinclude template=#Arguments.targetPage#>
</cfsavecontent>
<!--- This is a minimal example of an onRequest filter. --->
<cfoutput>
    #replace(content, "report", "MyCompany Quarterly Report", "all")#
<!---- Display a different footer for logged in users than for guest users or users who have not logged in. --->

<cffunction name="onRequestEnd">
  <cfargument type="String" name = "targetTemplate" required=true/>
  <cfset theAuthuser=getauthuser()>
  <cfif ((theAuthUser EQ "guest") OR (theAuthUser EQ ""))>
    <cfinclude template="noauthuserfooter.cfm">
  <cfelse>
    <cfinclude template="authuserfooter.cfm">
  </cfif>
</cffunction>

<cffunction name="onSessionStart">
  <cfscript>
    Session.started = now();
    Session.shoppingCart = StructNew();
    Session.shoppingCart.items = 0;
  </cfscript>
  <cflock timeout="5" throwontimeout="No" type="EXCLUSIVE" scope="SESSION">
    <cfset Application.sessions = Application.sessions + 1>
  </cflock>
  <cflog file="#This.Name#" type="Information" text="Session: #Session.sessionid# started">
</cffunction>

<cffunction name="onSessionEnd">
  <cfargument name = "SessionScope" required=true/>
  <cflog file="#This.Name#" type="Information" text="Session: #arguments.SessionScope.sessionid# ended">
</cffunction>

<cffunction name="onError">
  <cfargument name="Exception" required=true/>
  <cfargument type="String" name = "EventName" required=true/>
  <!--- Log all errors. --->
  <cflog file="#This.Name#" type="error" text="Event Name: #EventName#">
  <cflog file="#This.Name#" type="error" text="Message: #exception.message#">
  <!--- Some exceptions, including server-side validation errors, do not generate a rootcause structure. --->
  <cfif isdefined("exception.rootcause")>
    <cflog file="#This.Name#" type="error" text="Root Cause Message: #exception.rootcause.message#">
  </cfif>
  <!--- Display an error message if there is a page context. --->
  <cfif NOT (Arguments.EventName IS onSessionEnd) OR (Arguments.EventName IS onApplicationEnd)>
    <cfoutput>
      <h2>An unexpected error occurred.</h2>
      Please provide the following information to technical support:
      Error Event: #EventName#</p>
      Error details:<br>
      <cfdump var=#exception#></p>
    </cfoutput>
  </cfif>
</cffunction>

</cfcicomponent>
Migrating from Application.cfm to Application.cfc

To migrate an existing application that uses Application.cfm to one that uses Application.cfc, do the following:

• Replace the `cfapplication` tag with CFC initialization code that sets the Application.cfc. This scope variables that correspond to the tag attributes.

• Put in the `onApplicationStart` method any code that initializes Application scope variables, and any other application-specific code that executes only when the application starts. Often, such code in Application.cfm is inside a block that tests for the existence of an Application scope switch variable. Remove the variable test and the Application scope lock that surrounds the code that sets the Application scope variables.

• Put in the `onSessionStart` method any code that initializes Session scope variables, and any other application-specific code that executes only when the session starts. Remove any code that tests for the existence of Session scope variables to be for initialized and the Session scope lock that surrounds the code that sets the Session scope variables.

• Put in the `onRequestStart` method any `cflogin` tag and related authentication code.

• Put in the `onRequest` method any code that sets Variables scope variables and add a `cfinclude` tag that includes the page specified by the method's `Arguments.Targetpage` variable.

• Put in the `onRequestEnd` method any code you have in an OnRequestEnd.cfm page.

• Consider replacing `cferror` tags with an `onError` event method. If you do not do so, put the `cferror` tags in the CFC initialization code.

Using an Application.cfm page

If you do not use an Application.cfc file, you can use the Application.cfm page to define application-level settings and functions.

Naming the application

Use the `cfapplication` tag to specify the application name and define a set of pages as part of the same logical application. Although you can create an application by putting a `cfapplication` tag with the application name on each page, you normally put the tag in the Application.cfm file; for example:

```cfc
<cfapplication name="SearchApp">
```

Note: The value that you set for the `name` attribute in the `cfapplication` tag is limited to 64 characters.

Setting the client, application, and session variables options

Use the `cfapplication` tag to specify client state and persistent variable use, as follows:

• To use Client scope variables, you must specify `clientManagement=True`.

• To use Session scope variables, you must specify `sessionManagement=True`.

You can also optionally do the following:

• Set application-specific time-outs for Application and Session scope variables. These settings override the default values set in the ColdFusion Administrator.

• Specify a storage method for Client scope variables. This setting overrides the method set in the ColdFusion Administrator.
• Specify not to use cookies on the client browser.
For more information on configuring these options, see “Using Persistent Data and Locking” on page 272 and the CFML Reference.

Defining page processing settings
The cfsetting tag lets you specify page processing attributes that you might want to apply to all pages in your application. For more information, see “Setting page processing options” on page 226.

Setting application default variables and constants
You can set default variables and application-level constants on the Application.cfm page. For example, you can specify the following values:
• A data source
• A domain name
• Style settings, such as fonts or colors
• Other important application-level variables
Often, an Application.cfm page uses one or more cfinclude tags to include libraries of commonly used code, such as user-defined functions, that are required on many of the application's pages.

Processing logins
When an application requires a user to log in, you typically put the cflogin tag on the Application.cfm page. For detailed information on security and creating logins, including an Application.cfm page that manages user logins, see “Securing Applications” on page 311.

Handling errors
You can use the cferror tag on your Application.cfm page to specify application-specific error-handling pages for request, validation, or exception errors, as shown in the example in the following section. This way you can include application-specific information, such as contact information or application or version identifiers, in the error message, and you display all error messages in the application in a consistent manner.
For more information on error pages and error handling, see “Handling Errors” on page 246.

Example: an Application.cfm page
The following example shows a sample Application.cfm file that uses several of the techniques typically used in Application.cfm pages. For the sake of simplicity, it does not show login processing; for a login example, see “Securing Applications” on page 311.

<!--- Set application name and enable Client and Session variables. --->
<cfapplication name="Products"
   clientmanagement="Yes"
   clientstorage="myCompany"
   sessionmanagement="Yes">

<!--- Set page processing attributes. --->
<cfsetting showDebugOutput="No">

<!--- Set custom global error handling pages for this application.---->
<!--- Set the Application variables if they aren't defined. --->
<cfset app_is_initialized = False>
<!--- Get a read-only lock. --->
<cflock scope="application" type="readonly" timeout=10>
<!--- Read init flag and store it in local variable. --->
<cfset app_is_initialized = IsDefined("Application.initialized")>
</cflock>
<!--- Check the local flag. --->
<cfif not app_is_initialized>
<!--- Application variables are not initialized yet. Get an exclusive lock to write scope. --->
<cflock scope="application" type="exclusive" timeout=10>
<!--- Check the Application scope initialized flag since another request could have set the variables after this page released the read-only lock. --->
<cfif not IsDefined("Application.initialized")>
<!--- Do initializations --->
<cfset Application.ReadOnlyData.Company = "MyCompany">
<!--- and so on --->
<!--- Set the Application scope initialization flag. --->
<cfset Application.initialized = "yes">
</cfif>
</cflock>
</cfif>
<!--- Set a Session variable. --->
<cflock timeout="20" scope="Session" type="exclusive">
<cfif not IsDefined("session.pagesHit")>
<cfset session.pagesHit=1>
<cfelse>
<cfset session.pagesHit=session.pagesHit+1>
</cfif>
</cflock>
<!--- Set Application-specific Variables scope variables. --->
<cfset mainpage = "default.cfm">
<cfset current_page = "#cgi.path_info#?#cgi.query_string#">
<!--- Include a file containing user-defined functions called throughout the application. --->
<cfinclude template="commonfiles/productudfs.cfm">

**Reviewing the code**

The following table describes the code and its function:
You can optimize your ColdFusion application in many ways. Optimizing ColdFusion mostly involves good development and coding practices. For example, good database design and usage is a prime contributor to efficient ColdFusion applications.

In several places, this manual documents optimization techniques as part of the discussion of the related ColdFusion topic. This section provides information about general ColdFusion optimization tools and strategies, and particularly about using CFML caching tags for optimization. This section also contains information on optimizing database use, an important area for application optimization.

The ColdFusion Administrator provides caching options for ColdFusion pages and SQL queries. For information on these options, see the ColdFusion Administrator online Help and Configuring and Administering ColdFusion.

For information on debugging techniques that can help you identify slow pages, see "Debugging and Troubleshooting Applications" on page 351.

For additional information on optimizing ColdFusion, see the Adobe ColdFusion support center at www.adobe.com/go/support/coldfusion.
Caching ColdFusion pages that change infrequently

Some ColdFusion pages produce output that changes infrequently. For example, you might have an application that extracts a vendor list from a database or produces a quarterly results summary. Normally, when ColdFusion gets a request for a page in the application, it does all the business logic and display processing that are required to produce the report or generate and display the list. If the results change infrequently, this can be an inefficient use of processor resources and bandwidth.

The `cfcache` tag tells ColdFusion to cache the HTML that results from processing a page request in a temporary file on the server. This HTML does not need to be generated each time the page is requested. When ColdFusion gets a request for a cached ColdFusion page, it retrieves the pregenerated HTML page without having to process the ColdFusion page. ColdFusion can also cache the page on the client. If the client browser has its own cached copy of the page from a previous viewing, ColdFusion instructs the browser to use the client's page rather than resending the page.

Note: The `cfcache` tag caching mechanism considers that each URL is a separate page. Therefore, http://www.mySite.com/view.cfm?id=1 and http://www.mySite.com/view.cfm?id=2 result in two separate cached pages. Because ColdFusion caches a separate page for each unique set of URL parameters, the caching mechanism accommodates pages for which different parameters result in different output.

Using the `cfcache` tag

You tell ColdFusion to cache the page results by putting a `cfcache` tag on your ColdFusion page before code that outputs text. The tag lets you specify the following information:

- Whether to cache the page results on the server, the client system, or both. The default is both. The default is optimal for pages that are identical for all users. If the pages contain client-specific information, or are secured with ColdFusion user security, set the `action` attribute in the `cfcache` tag to `ClientCache`.

- The directory on the server in which to store the cached pages. The default directory is `cf_root/cache`. It is a good practice to create a separate cache directory for each application. Doing so can prevent the `cfcache` tag `flush` action from inappropriately flushing more than one application's caches at a time.

- The time span that indicates how long the page lasts in the cache from when it is stored until it is automatically flushed.

You can also specify several attributes for accessing a cached page on the web server, including a user name and password (if required by the web server), the port, and the protocol (HTTP or HTTPS) to use to access the page.

Place the `cfcache` tag before any code on your page that generates output, typically at the top of the page body. For example, the following tag tells ColdFusion to cache the page on both the client and the server. On the server, the page is cached in the `e:/temp/page_cache` directory. ColdFusion retains the cached page for one day.

```coldfusion
<cfcache timespan="#CreateTimespan(1, 0, 0, 0)#" directory="e:/temp/page_cache">
```

Important: If an Application.cfm or Application.cfc page displays text (for example, if it includes a header page), use the `cfcache` tag on the Application.cfm page, in addition to the pages that you cache. Otherwise, ColdFusion displays the Application.cfm page output twice on each cached page.

Flushing cached pages

ColdFusion automatically flushes any cached page if you change the code on the page. It also automatically flushes pages after the expiration timespan passes.

You can use the `cfcache` tag with the `action="flush"` attribute to immediately flush one or more cached pages. You can optionally specify the directory that contains the cached pages to be flushed and a URL pattern that identifies the pages to flush. If you do not specify a URL pattern, all pages in the directory are flushed. The URL pattern can include asterisk (*) wildcards to specify parts of the URL that can vary.
When you use the `cfcache` tag to flush cached pages, ColdFusion deletes the pages cached on the server. If a flushed page is cached on the client system, it is deleted, and a new copy gets cached the next time the client tries to access the ColdFusion page.

The following example flushes all the pages in the `e:/temp/page_cache/monthly` directory that start with HR:

```coldfusion
<cfcache action="flush" directory="e:/temp/page_cache/monthly" expirURL="HR*"/>
```

If you have a ColdFusion page that updates data that you use in cached pages, the page that does the updating includes a `cfcache` tag that flushes all pages that use the data.

For more information on the `cfcache` tag, see the CFML Reference.

### Caching parts of ColdFusion pages

In some cases, your ColdFusion page might contain a combination of dynamic information that ColdFusion must generate each time it displays the page, and information that it generates dynamically, but that change less frequently. In this case, you cannot use the `cfcache` tag to cache the entire page. Instead, use the `cfsavecontent` tag to cache the infrequently changed content.

The `cfsavecontent` tag saves the results of processing the tag body in a variable. For example, if the body of the `cfsavecontent` tag contains a `cfexecute` tag that runs an executable program that displays data, the variable saves the output.

You can use the `cfsavecontent` tag to cache infrequently changing output in a shared scope variable. If the information is used throughout the application, save the output in the Application scope. If the information is client-specific, use the Session scope. Because of the overhead of locking shared scope variables, use this technique only if the processing overhead of generating the output is substantial.

Before you use this technique, also consider whether other techniques are more appropriate. For example, query caching eliminates the need to repeat a common query. However, if the effort of processing the data or formatting the output is substantial, using the `cfsavecontent` tag can save processing time.

Using this technique, if the variable exists, the page uses the cached output. If the variable does not exist, the page gets the data, generates the output, and saves the results to the shared scope variable.

The following example shows this technique. It has two parts. The first part welcomes the user and prints out a random lucky number. This part runs and produces a different number each time a user opens the page. The second part performs a database query to get information that changes infrequently; in this example, a listing of the current special sale items. It uses the `cfsavecontent` tag to get the data only when needed.

If you use this technique frequently, consider incorporating it in a custom CFML tag.

```coldfusion
<!---- Greet the user. ---->
<cfoutput>
  Welcome to our home page.<br>
  The time is #TimeFormat(Now())#.  <br>
  Your lucky number is:  #RandRange(1,1000)#<br>
</cfoutput>

<!---- Set a flag to indicate whether the Application scope variable exists. ---->
<cflock scope="application" timeout="20" type="readonly">
  <cfset IsCached = Not IsDefined("Application.ProductCache")>
</cflock>

<!---- If the flag is false, query the DB, and save an image of the results output to a variable. ---->
```
<cfif not IsCached>
  <cfsavecontent variable="ProductCache">
    <!--- Perform database query. --->
    <cfquery dataSource="ProductInfo" name="specialQuery">
      SELECT ItemName, Item_link, Description, BasePrice
      FROM SaleProducts
    </cfquery>
    <!--- Calculate sale price and display the results. --->
    <h2>Check out the following specials</h2>
    <table>
      <cfoutput query="specialQuery">
        <cfset salePrice = BasePrice * .8>
        <tr>
          <td>#ItemName#</td>
          <td>#ItemLink#</td>
          <td>#Description#</td>
          <td>#salePrice#</td>
        </tr>
      </cfoutput>
    </table>
  </cfsavecontent>
  <!--- Save the results in the Application scope. --->
  <cflock scope="Application" type="Exclusive" timeout=30>
    <cfset Application.productCache = ProductCache>
  </cflock>
</cfif>

<!--- Use the Application scope variable to display the sale items. --->
<cflock scope="application" timeout="20" type="readonly">
  <cfoutput>#Application.ProductCache#</cfoutput>
</cflock>

**Reviewing the code**
The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfoutput&gt; Welcome to our home page.&lt;br&gt; The time is #TimeFormat(Now())#. Your lucky number is: #RandRange(1,1000)#&lt;br&gt; &lt;br&gt;&lt;/cfoutput&gt;</td>
<td>Displays the part of the page that must change each time.</td>
</tr>
<tr>
<td>&lt;cflock scope=&quot;application&quot; timeout=&quot;20&quot; type=&quot;readonly&quot;&gt; &lt;cfset IsCached = IsDefined('Application.ProductCache')&gt; &lt;/cflock&gt;</td>
<td>Inside a read-only lock, tests to see if the part of the page that changes infrequently is already cached in the Application scope, and sets a Boolean flag variable with the result.</td>
</tr>
<tr>
<td>&lt;cfif not IsCached&gt; &lt;cfsavecontent variable=&quot;ProductCache&quot;&gt; &lt;cfquery dataSource=&quot;ProductInfo&quot; name=&quot;specialQuery&quot;&gt; SELECT ItemName, Item_link, Description, BasePrice FROM SaleProducts &lt;/cfquery&gt;</td>
<td>If the flag is False, uses a cfsavecontent tag to save output in a Variables scope variable. Using the Variables scope eliminates the need to do a query (which can take a long time) in an Application scope lock.</td>
</tr>
<tr>
<td>&lt;cfquery dataSource=&quot;ProductInfo&quot; name=&quot;specialQuery&quot;&gt; SELECT ItemName, Item_link, Description, BasePrice FROM SaleProducts &lt;/cfquery&gt;</td>
<td>Queries the database to get the necessary information.</td>
</tr>
</tbody>
</table>
Optimizing database use

Poor database design and incorrect or inefficient use of the database are among the most common causes of inefficient applications. Consider the different methods that are available for using databases and information from databases when you design your application. For example, if you need to average the price of a number of products from an SQL query, it is more efficient to use SQL to get the average than to use a loop in ColdFusion.

Two important ColdFusion tools for optimizing your use of databases are the `cfstoredproc` tag and the `cfquery` tag `cachedWithin` attribute.

**Using stored procedures**

The `cfstoredproc` tag lets ColdFusion use stored procedures in your database management system. A stored procedure is a sequence of SQL statements that is assigned a name, compiled, and stored in the database system. Stored procedures can encapsulate programming logic in SQL statements, and database systems are optimized to execute stored procedures efficiently. As a result, stored procedures are faster than `cfquery` tags.

You use the `cfproccparam` tag to send parameters to the stored procedure, and the `cfprocresult` tag to get the record sets that the stored procedure returns.

The following example executes a Sybase stored procedure that returns three result sets, two of which the example uses. The stored procedure returns the status code and one output parameter, which the example displays.

```
<cfstoredproc procedure = "foo_proc" dataSource = "MY_SYBASE_TEST"
    username = "sa" password = "" returnCode = "Yes">
</cfstoredproc>
```
<cfprocresult name = RS3 resultSet = 3>

<!---- cfprocparam tags ---->
<cfprocparam type = "IN"
  CFSQLType = CF_SQL_INTEGER
  value = "1">
<cfprocparam type = "OUT"
  CFSQLType = CF_SQL_DATE
  variable = FOO>
<!---- Close the cfstoredproc tag. ---->
</cfstoredproc>

<cfoutput>
The output param value: '#foo#'<br>
</cfoutput>

<h3>The Results Information</h3>
<cfoutput query = RS1>
#name#, #DATE_COL#<br>
</cfoutput> <br>
<cfoutput>
<hr>
Record Count: #RS1.recordCount#<br>
Columns: #RS1.columnList#<br>
<hr>
</cfoutput>

<cfoutput query = RS3>
#col1#, #col2#, #col3#<br>
</cfoutput> <br>
<cfoutput>
<hr><br>
Record Count: #RS3.recordCount#<br>
Columns: #RS3.columnList#<br>
<hr><br>
The return code for the stored procedure is: '#cfstoredproc.statusCode#'<br>
</cfoutput>

Reviewing the code
The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfstoredproc procedure = &quot;foo_proc&quot; dataSource = &quot;MY_SYBASE_TEST&quot; username = &quot;sa&quot; password = &quot;&quot; returnCode = &quot;Yes&quot;&gt;</td>
<td>Runs the stored procedure foo_proc on the MY_SYBASE_TEST data source. Populates the cfstoredproc.statusCode variable with the status code returned by stored procedure.</td>
</tr>
</tbody>
</table>
For more information on creating stored procedures, see your database management software documentation. For more information on using the `<cfstoredproc>` tag, see the CFML Reference.

### Using the `cfquery` tag `cachedWithin` attribute

The `cfquery` tag `cachedWithin` attribute tells ColdFusion to save the results of a database query for a specific period of time. This way, ColdFusion accesses the database on the first page request, and does not query the database on further requests until the specified time expires. Using the `cachedWithin` attribute can significantly limit the overhead of accessing databases that do not change rapidly.

This technique is useful if the database contents only change at specific, known times, or if the database does not change frequently and the purpose of the query does not require absolutely up-to-date results.

You must use the `CreateTimeSpan` function to specify the `cachedWithin` attribute value (in days, hours, minutes, seconds format). For example, the following code caches the results of getting the contents of the Employees table of the `cfdocexamples` data source for one hour.

```cfml
<cfquery datasource="cfdocexamples" name="master"
    cachedWithin="#CreateTimeSpan(0,1,0,0)#">
    SELECT * FROM Employees
</cfquery>
```

The output parameter value, the contents of the two columns in the first record set identified by the `name` and `DATE_COL` variables. You set the values of these variables elsewhere on the page.

- The number of rows and the names of the columns in the first record set
- The contents of the columns in the other record set identified by the `col1`, `col2`, and `col3` variables.
- The number of rows and the names of the columns in the record set.
- The status value returned by the stored procedure.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfprocresult name = RS1&gt;</code></td>
<td>Gets two record sets from the stored procedure: the first and third result sets it returns.</td>
</tr>
<tr>
<td><code>&lt;cfprocresult name = RS3 resultSet = 3&gt;</code></td>
<td>Specifies two parameters for the stored procedure, an input parameter and an output parameter. Sets the input parameter to 1 and the ColdFusion variable that gets the output to FOO.</td>
</tr>
<tr>
<td><code>&lt;cfprocparam type = &quot;IN&quot; CFSQLType = CF_SQL_INTEGER value = &quot;1&quot;&gt;</code></td>
<td>Ends the <code>cfstoredproc</code> tag body.</td>
</tr>
<tr>
<td><code>&lt;cfprocparam type = &quot;OUT&quot; CFSQLType = CF_SQL_DATE variable = FOO&gt;</code></td>
<td>Displays the results of running the stored procedure:</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td>• The output parameter value,</td>
</tr>
<tr>
<td></td>
<td>• The contents of the two columns in the first record set identified by the name and <code>DATE_COL</code> variables. You set the values of these variables elsewhere on the page.</td>
</tr>
<tr>
<td></td>
<td>• The number of rows and the names of the columns in the first record set</td>
</tr>
<tr>
<td></td>
<td>• The contents of the columns in the other record set identified by the <code>col1</code>, <code>col2</code>, and <code>col3</code> variables.</td>
</tr>
<tr>
<td></td>
<td>• The number of rows and the names of the columns in the record set.</td>
</tr>
<tr>
<td></td>
<td>• The status value returned by the stored procedure.</td>
</tr>
</tbody>
</table>

Displays the results of running the stored procedure:

- The output parameter value,
- The contents of the two columns in the first record set identified by the name and `DATE_COL` variables. You set the values of these variables elsewhere on the page.
- The number of rows and the names of the columns in the first record set
- The contents of the columns in the other record set identified by the `col1`, `col2`, and `col3` variables.
- The number of rows and the names of the columns in the record set.
- The status value returned by the stored procedure.
Providing visual feedback to the user

If an application might take a while to process data, it is useful to provide visual feedback to indicate that something is happening, so the user does not assume that there is a problem and request the page again. Although doing this does not optimize your application's processing efficiency, it does make the application appear more responsive.

You can use the `cfflush` tag to return partial data to a user, as shown in “Introduction to Retrieving and Formatting Data” on page 511.

You can also use the `cfflush` tag to create a progress bar. For information on this technique, see the technical article “Understanding Progress Meters in ColdFusion 5” at www.adobe.com/v1/handlers/index.cfm?id=21216&method=full. (Although this article was written for ColdFusion 5, it also applies to ColdFusion 8.)
Chapter 15: Handling Errors

ColdFusion includes many tools and techniques for responding to errors that your application encounters. These tools include error handling mechanisms and error logging tools. This chapter describes these tools and how to use them.

For information on user input validation, see “Introduction to Retrieving and Formatting Data” on page 511 and “Building Dynamic Forms with cfform Tags” on page 530. For information on debugging, see “Debugging and Troubleshooting Applications” on page 351.

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Understanding errors ................................................................. 247
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Logging errors with the cflog tag ......................................................... 256
Handling runtime exceptions with ColdFusion tags ..................................... 258

About error handling in ColdFusion

By default, ColdFusion generates its own error messages when it encounters errors. In addition, it provides a variety of tools and techniques for you to customize error information and handle errors when they occur. You can use any of the following error-management techniques:

- Specify custom pages for ColdFusion to display in each of the following cases:
  - When a ColdFusion page is missing (the Missing Template Handler page)
  - When an otherwise-unhandled exception error occurs during the processing of a page (the Site-wide Error Handler page)

  You specify these pages on the Settings page in the Server Settings page in the ColdFusion Administrator; for more information, see the ColdFusion Administrator Help.

- Use the cferror tag to specify ColdFusion pages to handle specific types of errors.

- Use the cftry, cfcatch, cfthrow, and cfrethrow tags to catch and handle exception errors directly on the page where they occur.

- In CFScript, use the try and catch statements to handle exceptions.

- Use the onError event in Application.cfc to handle exception errors that are not handled by try/catch code on the application pages.

- Log errors. ColdFusion logs certain errors by default. You can use the cflog tag to log other errors.

The remaining sections in this chapter provide the following information:

- The basic building blocks for understating types of ColdFusion errors and how ColdFusion handles them
- How to use the cferror tag to specify error-handling pages
• How to log errors
• How to handle ColdFusion exceptions

**Note:** This chapter discusses using the `cftry` and `cfcatch` tags, but not the equivalent CFScript `try` and `catch` statements. The general discussion of exception handling in this chapter applies to tags and CFScript statements. However, the code that you use and the information available in CFScript differs from those in the tags. For more information on handling exceptions in CFScript, see "Handling errors in UDFs" on page 147.

**Understanding errors**

There are many ways to look at errors; for example, you can look at errors by their causes. You can also look at them by their effects, particularly by whether your application can recover from them. You can also look at them the way ColdFusion does. The following sections discuss these ways of looking at errors.

**About error causes and recovery**

Errors can have many causes. Depending on the cause, the error might be recoverable. A recoverable error is one for which your application can identify the error cause and take action on the problem. Some errors, such as time-out errors, might be recoverable without indicating to the user that an error was encountered. An error for which a requested application page does not exist is not recoverable, and the application can only display an error message.

Errors such as validation errors, for which the application cannot continue processing the request, but can provide an error-specific response, can also be considered recoverable. For example, an error that occurs when a user enters text where a number is required can be considered recoverable, because the application can recognize the error and redisplay the data field with a message providing information about the error’s cause and telling the user to reenter the data.

Some types of errors might be recoverable in some, but not all circumstances. For example, your application can retry a request following a time-out error, but it must also be prepared for the case where the request always times out.

Error causes fall in the broad categories listed in the following table:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program errors</td>
<td>Can be in the code syntax or the program logic. The ColdFusion compiler identifies and reports program syntax errors when it compiles CFML into Java classes. Errors in your application logic are harder to locate. For information on debugging tools and techniques, see “Debugging and Troubleshooting Applications” on page 351. Unlike ColdFusion syntax errors, SQL syntax errors are only caught at runtime.</td>
</tr>
<tr>
<td>Data errors</td>
<td>Are typically user data input errors. You use validation techniques to identify errors in user input data and enable the user to correct the errors.</td>
</tr>
<tr>
<td>System errors</td>
<td>Can come from a variety of causes, including database system problems, time-outs due to excessive demands on your server, out-of-memory errors in the system, file errors, and disk errors.</td>
</tr>
</tbody>
</table>

Although these categories do not map completely to the way ColdFusion categorizes errors they provide a useful way of thinking about errors and can help you in preventing and handling errors in your code.

**ColdFusion error types**

Before you can effectively manage ColdFusion errors, you must understand how ColdFusion classifies and handles them. ColdFusion categorizes errors as detailed in the following table:
Note: The onSubmit and onBlur form field validation techniques use JavaScript or Flash validation on the client browser.

About ColdFusion exceptions
Most ColdFusion errors are exceptions. You can categorize ColdFusion exceptions in two ways:

- When they occur
- Their type

When exceptions occur
ColdFusion errors can occur at two times, when the CFML is compiled into Java and when the resulting Java executes, called runtime exceptions.

Compiler exceptions
Compiler exceptions are programming errors that ColdFusion identifies when it compiles CFML into Java. Because compiler exceptions occur before the ColdFusion page is converted to executable code, you cannot handle them on the page that causes them. However, other pages can handle these errors. For more information, see “Handling compiler exceptions” on page 253.

Runtime exception
A runtime exception occurs when the compiled ColdFusion Java code runs. It is an event that disrupts the application's normal flow of instructions. Exceptions can result from system errors or program logic errors. Runtime exceptions include:

- Error responses from external services, such as an ODBC driver or CORBA server
- CFML errors or the results of cfthrow or cfabort tags
- Internal errors in ColdFusion

ColdFusion exception types
ColdFusion exceptions have types that you specify in the cferror, cfcatch, and cfthrow error-handling tags. A cferror or cfcatch tag will handle only exceptions of the specified type. You identify an exception type by using an identifier from one (or more) of the following type categories:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exception</td>
<td>An error that prevents normal processing from continuing. All ColdFusion exceptions are, at their root, Java exceptions.</td>
</tr>
<tr>
<td>Missing template</td>
<td>An HTTP request for a ColdFusion page that cannot be found. Generated if a browser requests a ColdFusion page that does not exist.</td>
</tr>
<tr>
<td></td>
<td>Missing template errors are different from missing include exceptions, which result from cfinclude tags or custom tag calls that cannot find their targets.</td>
</tr>
<tr>
<td>Form field data validation</td>
<td>Server-side form field validation errors are a special kind of ColdFusion exception. You specify server-side form validation by using cfform attributes or hidden HTML form fields. All other types of server-side validation, such as the cfparam tag generate runtime exceptions. For more information on validating form fields see “Validating Data” on page 553.</td>
</tr>
<tr>
<td></td>
<td>ColdFusion includes a built-in error page for server-side form field validation errors, and the cferror tag includes a type attribute that lets you handle these errors in a custom error page, but if you use onError processing in Application.cfc, or try/catch error handling, the error appears as an Application exception. For more information on handling Form field validation in Application.cfc see “Handling server-side validation errors in the onError method” on page 231.</td>
</tr>
</tbody>
</table>

Note: The onSubmit and onBlur form field validation techniques use JavaScript or Flash validation on the client browser.
• Basic
• Custom
• Advanced
• Java class

Note: Use only custom error type names and the Application basic type name in cfthrow tags. All other built-in exception type names identify specific types of system-identified errors, so you should not use them for errors that you identify yourself.

Basic exception types
All ColdFusion exceptions except for custom exceptions belong to a basic type category. These types consist of a broadly-defined categorization of ColdFusion exceptions. The following table describes the basic exception types:

<table>
<thead>
<tr>
<th>Type</th>
<th>Type name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database failures</td>
<td>Database</td>
<td>Failed database operations, such as failed SQL statements, ODBC problems, and so on.</td>
</tr>
<tr>
<td>Missing include file errors</td>
<td>MissingInclude</td>
<td>Errors where files specified by the cfinclude, cfmodule, and cferror tags are missing. (A cferror tag generates a missingInclude error only when an error of the type specified in the tag occurs.) The MissingInclude error type is a subcategory of Template error. If you do not specifically handle the MissingInclude error type, but do handle the Template error type, the Template error handler catches these errors. MissingInclude errors are caught at runtime.</td>
</tr>
<tr>
<td>Template errors</td>
<td>Template</td>
<td>General application page errors, including invalid tag and attribute names. Most Template errors are caught at compile time, not runtime.</td>
</tr>
<tr>
<td>Object exceptions</td>
<td>Object</td>
<td>Exceptions in ColdFusion code that works with objects.</td>
</tr>
<tr>
<td>Security exceptions</td>
<td>Security</td>
<td>Catchable exceptions in ColdFusion code that works with security.</td>
</tr>
<tr>
<td>Expression exceptions</td>
<td>Expression</td>
<td>Failed expression evaluations; for example, if you try to add 1 and &quot;a&quot;.</td>
</tr>
<tr>
<td>Locking exceptions</td>
<td>Lock</td>
<td>Failed locking operations, such as when a cflock critical section times out or fails at runtime.</td>
</tr>
<tr>
<td>Verity Search engine exception</td>
<td>SearchEngine</td>
<td>Exceptions generated by the Verity search engine when processing cfindex, cfcollection, or cfsearch tags.</td>
</tr>
<tr>
<td>Application-defined exception events raised by cfthrow</td>
<td>Application</td>
<td>Custom exceptions generated by a cfthrow tag that do not specify a type, or specify the type as Application.</td>
</tr>
<tr>
<td>All exceptions</td>
<td>Any</td>
<td>Any exceptions. Includes all types in this table and any exceptions that are not specifically handled in another error handler, including unexpected internal and external errors.</td>
</tr>
</tbody>
</table>

Note: The Any type includes all error with the Java object type of java.lang.Exception. It does not include java.lang.Throwable errors. To catch Throwable errors, specify java.lang.Throwable in the cfcatch tag type attribute.

Custom exceptions
You can generate an exception with your own type by specifying a custom exception type name, for example MyCustomErrorType, in a cfthrow tag. You then specify the custom type name in a cfcatch or cferror tag to handle the exception. Custom type names must be different from any built-in type names, including basic types and Java exception classes.
Advanced exception types
The Advanced exceptions consist of a set of specific, narrow exception types. These types are supported in ColdFusion for backward-compatibility. For a list of advanced exception types, see “Advanced exception types” on page 72 in the CFML Reference.

Java exception classes
Every ColdFusion exception belongs to, and can be identified by, a specific Java exception class in addition to its basic, custom, or advanced type. The first line of the stack trace in the standard error output for an exception identifies the exception’s Java class.

For example, if you attempt to use an array function such as ArrayIsEmpty on an integer variable, ColdFusion generates an exception that belongs to the Expression exception basic type and the coldfusion.runtime.NonArrayException Java class.

In general, most applications do not need to use Java exception classes to identify exceptions. However, you can use Java class names to catch exceptions in non-CFML Java objects; for example, the following line catches all Java input/output exceptions:

```
<cfcatch type="java.io.IOException">
```

How ColdFusion handles errors
The following sections describe briefly how ColdFusion handles errors. The rest of this chapter expands on this information.

Missing template errors
If a user requests a page that the ColdFusion cannot find, and the Administrator Server Settings Missing Template Handler field specifies a Missing Template Handler page, ColdFusion uses that page to display error information. Otherwise, it displays a standard error message.

Form field validation errors
When a user enters invalid data in an HTML tag that uses onServer or hidden form field server-side data validation ColdFusion does the following:

1. If the Application CFC (Application.cfc) has an onError event handler method, ColdFusion calls the method.
2. If the Application.cfc initialization code or the Application.cfm page has a cferror that specifies a Validation error handler, ColdFusion displays the specified error page.
3. Otherwise, it displays the error information in a standard format that consists of a default header, a bulleted list describing the errors, and a default footer.

For more information on using hidden form field validation, see “Validating Data” on page 553. For more information on Application.cfc, see “Designing and Optimizing a ColdFusion Application” on page 218.

Compiler exception errors
If ColdFusion encounters a compiler exception, how it handles the exception depends on whether the error occurs on a requested page or on an included page:

- If the error occurs on a page that is accessed by a cfinclude or cfmodule tag, or on a custom tag page that you access using the cf_ notation, ColdFusion handles it as a runtime exception in the page that accesses the tag. For a description of how these errors are handled, see the next section, “Runtime exception errors.”
• If the error occurs directly on the requested page, and the Administrator Settings Site-wide Error Handler field specifies an error handler page, ColdFusion displays the specified error page. Otherwise, ColdFusion reports the error using the standard error message format described in “Error messages and the standard error format” on page 251.

Runtime exception errors
If ColdFusion encounters a runtime exception, it does the action for the first matching condition in the following table:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The code with the error is inside a cftry tag and the exception type is specified in a cfcatch tag.</td>
<td>Executes the code in the cfcatch tag. If the cftry block does not have a cfcatch tag for this error, tests for an appropriate cferror handler or site-wide error handler.</td>
</tr>
<tr>
<td>The ColdFusion application has an Application.cfc with an onError method</td>
<td>Executes the code in the onError method. For more information on using the onError method, see “Handling errors in Application.cfc” on page 231.</td>
</tr>
<tr>
<td>A cferror tag specifies an exception error handler for the exception type.</td>
<td>Uses the error page specified by the cferror tag.</td>
</tr>
<tr>
<td>The Administrator Settings Site-wide Error Handler field specifies an error handler page.</td>
<td>Uses the custom error page specified by the Administrator setting.</td>
</tr>
<tr>
<td>A cferror tag specifies a Request error handler.</td>
<td>Uses the error page specified by the cferror tag.</td>
</tr>
<tr>
<td>The default case.</td>
<td>Uses the standard error message format</td>
</tr>
</tbody>
</table>

For example, if an exception occurs in CFML code that is not in a cftry block, and Application.cfc does not have an onError method, but a cferror tag specifies a page to handle this error type, ColdFusion uses the specified error page.

Error messages and the standard error format
If your application does not handle an error, ColdFusion displays a diagnostic message in the user’s browser.

Error information is also written to a log file for later review. (For information on error logging, see “Logging errors with the cflog tag” on page 256.)

The standard error format consists of the information listed in the following table. ColdFusion does not always display all sections.

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error description</td>
<td>A brief, typically on-line, description of the error.</td>
</tr>
<tr>
<td>Error message</td>
<td>A detailed description of the error. The error message diagnostic information displayed depends on the type of error. For example, if you specify an invalid attribute for a tag, this section includes a list of all valid tag attributes.</td>
</tr>
<tr>
<td>Error location</td>
<td>The page and line number where ColdFusion encountered the error, followed by a short section of your CFML that includes the line. This section does not display for all errors. In some cases, the cause of an error can be several lines above the place where ColdFusion determines that there is a problem, so the line that initially causes the error might not be in the display.</td>
</tr>
</tbody>
</table>
If you get a message that does not explicitly identify the cause of the error, check the key system parameters, such as available memory and disk space.

## Determining error-handling strategies

ColdFusion provides you with many options for handling errors, particularly exceptions, as described in the section "How ColdFusion handles errors" on page 250. This section describes considerations for determining which forms of error handling to use.

### Handling missing template errors

Missing template errors occur when ColdFusion receives an HTTP request for a page ending in .cfm that it cannot find. You can create your own missing template error page to present application-specific information or provide an application-specific appearance. You specify the missing template error page on the Administrator Settings page.

The missing error page can use CFML tags and variables. In particular, you can use the CGI.script_name variable in text such as the following to identify the requested page:

```cfoutput>
The page #Replace(CGI.script_name, "/", "")# is not available.<br>
Make sure that you entered the page correctly.<br>
</cfoutput>

(In this code, the Replace function removes the leading slash sign from the script name to make the display more friendly.)

### Handling form field validation errors

When you use server-side form field validation, the default validation error message describes the error cause plainly and clearly. However, you might want to give the error message a custom look or provide additional information such as service contact phone numbers and addresses. In this case, use the cferror tag with the Validation attribute in the Application.cfc initialization code or on the Application.cfm page to specify your own validation error handler. The section "Example of a validation error page" on page 256 provides an example of such a page. You can also put form field validation error handling code in the Application.cfc onError method.
Handling compiler exceptions

You cannot handle compiler exceptions directly on the page where they occur, because the exception is caught before ColdFusion starts running the page code. You should fix all compiler exceptions as part of the development process. Use the reported error message and the code debugging techniques discussed in “Debugging and Troubleshooting Applications” on page 351 to identify and correct the cause of the error.

Compiler exceptions that occur on pages you access by using the `cfinclude` or `cfmodule` tags can actually be handled as runtime errors by surrounding the `cfinclude` or `cfmodule` tag in a `cftry` block. The compiler exception on the accessed page gets caught as a runtime error on the base page. However, you should avoid this “solution” to the problem, as the correct method for handling compiler errors is to remove them before you deploy the application.

Handling runtime exceptions

You have many choices for handling exceptions, and the exact path you take depends on your application and its needs. The following table provides a guide to selecting an appropriate technique:

<table>
<thead>
<tr>
<th>Technique</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cftry</code></td>
<td>Place <code>cftry</code> blocks around specific code sections where exceptions can be expected and you want to handle those exceptions in a context-specific manner; for example, if you want to display an error message that is specific to that code. Use <code>cftry</code> blocks where you can recover from an exception. For example, you can retry an operation that times out, or access an alternate resource. You can also use the <code>cftry</code> tag to continue processing where a specific exception will not harm your application; for example, if a missing resource is not required. For more information, see “Handling runtime exceptions with ColdFusion tags” on page 258.</td>
</tr>
<tr>
<td>Application.cfc <code>onError</code> method</td>
<td>Implement the <code>onError</code> method in your Application.cfc to consistently handle application-specific exceptions that might be generated by multiple code sections in the application. For more information on error handling using Application.cfc, see “Handling errors in Application.cfc” on page 231.</td>
</tr>
<tr>
<td><code>cferror</code> with exception-specific error handler pages</td>
<td>Use the <code>cferror</code> tag to specify error pages for specific exception types. These pages cannot recover from errors, but they can provide the user with information about the error’s cause and steps that they can take to prevent the problem. For more information, see “Specifying custom error messages with the cferror tag” on page 254.</td>
</tr>
<tr>
<td><code>cferror</code> with a Request error page</td>
<td>Use the <code>cferror</code> tag to specify a Request error handler that provides a customized, application-specific message for unrecoverable exceptions. Put the tag in the Application.cfc initialization code or on the Application.cfm page to make it apply to all pages in an application. A Request error page cannot use CFML tags, but it can display error variables. As a result, you can use it to display common error information, but you cannot provide error-specific instructions. Typically, Request pages display error variable values and application-specific information, including support contact information. For example code, see “Example of a request error page” on page 255.</td>
</tr>
<tr>
<td>Site-wide error handler page</td>
<td>Specify a site-wide error handler in the Administrator to provide consistent appearance and contents for all otherwise-unhandled exceptions in all applications on your server. Like the Request page, the site-wide error handler cannot perform error recovery. However, it can include CFML tags in addition to the error variables. Because a site-wide error handler prevents ColdFusion from displaying the default error message, it allows you to limit the information reported to users. It also lets you provide all users with default contact information or other instructions.</td>
</tr>
</tbody>
</table>
Specifying custom error messages with the cfferror tag

Custom error pages let you control the error information that users see. You can specify custom error pages for different types of errors and handle different types of errors in different ways. For example, you can create specific pages to handle errors that could be recoverable, such as request time-outs. You can also make your error messages consistent with the look and feel of your application.

You can specify the following types of custom error message pages:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validation</td>
<td>Handles server-side form field data validation errors. The validation error page cannot include CFML tags, but it can display error page variables. You can use this attribute only in the Application.cfc initialization code or on the Application.cfm page. It has no effect when used on any other page. Therefore, you can specify only one validation error page per application, and that page applies to all server-side validation errors.</td>
</tr>
<tr>
<td>Exception</td>
<td>Handles specific exception errors. You can specify individual error pages for different types of exceptions.</td>
</tr>
<tr>
<td>Request</td>
<td>Handles any exception that is not otherwise-handled. The request error page runs after the CFML language processor finishes. As a result, the request error page cannot include CFML tags, but can display error page variables. A request error page is useful as a backup if errors occur in other error handlers.</td>
</tr>
</tbody>
</table>

Specifying a custom error page

You specify the custom error pages with the cfferror tag. For Validation errors, the tag must be in the Application.cfc initialization code or on the Application.cfm page. For Exception and Request errors, you can set the custom error pages on each application page. However, because custom error pages generally apply to an entire application, it is more efficient to put these cfferror tags in the Application.cfc or Application.cfm file also. For more information on using these pages, see “Designing and Optimizing a ColdFusion Application” on page 218.

The cfferror tag has the attributes listed in the following table:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>The type of error that will cause ColdFusion to display this page: Exception, Request, or Validation.</td>
</tr>
<tr>
<td>Exception</td>
<td>Use only for the Exception type. The specific exception or exception category that will cause the page to be displayed. This attribute can specify any of the types described in “About ColdFusion exceptions” on page 248.</td>
</tr>
<tr>
<td>Template</td>
<td>The ColdFusion page to display.</td>
</tr>
<tr>
<td>MailTo</td>
<td>(Optional) An e-mail address. The cfferror tag sets the error page error.mailTo variable to this value. The error page can use the error.mailTo value in a message that tells the user to send an error notification. ColdFusion does not send any message itself.</td>
</tr>
</tbody>
</table>

The following cfferror tag specifies a custom error page for exceptions that occur in locking code and informs the error page of the of an e-mail address it can use to send a notification each time this type of error occurs:

```xml
<cfferror type = "exception"
    exception = "lock"
    template = "../common/lockexcept.cfm"
    mailto = "server@mycompany.com">
```

For detailed information on the cfferror tag, see the CFML Reference.
Creating an error application page

The following table lists the rules and considerations that apply to error application pages:

<table>
<thead>
<tr>
<th>Type</th>
<th>Considerations</th>
</tr>
</thead>
</table>
| Validation | • Cannot use CFML tags.  
• Can use HTML tags.  
• Can use the Error.InvalidFields, Error.validationHeader, and Error.validationFooter variables by enclosing them with number signs (#).  
• Cannot use any other CFML variables. |
| Request    | • Cannot use CFML tags.  
• Can use HTML tags.  
• Can use nine CFML error variables, such as Error.Diagnostics, by enclosing them with number signs.  
• Cannot use other CFML variables. |
| Exception  | • Can use full CFML syntax, including tags, functions, and variables.  
• Can use nine standard CFML Error variables and cfcatch variables. Use either Error or cferror as the prefix for both types of variables.  
• Can use other application-defined CFML variables.  
• To display any CFML variable, use the cfoutput tag. |

The following table describes the variables available on error pages: Exception error pages can also use all of the exception variables listed in the section “Exception information in cfcatch blocks” on page 260. To use these variables, replace the cfcatch prefix with cferror or error. For example, to use the exception message in an error page, refer to it as error.message.

In general, production Exception and Request pages should not display detailed error information, such as that supplied by the error.diagnostics variable. Typically, Exception pages e-mail detailed error information to an administrative address or log the information using the cflog tag instead of displaying it to the user. For more information on using the cflog tag, see “Logging errors with the cflog tag” on page 256.

Example of a request error page

The following example shows a custom error page for a request error:

```html
<html>
<head>
<title>Products - Error</title>
</head>
<body>
<h2>Sorry</h2>
<p>An error occurred when you requested this page.</p>
<p>Please send e-mail with the following information to #error.mailTo# to report this error.</p>
<table border=1>
<tr><td><b>Error Information</b>  
Date and time: #error.DateTime#  
Page: #error.template#  
Remote Address: #error.remoteAddress#  
HTTP Referer: #error.HTTPReferer#</td></tr>
</table>
</body>
</html>
```
<p>We apologize for the inconvenience and will work to correct the problem.</p>
</body>
</html>

Example of a validation error page
The following example shows a simple custom error page for a validation error:

```html
<html>
<head>
<title>Products - Error</title>
</head>
<body>

<h2>Data Entry Error</h2>

<p>You failed to correctly complete all the fields in the form. The following problems occurred:</p>

#error.invalidFields#

</body>
</html>
```

Logging errors with the cflog tag

ColdFusion provides extensive capabilities for generating, managing, and viewing log files, as described in Configuring and Administering ColdFusion. It also provides the cflog tag which adds entries to ColdFusion logs.

ColdFusion automatically logs errors to the default logs if you use the default error handlers. In all other cases, you must use the cflog tag in your error handling code to generate log entries.

The cflog tag lets you specify the following information:

- A custom file or standard ColdFusion log file in which to write the message.
- Text to write to the log file. This can include the values of all available error and cfcatch variables.
- Message severity (type): Information Warning, Fatal, or Error.
- Whether to log any of the following: application name, thread ID, system date, or system time. By default, all get logged.

For example, you could use a cflog tag in an exception error-handling page to log the error information to an application-specific log file, as in the following page:

```html
<html>
<head>
<title>Products - Error</title>
</head>
<body>

<h2>Sorry</h2>

<p>An error occurred when you requested this page. The error has been logged and we will work to correct the problem. We apologize for the inconvenience.</p>

<cflog type="Error"
Reviewing the code

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cflog type=&quot;Error&quot;</code> <code>&lt;file=&quot;myapp_errors&quot;</code> <code>&lt;text=&quot;Exception error --</code>\n</td>
<td>When this page is processed, log an entry in the file myapp_errors.log file in the ColdFusion log directory. Identify the entry as an error message and include an error message that includes the exception type, the path of the page that caused the error, the remote address that called the page, and the error's diagnostic message.</td>
</tr>
</tbody>
</table>
| `Exception type: #error.type#` `<Template: #error.template#`, `<Remote Address: #error.remoteAddress#`, `<HTTP Reference: #error.HTTPReferer#`\n| • Log entry type, specified by the `cflog type` attribute
| `Diagnostics: #error.diagnostics#">`                                              | • ID of the thread that was executing
|                                                                                                                                 | • Date the entry was written to the log
|                                                                                                                                 | • Time the entry was written to the log
|                                                                                                                                 | • Application name, as specified in the Application.cfc initialization code (by setting the This.application variable) or by a `cfapplication` tag (for example, in an Application.cfm file).
|                                                                                                                                 | • The message specified by the `cflog text` attribute.

A log file entry similar to the following is generated if you try to call a nonexistent custom tag and this page catches the error (line breaks added for clarity):

"Error","web-13","12/19/01","11:29:07",MYAPP,"Exception error --`\n| Exception type: coldfusion.runtime.CFErrorWrapper
| Template: /MYStuff/MyDocs/exceptiontest.cfm,
| Remote Address: 127.0.0.1,
| HTTP Reference: Cannot find CFML template for custom tag testCase. Cannot find CFML template for custom tag testCase. ColdFusion attempted looking in the tree of installed custom tags but did not find a custom tag with this name."

The text consists of a comma-delimited list of the following entries:

• Log entry type, specified by the `cflog type` attribute
• ID of the thread that was executing
• Date the entry was written to the log
• Time the entry was written to the log
• Application name, as specified in the Application.cfc initialization code (by setting the This.application variable) or by a `cfapplication` tag (for example, in an Application.cfm file).
• The message specified by the `cflog text` attribute.
Handling runtime exceptions with ColdFusion tags

Exceptions include any event that disrupts the normal flow of instructions in a ColdFusion page, such as failed database operations, missing include files, or developer-specified events. Ordinarily, when ColdFusion encounters an exception, it stops processing and displays an error message, or an error page specified by a cferror tag or the Site-wide Error Handler option on the Settings page in the Administrator. However, you can use the ColdFusion exception handling tags to catch and process runtime exceptions directly in ColdFusion pages.

This ability to handle exceptions directly in your application pages enables your application to do the following:

• Respond appropriately to specific errors within the context of the current application page
• Recover from errors whenever possible.

Exception-handling tags
ColdFusion provides the exception-handling tags listed in the following table:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cftry</td>
<td>If any exceptions occur while processing the tag body, look for a cfcatch tag that handles the exception, and execute the code in the cfcatch tag body.</td>
</tr>
<tr>
<td>cfcatch</td>
<td>Execute code in the body of this tag if the exception caused by the code in the cftry tag body matches the exception type specified in this tag's attributes. Used in cftry tag bodies only.</td>
</tr>
<tr>
<td>cfthrow</td>
<td>Generate a user-specified exception.</td>
</tr>
<tr>
<td>cfrethrow</td>
<td>Exit the current cfcatch block and generates a new exception of the same type. Used only in cfcatch tag bodies.</td>
</tr>
</tbody>
</table>

Using cftry and cfcatch tags
The cftry tag lets you go beyond reporting error data to the user:

• You can include code that recovers from errors so your application can continue processing without alerting the user.
• You can create customized error messages that apply to the specific code that causes the error.

For example, you can use cftry to catch errors in code that enters data from a user registration form to a database. The cfcatch code could do the following:

1. Retry the query, so the operation succeeds if the resource was only temporarily unavailable.
2. If the retries fail:
   • Display a custom message to the user
   • Post the data to an email address so the data could be entered by company staff after the problem has been solved.

Code that accesses external resources such as databases, files, or LDAP servers where resource availability is not guaranteed is a good candidate for using try/catch blocks.
Try/catch code structure

In order for your code to directly handle an exception, the tags in question must appear within a `cftry` block. It is a good idea to enclose an entire application page in a `cftry` block. You then follow the `cftry` block with `cfcatch` blocks, which respond to potential errors. When an exception occurs within the `cftry` block, processing is thrown to the `cfcatch` block for that type of exception.

Here is an outline for using `cftry` and `cfcatch` to handle errors:

```cfml
<cftry>
  Put your application code here ...
  <cfcatch type="exception type1">
    Add exception processing code here ...
  </cfcatch>
  <cfcatch type="exception type2">
    Add exception processing code here ...
  </cfcatch>
  ...
  <cfcatch type="Any">
    Add exception processing code appropriate for all other exceptions here ...
  </cfcatch>
</cftry>
```

Try/catch code rules and recommendations

Follow these rules and recommendations when you use `cftry` and `cfcatch` tags:

- The `cfcatch` tags must follow all other code in a `cftry` tag body.
- You can nest `cftry` blocks. For example, the following structure is valid:

  ```cfml
  <cftry>
    code that may cause an exception
    <cfcatch ...>
    <cftry>
      First level of exception handling code
      <cfcatch ...>
      Second level of exception handling code
      </cfcatch>
    </cftry>
    </cfcatch>
  </cftry>
  ```

  If an exception occurs in the first level of exception-handling code, the inner `cfcatch` block can catch and handle it. (An exception in a `cfcatch` block cannot be handled by `cfcatch` blocks at the same level as that block.)

- ColdFusion always responds to the latest exception that gets raised. For example, if code in a `cftry` block causes an exception that gets handled by a `cfcatch` block, and the `cfcatch` block causes an exception that has no handler, ColdFusion will display the default error message for the exception in the `cfcatch` block, and you will not be notified of the original exception.

- If an exception occurs when the current tag is nested inside other tags, the CFML processor checks the entire stack of open tags until it finds a suitable `cftry/cfcatch` combination or reaches the end of the stack.

- Use `cftry` with `cfcatch` to handle exceptions based on their point of origin within an application page, or based on diagnostic information.

- The entire `cftry` tag, including all its `cfcatch` tags, must be on a single ColdFusion page. You cannot put the `cftry` start tag on one page and have the `cftry` end tag on another page.
• For cases when a `cfcatch` block is not able to successfully handle an error, consider using the `cfrethrow` tag, as described in “Using the `cfrethrow` tag” on page 267.

• If an exception can be safely ignored, use a `cfcatch` tag with no body; for example:

  ```cfscript
  <cfcatch Type = Database />
  ```

  1 In particularly problematic cases, you might enclose an exception-prone tag in a specialized combination of `cftry` and `cfcatch` tags to immediately isolate the tag's exceptions.

Exception information in `cfcatch` blocks

Within the body of a `cfcatch` tag, the active exception's properties are available in a `cfcatch` object. The following sections describe the object contents.

Standard `cfcatch` variables

The following table describes the variables that are available in most `cfcatch` blocks:

<table>
<thead>
<tr>
<th>Property variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cfcatch.Detail</code></td>
<td>A detailed message from the CFML compiler. This message, which can contain HTML formatting, can help to determine which tag threw the exception. The <code>cfcatch.Detail</code> value is available in the CFScript <code>catch</code> statement as the <code>exceptionVariable</code> parameter.</td>
</tr>
<tr>
<td><code>cfcatch.ErrorCode</code></td>
<td>The <code>cfthrow</code> tag can supply a value for this code through the <code>errorCode</code> attribute. For <code>Type=&quot;Database&quot;</code>, <code>cfcatch.ErrorCode</code> has the same value as <code>cfcatch.SQLState</code>. Otherwise, the value of <code>cfcatch.ErrorCode</code> is the empty string.</td>
</tr>
<tr>
<td><code>cfcatch.ExtendedInfo</code></td>
<td>Custom error message information. This is returned only to <code>cfcatch</code> tags for which the <code>type</code> attribute is <code>Application</code> or a custom type. Otherwise, the value of <code>cfcatch.ExtendedInfo</code> is the empty string.</td>
</tr>
<tr>
<td><code>cfcatch.Message</code></td>
<td>The exception's default diagnostic message, if one was provided. If no diagnostic message is available, this is an empty string. The <code>cfcatch.Message</code> value is included in the value of the CFScript <code>catch</code> statement <code>exceptionVariable</code> parameter.</td>
</tr>
<tr>
<td><code>cfcatch.RootCause</code></td>
<td>The Java servlet exception reported by the JVM as the cause of the “root cause” of the exception.</td>
</tr>
<tr>
<td><code>cfcatch.TagContext</code></td>
<td>An array of structures structure containing information for each tag in the tag stack. The tag stack consists of each tag that is currently open.</td>
</tr>
<tr>
<td><code>cfcatch.Type</code></td>
<td>The exception's type, returned as a string.</td>
</tr>
</tbody>
</table>

Note: If you use the `cfdump` tag to display the `cfcatch` variable, the display does not include variables that do not have values.

The `cfcatch.TagContext` variable contains an array of tag information structures. Each structure represents one level of the active tag context at the time when ColdFusion detected the exception. That is, there is one structure for each tag that is open at the time of the exception. For example, if the exception occurs in a tag on a custom tag page, the tag context displays information about the called custom tag and the tag in which the error occurs.

The structure at position 1 in the array represents the currently executing tag at the time the exception was detected. The structure at position `ArrayLen(cfcatch.tagContext)` represents the initial tag in the stack of tags that were executing when the compiler detected the exception.

The following table lists the `tagContext` structure attributes:
Database exceptions
The following additional variables are available whenever the exception type is database:

<table>
<thead>
<tr>
<th>Property variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cfcatch.NativeErrorCode</code></td>
<td>The native error code associated with this exception. Database drivers typically provide error codes to assist in the diagnosis of failing database operations. The values assumed by <code>cfcatch.NativeErrorCode</code> are driver-dependent. If no error code is provided, the value of <code>cfcatch.nativeErrorCode</code> is -1. The value is 0 for queries of queries.</td>
</tr>
<tr>
<td><code>cfcatch.SQLState</code></td>
<td>The SQLState code associated with this exception. Database drivers typically provide error codes to assist in the diagnosis of failing database operations. SQLState codes are more consistent across database systems than native error codes. If the driver does not provide an SQLState value, the value of <code>cfcatch.SQLState</code> is -1.</td>
</tr>
<tr>
<td><code>cfcatch.Sql</code></td>
<td>The SQL statement sent to the data source.</td>
</tr>
<tr>
<td><code>cfcatch.queryError</code></td>
<td>The error message as reported by the database driver.</td>
</tr>
<tr>
<td><code>cfcatch.where</code></td>
<td>If the query uses the <code>cfqueryparam</code> tag, query parameter name-value pairs.</td>
</tr>
</tbody>
</table>

Expression exceptions
The following variable is only available for Expression exceptions:

<table>
<thead>
<tr>
<th>Property variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cfcatch.ErrNumber</code></td>
<td>An internal expression error number, valid only when <code>type=&quot;Expression&quot;</code>.</td>
</tr>
</tbody>
</table>

Locking exceptions
The following additional information is available for exceptions related to errors that occur in `cflock` tags:

<table>
<thead>
<tr>
<th>Property variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cfcatch.lockName</code></td>
<td>The name of the affected lock. This is set to &quot;anonymous&quot; if the lock name is unknown.</td>
</tr>
<tr>
<td><code>cfcatch.lockOperation</code></td>
<td>The operation that failed. This is set to &quot;unknown&quot; if the failed operation is unknown.</td>
</tr>
</tbody>
</table>

Missing include exceptions
The following additional variable is available if the error is caused by a missing file specified by a `cfinclude` tag:
Using the cftry tag: an example

The following example shows the cftry and cfcatch tags. It uses the cfdocexamples data source, which many of the examples in this manual use, and a sample included file, includeme.cfm.

If an exception occurs during the cfquery statement’s execution, the application page flow switches to the cfcatch type="Database" exception handler. It then resumes with the next statement after the cftry block, once the cfcatch type="Database" handler completes. Similarly, the cfcatch type="MissingInclude" block handles exceptions raised by the cfinclude tag.

```cfc
<!---- Wrap code you want to check in a cftry block --->
<cfset EmpID=3>
<cfparam name="errorCaught" default="">
<cftry>
  <cfquery name="test" datasource="cfdocexamples">
    SELECT Dept_ID, FirstName, LastName
    FROM Employee
    WHERE Emp_ID=#EmpID#
  </cfquery>
  <html>
  <head>
  <title>Test cftry/cfcatch</title>
  </head>
  <body>
  <cfinclude template="includeme.cfm">
  <cfoutput query="test">
    <p>Department: #Dept_ID#<br>
    Last Name: #LastName#<br>
    First Name: #FirstName#</p>
  </cfoutput>

  <!--- Use cfcatch to test for missing included files. --->
  <!--- Print Message and Detail error messages. --->
  <!--- Block executes only if a MissingInclude exception is thrown. --->
  <cfcatch type="MissingInclude">
    <h1>Missing Include File</h1>
    <cfoutput>
      <ul>
        <li><b>Message:</b> #cfcatch.Message#</li>
        <li><b>Detail:</b> #cfcatch.Detail#</li>
        <li><b>Filename:</b> #cfcatch.MissingFileName#</li>
      </ul>
    </cfoutput>
    <cfset errorCaught = "MissingInclude">
  </cfcatch>

  <!--- Use cfcatch to test for database errors. --->
  <!--- Print error messages. --->
  <!--- Block executes only if a Database exception is thrown. --->
  <cfcatch type="Database">
    <h1>Database Error</h1>
    <cfoutput>
      <ul>
        <li><b>Message:</b> #cfcatch.Message#</li>
      </ul>
    </cfoutput>
  </cfcatch>
```
Use the following procedure to test the code.

**Test the code**

1. Make sure there is no includeme.cfm file and display the page. The `cfcatch type="MissingInclude"` block displays the error.

2. Create a nonempty includeme.cfm file and display the page. If your database is configured properly, you should see an employee entry and not get any error.

3. In the `cfquery` tag, change the line:
   ```
   FROM Employee
   ```
   to:
   ```
   FROM Employer
   ```
   Display the page. This time the `cfcatch type="Database"` block displays an error message.

4. Change Employer to Employee.
   Change the `cfoutput` line:
   ```
   <p>Department: #Dept_ID#</p>
   ```
   to:
   ```
   <p>Department: #DepartmentID#</p>
   ```
   Display the page. This time the `cfcatch type="Any"` block displays an error message indicating an expression error.

5. Change DepartmentID back to Dept_ID and redisplay the page. The page displays properly.

Open `/CFusion/Log/MyAppPage.log` in your text editor. You should see a header line, an initialization line, and four detail lines, similar to the following:

"Severity","ThreadID","Date","Time","Application","Message"
Reviewing the code
The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfset EmpID=3&gt;</code></td>
<td>Initializes the employee ID to a valid value. An application would get the</td>
</tr>
<tr>
<td><code>&lt;cfparam name=&quot;errorCaught&quot; default=&quot;&quot;&gt;</code></td>
<td>value from a form or other source. Sets the default <code>errorCaught</code> variable value to the empty string (to indicate no error was caught). There is no need to put these lines in a <code>cftry</code> block.</td>
</tr>
<tr>
<td><code>&lt;cftry&gt;</code></td>
<td>Starts the <code>cftry</code> block. Exceptions from here to the end of the block can</td>
</tr>
<tr>
<td><code>&lt;cfquery name=&quot;test&quot;</code></td>
<td>be caught by <code>cfcatch</code> tags. Queries the <code>cfdocexamples</code> database to get the</td>
</tr>
<tr>
<td><code>datasource=&quot;cfdocexamples&quot;</code></td>
<td>data for the employee identified by the <code>EmpID</code> variable.</td>
</tr>
<tr>
<td><code>SELECT Dept_ID, FirstName, LastName</code></td>
<td></td>
</tr>
<tr>
<td><code>FROM Employee</code></td>
<td></td>
</tr>
<tr>
<td><code>WHERE Emp_ID=#EmpID#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfquery&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;html&gt;</code></td>
<td>Begins the HTML page. This section contains all the code that displays</td>
</tr>
<tr>
<td><code>&lt;head&gt;</code></td>
<td>information if no errors occur.</td>
</tr>
<tr>
<td><code>&lt;title&gt;Test cftry/cfcatch&lt;/title&gt;</code></td>
<td>Includes the <code>includeme.cfm</code> page.</td>
</tr>
<tr>
<td><code>&lt;body&gt;</code></td>
<td>Displays the user information record from the test query.</td>
</tr>
<tr>
<td><code>&lt;cfinclude template=&quot;includeme.cfm&quot;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfoutput query=&quot;test&quot;&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;p&gt;Department: #Dept_ID#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>Last Name: #LastName#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>First Name: #FirstName#&lt;/p&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfcatch type=&quot;MissingInclude&quot;&gt;</code></td>
<td>Handles exceptions thrown when a page specified by the <code>cfinclude</code> tag cannot be found. Displays <code>cfcatch</code> variables, including the ColdFusion basic error message, detail message, and the name of the file that could not be found. Sets the <code>errorCaught</code> variable to indicate the error type.</td>
</tr>
<tr>
<td><code>&lt;h1&gt;Missing Include File&lt;/h1&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;li&gt;</code> <code>b&gt;Message:&lt;b&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfcatch.Message#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;li&gt;</code> <code>b&gt;Detail:&lt;b&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfcatch.Detail#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;li&gt;</code> <code>b&gt;Filename:&lt;b&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfcatch.MissingFilename#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/li&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfset errorCaught = &quot;MissingInclude&quot;&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfcatch&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>
Using the `cfthrow` tag

You can use the `cfthrow` tag to raise your own, custom exceptions. When you use the `cfthrow` tag, you specify any or all of the following information:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>type</code></td>
<td>The type of error. It can be a custom type that has meaning only to your application, such as InvalidProductCode. You can also specify Application, the default type. You cannot use any of the predefined ColdFusion error types, such as Database or MissingTemplate.</td>
</tr>
<tr>
<td><code>message</code></td>
<td>A brief text message indicating the error.</td>
</tr>
<tr>
<td><code>detail</code></td>
<td>A more detailed text message describing the error.</td>
</tr>
<tr>
<td><code>errorCode</code></td>
<td>An error code that is meaningful to the application. This field is useful if the application uses numeric error codes.</td>
</tr>
<tr>
<td><code>extendedInfo</code></td>
<td>Any additional information of use to the application.</td>
</tr>
</tbody>
</table>

All of these values are optional. You access the attribute values in `cfcatch` blocks and Exception type error pages by prefixing the attribute with either `cfcatch` or `error`, as in `cfcatch.extendedInfo`. The default ColdFusion error handler displays the message and detail values in the Message pane and the remaining values in the Error Diagnostic Information pane.

Catching and displaying thrown errors

The `cfcatch` tag catches a custom exception when you use any of the following values for the `cfcatch type` attribute:

- The custom exception type specified in the `cfthrow` tag.
A custom exception type that hierarchically matches the initial portion of the type specified in the cfthrow tag. For more information, see the next section, Custom error type name hierarchy.

- Application, which matches an exception that is thrown with the Application type attribute or with no type attribute.
- Any, which matches any exception that is not caught by a more specific cfcatch tag.

Similarly, if you specify any of these types in a cferror tag, the specified error page will display information about the thrown error.

Because the cfthrow tag generates an exception, a Request error handler or the Site-wide error handler can also display these errors.

**Custom error type name hierarchy**

You can name custom exception types using a method that is similar to Java class naming conventions: domain name in reverse order, followed by project identifiers, as in the following example:

```xml
<cfthrow
type="com.myCompany.myApp.Invalid_field.codeValue"
errorcode="Dodge14B">
```

This fully qualified naming method is not required; you can use shorter naming rules, for example, just myApp.Invalid_field.codeValue, or even codeValue.

This naming method is *not* just a convention; ColdFusion uses the naming hierarchy to select from a possible hierarchy of error handlers. For example, assume you use the following cfthrow statement:

```xml
<cfthrow type="MyApp.BusinessRuleException.InvalidAccount">
```

Any of the following cfcatch error handlers would handle this error:

```xml
<cfcatch type="MyApp.BusinessRuleException.InvalidAccount">
<cfcatch type="MyApp.BusinessRuleException">
<cfcatch type="MyApp">
```

The handler that most exactly matches handles the error. In this case, the MyApp.BusinessRuleException.InvalidAccount handler gets invoked. However, if you used the following cfthrow tag:

```xml
```

the MyApp.BusinessRuleException handler receives the error.

The type comparison is not case-sensitive.

**When to use the cfthrow tag**

Use the cfthrow tag when your application can identify and handle application-specific errors. One typical use for the cfthrow tag is in implementing custom data validation. The cfthrow tag is also useful for throwing errors from a custom tag page to the calling page.

For example, on a form action page or custom tag used to set a password, the application can determine whether the password entered is a minimum length, or contains both letters and number, and throw an error with a message that indicates the password rule that was broken. The cfcatch block handles the error and tells the user how to correct the problem.
Using the cfrethrow tag

The cfrethrow tag lets you create a hierarchy of error handlers. It tells ColdFusion to exit the current cfcatch block and “rethrow” the exception to the next level of error handler. Thus, if an error handler designed for a specific type of error cannot handle the error, it can rethrow the error to a more general-purpose error handler. The cfrethrow tag can only be used in a cfcatch tag body.

The cfrethrow tag syntax

The following pseudocode shows how you can use the cfrethrow tag to create an error-handling hierarchy:

```coldfusion
<cftry>
  <cftry>
    Code that might throw a database error
    <cfcatch Type="Database">
      <cfif Error is of type I can Handle>
        Handle it
      <cfelse>
        <cfrethrow>
      </cfif>
    </cfcatch>
  </cftry>
  <cfcatch Type="Any">
    General Error Handling code
  </cfcatch>
</cftry>
```

Although this example uses a Database error as an example, you can use any cfcatch type attribute in the innermost error type.

Follow these rules when you use the cfrethrow tag:

- Nest cftry tags, with one tag for each level of error handling hierarchy. Each level contains the cfcatch tags for that level of error granularity.
- Place the most general error catching code in the outermost cftry block.
- Place the most specific error catching code in the innermost cftry block.
- Place the code that can cause an exception error at the top of the innermost cftry block.
- End each cfcatch block except those in the outermost cftry block with a cfrethrow tag.

Example: using nested tags, cfthrow, and cfrethrow

The following example shows many of the techniques discussed in this chapter, including nested cftry blocks and the cfthrow and cfrethrow tags. The example includes a simple calling page and a custom tag page:

- The calling page does little more than call the custom tag with a single attribute, a name to be looked up in a database. It does show, however, how a calling page can handle an exception thrown by the custom tag.
- The custom tag finds all records in the cfdocexamples database with a matching last name, and returns the results in a Caller variable. If it fails to connect with the main database, it tries a backup database.

The calling page

The calling page represents a section from a larger application page. To keep things simple, the example hard-codes the name to be looked up.

```coldfusion
<cftry>
  <cf_getEmps EmpName="Jones">
  <cfcatch type="myApp.getUser.noEmpName">
```
**Reviewing the code**

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cftry&gt;</code></td>
<td>In a <code>cftry</code> block, calls the <code>cf_getEmps</code> custom tag (getEmps.cfm).</td>
</tr>
<tr>
<td><code>&lt;cf_getEmps EmpName='Jones'&gt;</code></td>
<td>In a <code>cftry</code> block, calls the <code>cf_getEmps</code> custom tag (getEmps.cfm).</td>
</tr>
<tr>
<td><code>&lt;cfcatch type='myApp.getUser.noEmpName'&gt;</code></td>
<td>If the tag throws an exception indicating that it did not receive a valid</td>
</tr>
<tr>
<td><code>&lt;h2&gt;Oops&lt;/h2&gt;</code></td>
<td>attribute, catches the exception and displays a message, including the</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;#cfcatch.Message#&lt;/cfoutput&gt;&lt;br&gt;</code></td>
<td>message variable set by the <code>cfthrow</code> tag in the custom tag.</td>
</tr>
<tr>
<td><code>&lt;cfif isdefined(&quot;getEmpsResult&quot;)&gt;</code></td>
<td>If the tag returns a result, uses the <code>cfdump</code> tag to display it. (A</td>
</tr>
<tr>
<td><code>&lt;cfdump var=&quot;#getEmpsResult#&quot;&gt;</code></td>
<td>production application would not use the <code>cfdump</code> tag.)</td>
</tr>
</tbody>
</table>

**The custom tag page**

The custom tag page searches for the name in the database and returns any matching records in a `getEmpsResult` variable in the calling page. It includes several nested `cftry` blocks to handle error conditions. For a full description, see “Reviewing the code” on page 269, following the example:

Save the following code as getEmps.cfm in the same directory as the calling page.

```cfc
<!--- If the tag didn't pass an attribute, throw an error to be handled by --->
<!--- the calling page --->
<cfif NOT IsDefined("attributes.EmpName")>
  <cfthrow Type="myApp.getUser.noEmpName"
    message = "Last Name was not supplied to the cf_getEmps tag.">
  <cfexit method = "exittag"/>
</cfif>
<!--- Have a name to look up --->
<cfelse>
<!--- Outermost Try Block --->
<cftry>

<!--- Inner Try Block --->
<cftry>

<!--- Try to query the main database and set a caller variable to the result --->
<cfquery Name = "getUser" DataSource="cfdocexamples">
  SELECT *
  FROM Employee
  WHERE LastName = '#attributes.EmpName#'
</cfquery>
<cfset caller.getEmpsResult = getUser>

<!--- If the query failed with a database error, check the error type ---
 to see if the database was found --->
<cfcatch type="Database">
  <cfif (cfcatch.SQLState IS "S100") OR (cfcatch.SQLState IS "IM002")>
```
<!---- If the database wasn't found, try the backup database --->
<!---- Use a third-level Try block --->
  <cftry>
    <cfquery Name = "getUser" DataSource="cfdocexamplesBackup">
      SELECT *
      FROM Employee
      WHERE LastName = '#attributes.EmpName#'
    </cfquery>
    <cfset caller.getEmpsResult = getUser>
  </cftry>

  <!---- If still get a database error, just return to the calling page
        without setting the caller variable. There is no cfcatch body.
        This might not be appropriate in some cases.
        The Calling page ends up handling this case as if a match was not
        found --->
  <cfcatch type = "Database"/>
  <!---- Still in innermost try block. Rethrow any other errors to the next
        try block level --->
  <cfcatch type = "Any">
    <cfrethrow>
  </cfcatch>
  </cftry>

<!---- Now in second level try block.
      Throw all other types of Database exceptions to the next try
      block level --->
<!if>
  <cfelse>
    <cfrethrow>
  </cfif>
</cfcatch>
<!---- Throw all other exceptions to the next try block level --->
<cfcatch type = "Any">
  <cfrethrow>
</cfcatch>
</cftry>

<!---- Now in Outermost try block.
      Handle all unhandled exceptions, including rethrown exceptions, by
      displaying a message and exiting to the calling page. --->
<cfcatch Type = "Any">
  <h2>Sorry</h2>
  <p>An unexpected error happened in processing your user inquiry.
     Please report the following to technical support:</p>
  <cfoutput>
    Type: #cfcatch.Type#
    Message: #cfcatch.Message#
  </cfoutput>
  <cfexit method = "exittag">
</cfcatch>
</cfif>

### Reviewing the code

The following table describes the code:
<cfif NOT IsDefined("attributes.EmpName")>
  <cfthrow Type="myApp.getUser.noEmpName" message = "Last Name was not supplied to the cf_getEmps tag.">
  <cfexit method = "exittag">
</cfif>

If the tag has an EmpName attribute, does the remaining work inside an outermost try block. The cfcatch block at its end handles any otherwise-uncought exceptions.

<cftry>
  <cfquery Name = "getUser" DataSource="cfdocexamples">
    SELECT *
    FROM Employee
    WHERE LastName = '#attributes.EmpName#'
  </cfquery>
  <cfset caller.getEmpsResult = getUser>
</cftry>

Starts a second nested try block. This block catches exceptions in the database query.

<cfcatch type = "Database" />

If there are no exceptions, sets the calling page's getEmpsResult variable with the query results.

<cfcatch type = "Database" />

If the query threw a Database error, checks to see if the error was caused by an inability to access the database (indicated by an SQLState variable value of S100 or IM002).

If the database was not found, starts a third nested try block and tries accessing the backup database. This try block catches exceptions in this second database access.

If the database inquiry succeeds, sets the calling page's getEmpsResult variable with the query results.

<cfcatch type = "Database" />

If the second database query failed with a database error, gives up silently. Because the Database type cfcatch tag does not have a body, the tag exits. The calling page does not get a getEmpsResult variable. It cannot tell whether the database had no match or an unrecoverable database error occurred, but it does know that no match was found.

<cfcatch type = "Any">
  <cfrethrow>
</cfcatch>
</cftry>

If the second database query failed for any other reason, throws the error up to the next try block.

Ends the innermost try block

<cfcatch type = "Any">
  <cfrethrow>
</cfcatch>
</cfcatch>

In the second try block, handles the case in which the first database query failed for a reason other than a failure to find the database.

Rethrows the error up to the next level, the outermost try block.

<cfcatch type = "Any">
  <cfrethrow>
</cfcatch>
</cfcatch>

In the second try block, catches any errors other exceptions and rethrows them up to the outermost try block.

Ends the second try block.

<cfcatch Type = "Any">
  <h2>Sorry</h2>
  <p>An unexpected error happened in processing your user inquiry. Please report the following to technical support:</p>
  <cfoutput>
    Type: #cfcatch.Type#
    Message: #cfcatch.Message#
  </cfoutput>
  <cfexit method = "exittag">
</cfcatch>
</cftry>

In the outermost try block, handles any exceptions by displaying an error message that includes the exception type and the exception's error message. Because there was no code to try that is not also in a nested try block, this cfcatch tag handles only errors that are rethrown from the nested blocks.

Exits the custom tag and returns to the calling page.

Ends the catch block, try block, and initial cfif block.
Testing the code
To test the various ways errors can occur and be handled in this example, try the following:

- In the calling page, change the attribute name to any other value; for example, My Attrib. Then change it back.
- In the first cfquery tag, change the data source name to an invalid data source; for example, NoDatabase.
- With an invalid first data source name, change the data source in the second cfquery tag to cfdocexamples.
- Insert cfthrow tags throwing custom exculpations in various places in the code and observe the effects.
Chapter 16: Using Persistent Data and Locking

ColdFusion provides several variable scopes in which data persists past the life of a single request. These are the Client, Application, Session, and Server scopes. These scopes let you save data over time and share data between pages and even applications. These scopes as *persistent* scopes. In particular, you can use the Client and Session scopes to maintain information about a user across multiple requests.

ColdFusion lets you lock access to sections of code to ensure that ColdFusion does not attempt to run the code, or access the data that it uses, simultaneously or in an unpredictable order. This locking feature is important for ensuring the consistency of all shared data, including data in external sources in addition to data in persistent scopes.

You can use persistent scopes to develop an application and use locking to ensure data consistency.

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**About persistent scope variables**

ColdFusion provides four variable scopes, described in the following table, that let you maintain data that must be available to multiple applications or users or must last beyond the scope of the current request.
The following sections provide information that is common to all or several of these variables. Later sections describe how to use the Client, Session, Application, and Server scopes in your applications, and provide detailed information about locking code.

**ColdFusion persistent variables and ColdFusion structures**

All persistent scopes are available as ColdFusion structures. As a result, you can use ColdFusion structure functions to access and manipulate Client, Session, Application, and Server scope contents. This chapter does not cover using these functions in detail, but does mention features or limitations that apply to specific scopes.

*Note:* Although you can use the `StructClear` function to clear your data from the Server scope, the function does not delete the names of the variables, only their values, and it does not delete the contents of the Server.os and Server.ColdFusion structures. Using the `StructClear` function to clear the Session, or Application scope clears the entire scope, including the built-in variables. Using the `StructClear` function to clear the Client scope clears the variables from the server memory, but does not delete the stored copies of the variables.

**ColdFusion persistent variable issues**

Variables in the Session, Application, and Server scopes are kept in ColdFusion server memory. This storage method has several implications:

<table>
<thead>
<tr>
<th>Variable scope</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Client</strong></td>
<td>Contains variables that are available for a single client browser over multiple browser sessions in an application. For information about browser sessions, see, &quot;What is a session?” on page 282. Useful for client-specific information, such as client preferences, that you want to store for a significant period of time. Data is stored as cookies, database entries, or Registry values. Client variables can time out after an extended period. Although do not have to use the Client scope prefix in the variable name, code that uses the prefix is more efficient and easier to maintain.</td>
</tr>
<tr>
<td><strong>Session</strong></td>
<td>Contains variables that are available for a single client browser for a single browser session in an application. Useful for client-specific information, such as shopping cart contents, that you want to persist while the client is visiting your application. Data is stored in memory and times out after a period of inactivity or when the server shuts down. ColdFusion Administrator lets you select between two kinds of session management, Standard ColdFusion Session management and J2EE session management. For information about types of session management, see &quot;ColdFusion and J2EE session management&quot; on page 283. You must use the Session scope prefix in the variable name.</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Contains variables that are available to all pages in an application for all clients. Useful for application-specific information, such as contact information, that can vary over time and should be stored in a variable. Data is stored in memory and times out after a period of inactivity or when the server shuts down. You must use the Application scope prefix in the variable name.</td>
</tr>
<tr>
<td><strong>Server</strong></td>
<td>Contains variables that are available to all applications in a server and all clients. Useful for information that applies to all pages on the server, such as an aggregate page-hit counter. Data is stored in memory. The variables do not time out, but you can delete variables you create, and all server variables are automatically deleted when the server stops running. You must use the Server scope prefix in the variable name.</td>
</tr>
</tbody>
</table>
• All variables in these scopes are lost if the server stops running.
• Variables in these scopes are not shared by servers in a cluster.
• To prevent race conditions and ensure data consistency, lock access to all code that changes variables in these scopes or reads variables in these scopes with values that can change.

**Note:** If you use J2EE session management and configure the J2EE server to retain session data between server restarts, ColdFusion retains session variables between server restarts.

Additionally, you must be careful when using client variables in a server cluster, where an application can run on multiple servers.

**Locking memory variables**
Because ColdFusion is a multithreaded system in which multiple requests can share Session, Application, and Server scope variables, it is possible for two or more requests to try to access and modify data at the same time. ColdFusion runs in a J2EE environment, which prevents simultaneous data access, so multiple requests do not cause severe system errors. However, such requests can result in inconsistent data values, particularly when a page might change more than one variable.

To prevent data errors with session, application, and server variables, lock code that writes and reads data in these scopes. For more information, see "Locking code with cflock" on page 289.

**Using variables in clustered systems**
Because memory variables are stored in memory, they are not available to all servers in a cluster. As a result, you generally do not use Session, Application, or Server scope variables in clustered environment. However, you might use these scope variables in a clustered system in the following circumstances:

• If the clustering system supports “sticky” sessions, in which the clustering system ensures that each user session remains on a single server. In this case, you can use session variables as you would on a single server.
• You can use Application and Server scope variables in a cluster for write-once variables that are consistently set, for example, from a database.

To use client variables on a clustered system, store the variables as cookies or in a database that is available to all servers. If you use database storage, on one server only, select the Purge Data for Clients that Remain Unvisited option on the Client Variables, Add/Edit Client Store page in the Server Settings area in the ColdFusion Administrator.

For more information on using client and session variables in clustered systems, see “Managing client identity information in a clustered environment” on page 277.

**Managing the client state**
Because the web is a stateless system, each connection that a browser makes to a web server is unique to the web server. However, many applications must keep track of users as they move through the pages within the application. This is the definition of client state management.

ColdFusion provides tools to maintain the client state by seamlessly tracking variables associated with a browser as the user moves from page to page within the application. You can use these variables in place of other methods for tracking client state, such as URL parameters, hidden form fields, and HTTP cookies.
About client and session variables

ColdFusion provides two tools for managing the client state: client variables and session variables. Both types of variables are associated with a specific client, but you manage and use them differently, as described in the following table:

<table>
<thead>
<tr>
<th>Variable type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>Data is saved as cookies, database entries, or Registry entries. Data is saved between server restarts, but is initially accessed and saved more slowly than data stored in memory. Each type of data storage has its own time-out period. You can specify the database and Registry data time-outs in the ColdFusion Administrator. ColdFusion sets Cookie client variables to expire after approximately 10 years. Data is stored on a per-user and per-application basis. For example, if you store client variables as cookies, the user has a separate cookie for each ColdFusion application provided by a server. Client variables must be simple variables, such as numbers, dates, or strings. They cannot be arrays, structures, query objects, or other objects. Client variable names can include periods. For example, My.ClientVar is a valid name for a simple client variable. Avoid such names, however, to ensure code clarity. You do not have to prefix client variables with the scope name when you reference them. However, if you do not use the Client prefix, you might unintentionally refer to a variable with the same name in another scope. Using the prefix also optimizes performance and increases program clarity. You do not lock code that uses client variables. You can use client variables that are stored in cookies or a common database in clustered systems.</td>
</tr>
<tr>
<td>Session</td>
<td>Data is stored in memory so it is accessed quickly. Data is lost when the client browser is inactive for a time-out period. You specify the time-out in the ColdFusion Administrator, the Application.cfc initialization code, or Application.cfm. As with client variables, data is available to a single client and application only. Variables can store any ColdFusion data type. You must prefix all variable names with the Session scope name. Lock code that uses session variables to prevent race conditions. You can use session variables in clustered systems only if the systems support &quot;sticky&quot; sessions, where a session is limited to a single server.</td>
</tr>
</tbody>
</table>

Session variables are normally better than client variables for values that need to exist for only a single browser session. You should reserve client variables for client-specific data, such as client preferences that you want available for multiple browser sessions.

Maintaining client identity

Because the web is a stateless system, client management requires some method for maintaining knowledge of the client between requests. Normally you do this using cookies, but you can also do it by passing information between application pages. The following sections describe how ColdFusion maintains client identity in a variety of configurations and environments, and discuss issues that can arise with client state management.

About client identifiers

To use client and session variables, ColdFusion must be able to identify the client. It normally does so by setting the following two cookie values on the client’s system:

- **CFID**: A sequential client identifier
• **CFToken**: A random-number client security token

These cookies uniquely identify the client to ColdFusion, which also maintains copies of the variables as part of the Session and Client scopes. You can configure your application so that it does not use client cookies, but in this case, you must pass these variables to all the pages that your application calls. For more information about maintaining client and session information without using cookies, see "Using client and session variables without cookies" on page 276.

You can configure ColdFusion to use J2EE servlet session management instead of ColdFusion session management for session variables. This method of session management does not use CFID and CFToken values, but does use a client-side jsessionid session management cookie. For more information on using J2EE session management, see "ColdFusion and J2EE session management" on page 283.

**Using client and session variables without cookies**

Often, users disable cookies in their browsers. In this case, ColdFusion cannot maintain the client state automatically. You can use client or session variables without using cookies, by passing the client identification information between application pages. However, this technique has significant limitations, as follows:

1. **Client variables are effectively the same as session variables, except that they leave unusable data in the client data store.**

   Because the client’s system does not retain any identification information, the next time the user logs on, ColdFusion cannot identify the user with the previous client and must create a new client ID for the user. Any information about the user from a previous session is not available, but remains in client data storage until ColdFusion deletes it. If you clear the Purge Data for Clients that Remain Unvisited option in the ColdFusion Administrator, ColdFusion never deletes this data.

   Therefore, do not use client variables, if you allow users to disable cookies. To retain client information without cookies, require users to login with a unique ID. You can then save user-specific information in a database with the user’s ID as a key.

2. **ColdFusion creates a new session each time the user requests a page directly in the browser, because the new request contains no state information to indicate the session or client.**

   **Note:** You can prevent ColdFusion from sending client information to the browser as cookies by setting This.setClientCookies variable in Application.cfc or the setClientCookies attribute of the cfapplication tag to No.

   To use ColdFusion session variables without using cookies, each page must pass the CFID and CFToken values to any page that it calls as part of the request URL. If a page contains any HTML href= links, cflocation tags, form tags, or cfform tags the tags must pass the CFID and CFToken values in the tag URL. To use J2EE session management, you must pass the jsessionid value in page requests. To use ColdFusion client variables and J2EE session variables, you must pass the CFID, CFToken, and jsessionid values in URLs.

   ColdFusion provides the URLSessionFormat function, which does the following:

   - If the client does not accept cookies, automatically appends all required client identification information to a URL.
   - If the client accepts cookies, does not append the information.

   The URLSessionFormat function automatically determines which identifiers are required, and sends only the required information. It also provides a more secure and robust method for supporting client identification than manually encoding the information in each URL, because it only sends the information that is required, when it is required, and it is easier to code.
To use the `URLSessionFormat` function, enclose the request URL in the function. For example, the following `cfform` tag posts a request to another page and sends the client identification, if required:

```cftags
<cfform method="Post" action="#URLSessionFormat("MyActionPage.cfm")#">
```

If you use the same page URL in multiple `URLSessionFormat` functions, you can gain a small performance improvement and simplify your code if you assign the formatted page URL to a variable, for example:

```cftags
<cfset myEncodedURL=URLSessionFormat(MyActionPage.cfm)>
<cfform method="Post" action="#myEncodedURL#">
```

**Client identifiers and security**

The following client identifier issues can have security implications:

- Ensuring the uniqueness and complexity of the `CFToken` identifier
- Limiting the availability of Session identifiers

The next sections discuss these issues.

**Ensuring CFToken uniqueness and security**

By default, ColdFusion uses an eight-digit random number in the `CFToken` identifier. This `CFToken` format provides a unique, secure identifier for users under most circumstances. (In ColdFusion, the method for generating this number uses a cryptographic-strength random number generator that is seeded only when the server starts.)

However, in the ColdFusion Administrator, you can enable the Settings page to produce a more complex `CFToken` identifier. If you enable the Use UUID for cftoken option, ColdFusion creates the `CFToken` value by prepending a 16-digit random hexadecimal number to a ColdFusion UUID. The resulting `CFToken` identifier looks similar to the following:

```
3ee6c307a7278c7b-5278BEA6-1030-C351-3E33390F2EAD02B9
```

**Providing Session security**

ColdFusion uses the same client identifiers for the Client scope and the standard Session scope. Because the `CFToken` and `CFID` values are used to identify a client over a period of time, they are normally saved as cookies on the user's browser. These cookies persist until the client's browser deletes them, which can be a considerable length of time. As a result, hackers could have more access to these variables than if ColdFusion used different user identifiers for each session.

A hacker who has the user's `CFToken` and `CFID` cookies could gain access to user data by accessing a web page during the user's session using the stolen `CFToken` and `CFID` cookies. While this scenario is unlikely, it is theoretically possible.

You can remove this vulnerability by selecting the Use J2EE Session Variables option on the ColdFusion Administrator Memory Variables page. The J2EE session management mechanism creates a new session identifier for each session, and does not use either the `CFToken` or the `CFID` cookie value.

**Managing client identity information in a clustered environment**

To maintain your application's client identity information in a clustered server environment, you must specify `This.setdomaincookies="True"` in the Application.cfc initialization code, or use the `cfapplication` `setdomaincookies` attribute in your Application.cfm page.
The `setdomaincookies` attribute specifies that the server-side copies of the `CFID` and `CFToken` variables used to identify the client to ColdFusion are stored at the domain level (for example, .adobe.com). If `CFID` and `CFToken` variable combinations already exist on each host in the cluster, ColdFusion migrates the host-level variables on each cluster member to the single, common domain-level variable. Following the setting or migration of host-level cookie variables to domain-level variables, ColdFusion creates a new cookie variable (`CFMagic`) that tells ColdFusion that domain-level cookies have been set.

If you use client variables in a clustered system, you must also use a database or cookies to store the variables.

## Configuring and using client variables

Use client variables for data that is associated with a particular client and application and that must be saved between user sessions. Use client variables for long-term information such as user display or content preferences.

### Enabling client variables

To enable client variables, you specify `This.clientmanagement="True"` in the `Application.cfc` initialization code, or set the `cfapplication` tag `clientmanagement` attribute to `Yes` in the `Application.cfm` file. For example, to enable client variables in an application named `SearchApp`, you can use the following line in the application's `Application.cfm` page:

```cfm
<cfapplication NAME="SearchApp" clientmanagement="Yes">
```

### Choosing a client variable storage method

By default, ColdFusion stores client variables in the Registry. In most cases, however, it is more appropriate to store the information as client cookies or in a SQL database.

The ColdFusion Administrator Client Variables page controls the default client variable location. You can override the default location by specifying a `This.clientStorage` value in `Application.cfc` or by setting the `clientStorage` attribute in the `cfapplication` tag.

You can specify the following values for the client storage method:

- **Registry** (default). Client variables are stored under the key `HKEY_LOCAL_MACHINE\SOFTWARE\Macromedia\ColdFusion\CurrentVersion\Clients`.  
- **Name of a data source configured in ColdFusion Administrator**  
- **Cookie**

Generally, it is most efficient to store client variables in a database. Although the Registry option is the default, the Registry has significant limitations for client data storage. The Registry cannot be used in clustered systems and its use for client variables on UNIX is not supported in ColdFusion.

### Using cookie storage

When you set the client storage method to Cookie, the cookie that ColdFusion creates has the application's name. Storing client data in a cookie is scalable to large numbers of clients, but this storage mechanism has some limitations. In particular, if the client turns off cookies in the browser, client variables do not work.

Consider the following additional limitations before implementing cookie storage for client variables:

- Any Client variable that you set after a `cfflush` tag is not sent to the browser, so the variable value does not get saved.
Some browsers allow only 20 cookies to be set from a particular host. ColdFusion uses two of these cookies for the CFID and CFToken identifiers, and also creates a cookie named cfglobals to hold global data about the client, such as HitCount, TimeCreated, and LastVisit. This limits you to 17 unique applications per client-host pair.

Some browsers set a size limit of 4K bytes per cookie. ColdFusion encodes nonalphanumeric data in cookies with a URL encoding scheme that expands at a 3-1 ratio, which means you should not store large amounts of data per client. ColdFusion throws an error if you try to store more than 4,000 encoded bytes of data for a client.

Configuring database storage
When you specify a database for client variable storage, do not always have to manually create the data tables that store the client variables.

If ColdFusion can identify that the database you are using supports SQL creation of database tables, you only need to create the database in advance. When you click the Add button on the Select Data Source to Add as Client Store box on the Memory Variables page, the Administrator displays a Add/Edit Client Store page which contains a Create Client Database Tables selection box. Select this option to have ColdFusion create the necessary tables in your database. (The option does not appear if the database already has the required tables.)

If your database does not support SQL creation of tables, or if you are using the ODBC socket [Macromedia] driver to access your database, you must use your database tool to create the client variable tables. Create the CDATA and CGLOBAL tables.

The CDATA table must have the following columns:

<table>
<thead>
<tr>
<th>Column</th>
<th>Data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfid</td>
<td>CHAR(64), TEXT, VARCHAR, or any data type capable of taking variable length strings up to 64 characters</td>
</tr>
<tr>
<td>app</td>
<td>CHAR(64), TEXT, VARCHAR, or any data type capable of taking variable length strings up to 64 characters</td>
</tr>
<tr>
<td>data</td>
<td>MEMO, LONGTEXT, LONG VARCHAR, CLOB, or any data type capable of taking long, indeterminate-length strings</td>
</tr>
</tbody>
</table>

The CGLOBAL table must have the following columns:

<table>
<thead>
<tr>
<th>Column</th>
<th>Data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfid</td>
<td>CHAR(64), TEXT, VARCHAR, or any data type capable of taking variable length strings up to 64 characters</td>
</tr>
<tr>
<td>data</td>
<td>MEMO, LONGTEXT, LONG VARCHAR, CLOB, or any data type capable of taking long, indeterminate-length strings</td>
</tr>
<tr>
<td>lvisit</td>
<td>TIMESTAMP, DATETIME, DATE, or any data type that stores date and time values</td>
</tr>
</tbody>
</table>

Note: Different databases use different names for their data types. The names in the preceding tables are common, but your database might use other names.

To improve performance, you should also create indexes when you create these tables. For the CDATA table, index these cfid and app columns. For the CGLOBAL table, index the cfid column.

Specifying client variable storage in your application
The override the default client variable storage location, set the This.clientstorage variable in the Application.cfc initialization code, or use the cfapplication tag clientStorage attribute.

The following lines from an Application.cfc file tell ColdFusion to store the client variables in the mydatasource data source:

```cfc
<cfscript>
    This.name"SearchApp";
</cfscript>
The following code from an Application.cfm file does the same thing as the previous example:

```cfapplication name="SearchApp"
  clientmanagement="Yes"
  clientstorage="mydatasource"
</cfapplication>```

**Using client variables**

When you enable client variables for an application, you can use them to keep track of long-term information that is associated with a particular client.

Client variables must be simple data types: strings, numbers, lists, Booleans, or date and time values. They cannot be arrays, record sets, XML objects, query objects, or other objects. If you must store a complex data type as a client variable, you can use the `cfwddx` tag to convert the data to WDDX format (which is represented as a string), store the WDDX data, and use the `cfwddx` tag to convert the data back when you read it. For more information on using WDDX, see "Using WDDX" on page 894.

**Note:** When saving client variable data in WDDX format, in the case of the registry and SQL Server, the limit is about 4K; with ORACLE, the limit is about 2K.

**Creating a client variable**

To create a client variable and set its value, use the `cfset` or `cfparam` tag and use the Client scope identifier as a variable prefix; for example:

```cfset Client.FavoriteColor="Red">
```

After you set a client variable this way, it is available for use within any page in your application that is accessed by the client for whom the variable is set.

The following example shows how to use the `cfparam` tag to check for the existence of a client parameter and set a default value if the parameter does not already exist:

```cfparam name="Client.FavoriteColor" default="Red">
```

**Accessing and changing client variables**

You use the same syntax to access a client variable as for other types of variables. You can use client variables anywhere you use other ColdFusion variables.

To display the favorite color that has been set for a specific user, for example, use the following code:

```cfoutput>
  Your favorite color is #Client.FavoriteColor#.
</cfoutput>
```

To change the client's favorite color, for example, use code such as the following:

```cfset Client.FavoriteColor = Form.FavoriteColor>
```

**Standard client variables**

The Client scope has the following built-in, read-only variables that your application can use:
Note: ColdFusion lets you delete or change the values of the built-in client variables. As a general rule, avoid doing so.

You use the Client.CFID, Client.CFToken, and Client.URLToken variables if your application supports browsers that do not allow cookies. For more information on supporting browsers that do not allow cookies, see “Using client and session variables without cookies” on page 276.

You can use the Client.HitCount and time information variables to customize behavior that depends on how often users visit your site and when they last visited. For example, the following code shows the date of a user’s last visit to your site:

```cfoutput>
  Welcome back to the Web SuperShop. Your last
  visit was on #DateFormat(Client.LastVisit)#.
</cfoutput>
```

**Getting a list of client variables**

To obtain a list of the custom client parameters associated with a particular client, use the `GetClientVariablesList` function, as follows:

```cfoutput>
  #GetClientVariablesList()#
</cfoutput>
```

The `GetClientVariablesList` function returns a comma-separated list of the names of the client variables for the current application. The standard system-provided client variables (CFID, CFToken, URLToken, HitCount, TimeCreated, and LastVisit) are not returned in the list.

**Deleting client variables**

To delete a client variable, use the `StructDelete` function or the `DeleteClientVariable` function. For example, the following lines are equivalent:

```cfset IsDeleteSuccessful=DeleteClientVariable("MyClientVariable")>
<cfset IsDeleteSuccessful=StructDelete(Client, "MyClientVariable")>
```

The Client Variables page in the ColdFusion Administrator lets you set a time-out period of inactivity after which ColdFusion removes client variables stored in either the Registry or a data source. (The default value is 10 days for client variables stored in the Registry, and 90 days for client variables stored in a data source.)

**Note:** You cannot delete the system-provided client variables (CFID, CFToken, URLToken, HitCount, TimeCreated, and LastVisit).
**Using client variables with cflocation**
If you use the `cflocation` tag to redirect ColdFusion to a path that ends with .dbm or .cfm, the `Client.URLToken` variable is automatically appended to the URL. You can prevent this behavior by adding the attribute `addtoken="No"` to the `cflocation` tag.

**Caching client variable**
When ColdFusion reads or writes client variables, it caches the variables in memory to help decrease the overhead of accessing the client data. As a result, ColdFusion only accesses the client data store when you read its value for the first time or, for values you set, when the request ends. Additional references to the client variable use the cached value in ColdFusion memory, thereby processing the page more quickly.

**Exporting the client variable database**
If your client variable database is stored in the Windows system Registry and you need to move it to another machine, you can export the Registry key that stores your client variables and take it to your new server. The system Registry lets you export and import Registry entries.

**To export your client variable database from the Registry in Windows:**
1. Open the Registry editor.
2. Find and select the following key:
   ```plaintext
   HKEY_LOCAL_MACHINE\SOFTWARE\Macromedia\ColdFusion\CurrentVersion\Clients
   ```
3. On the Registry menu, click Export Registry File.
4. Enter a name for the Registry file.

After you create a Registry file, you can copy it to a new machine and import it by clicking Import Registry File on the Registry editor Registry menu.

**Note:** On UNIX systems, the registry entries are kept in /opt/coldfusion/registry/cf.registry, a text file that you can copy and edit directly.

**Configuring and using session variables**
Use session variables when you need the variables for a single site visit or set of requests. For example, you might use session variables to store a user's selections in a shopping cart application. (Use client variables if you need a variable in multiple visits.)

**Important:** Put code that uses session variables inside `cflock` tags in circumstances that might result in race conditions from multiple accesses to the same variable. For information on using `cflock` tags see “Locking code with `cflock`” on page 289.

**What is a session?**
A session refers to all the connections that a single client might make to a server in the course of viewing any pages associated with a given application. Sessions are specific to both the individual user and the application. As a result, every user of an application has a separate session and has access to a separate set of session variables.

This logical view of a session begins with the first connection to an application by a client and ends after that client's last connection. However, because of the stateless nature of the web, it is not always possible to define a precise point at which a session ends. A session should end when the user finishes using an application. In most cases, however, a web application has no way of knowing if a user has finished or is just lingering over a page.
Therefore, sessions always terminate after a time-out period of inactivity. If the user does not access a page of the application within this time-out period, ColdFusion interprets this as the end of the session and clears any variables associated with that session.

The default time-out for session variables is 20 minutes. You can change the default time-out on the Memory Variables page in the Server Settings area in the ColdFusion Administrator.

You can also set the time-out period for session variables inside a specific application (thereby overruling the Administrator default setting) by setting the Application.cfc This.sessionTimeout variable or by using the `cfapplication` tag `sessionTimeout` attribute. However, you cannot set a time-out value for that is greater than the maximum session time-out value set on the Administrator Memory Variables page.

For detailed information on ending sessions and deleting session variables, see “Ending a session” on page 286.

**ColdFusion and J2EE session management**

The ColdFusion server can use either of the following types of session management:

- ColdFusion session management
- J2EE servlet session management

ColdFusion session management uses the same client identification method as ColdFusion client management.

J2EE session management provides the following advantages over ColdFusion session management:

- J2EE session management uses a session-specific session identifier, `jsessionid`, which is created afresh at the start of each session.
- You can share session variables between ColdFusion pages and JSP pages or Java servlets that you call from the ColdFusion pages.
- The Session scope is serializable (convertible into a sequence of bytes that can later be fully restored into the original object). With ColdFusion session management, the Session scope is not serializable. Only serializable scopes can be shared across servers.

Therefore, consider using J2EE session management in any of the following cases:

- You want to maximize session security, particularly if you also use client variables
- You want to share session variables between ColdFusion pages and JSP pages or servlets in a single application.
- You want to be able to manually terminate a session while maintaining the client identification cookie for use by the Client scope.
- You want to support clustered sessions; for example, to support session failover among servers.

**Configuring and enabling session variables**

To use session variables, you must enable them in two places:

- ColdFusion Administrator
- The Application.cfc initialization code `This.sessionManagement` variable or the active `cfapplication` tag.

ColdFusion Administrator, Application.cfc, and the `cfapplication` tag also provide facilities for configuring session variable behavior, including the variable time-out.

**Selecting and enabling session variables in ColdFusion Administrator**

To use session variables, they must be enabled on the ColdFusion Administrator Memory Variables page. (They are enabled by default.) You can also use the Administrator Memory Variables page to do the following:
• Select to use ColdFusion session management (the default) or J2EE session management.
• Change the default session time-out. Application code can override this value. The default value for this time-out is 20 minutes.
• Specify a maximum session time-out. Application code cannot set a time-out greater than this value. The default value for this time-out is two days.

**Enabling session variables in your application**
You must also enable session variables in the initialization code of your Application.cfc file or in the `cfapplication` tag in your Application.cfm file.

Do the following in the Application.cfc initialization code, below the `cfcomponent` tag, to enable session variables:

- Set `This.sessionManagement="Yes"`.
- Set `This.name` to specify the application's name.
- Optionally, set `This.sessionTimeout` to set an application-specific session time-out value. Use the `CreateTimeSpan` function to specify the number of days, hours, minutes, and seconds for the time-out.

Do the following in the Application.cfm file to enable session variables:

- Set `sessionManagement="Yes"`
- Use the `name` attribute to specify the application's name.
- Optionally, use the `sessionTimeout` attribute to set an application-specific session time-out value. Use the `CreateTimeSpan` function to specify the number of days, hours, minutes, and seconds for the time-out.

The following sample code enables session management for the GetLeadApp application and sets the session variables to time out after a 45-minute period of inactivity:

```coldfusion
<cfapplication name="GetLeadApp"
    sessionmanagement="Yes"
    sessiontimeout=#CreateTimeSpan(0,0,45,0)#>
```

**Storing session data in session variables**
Session variables are designed to store session-level data. They are a convenient place to store information that all pages of your application might need during a user session, such as shopping cart contents or score counters.

Using session variables, an application can initialize itself with user-specific data the first time a user accesses one of the application's pages. This information can remain available while that user continues to use that application. For example, you can retrieve information about a specific user's preferences from a database once, the first time a user accesses any page of an application. This information remains available throughout that user's session, thereby avoiding the overhead of retrieving the preferences repeatedly.

**Standard session variables**
If you use ColdFusion session variables, the Session scope has four built-in, read-only variables that your application can use. If you use J2EE session management, the Session scope has two built-in variables. Generally, you use these variables in your ColdFusion pages only if your application supports browsers that do not allow cookies. For more information on supporting browsers that do not allow cookies, see “Using client and session variables without cookies” on page 276. The following table describes the built-in session variables.
ColdFusion lets you delete or change the values of the built-in session variables. As a general rule, avoid doing so.

If you enable client variables and ColdFusion session management, ColdFusion uses the same values for the Client and Session scope CFID, CFToken, and URLToken variables. ColdFusion gets the values for these variables from the same source, the client's CFID and CFTOKEN cookies.

If you use J2EE session management, the Session scope does not include the Session.CFID or Session.CFToken variables, but does include the Session.URLToken and Session.SessionID variables. In this case, the Session.SessionID is the J2EE session ID and Session.URLToken consists of the string jsessionid= followed by the J2EE session ID.

**Getting a list of session variables**

Use the `StructKeyList` function to get a list of session variables, as follows:

```cfml
<cflock timeout=20 scope="Session" type="Readonly">
  <cfoutput> #StructKeyList(Session)# </cfoutput>
</cflock>
```

*Important:* Always put code that accesses session variables inside `cflock` tags.

**Creating and deleting session variables**

Use a standard assignment statement to create a new session variable, as follows:

```cfml
<cflock timeout=20 scope="Session" type="Exclusive">
  <cfset Session.ShoppingCartItems = 0>
</cflock>
```

Use the `structdelete` tag to delete a session variable; for example:

```cfml
<cflock timeout=20 scope="Session" type="Exclusive">
  <cfset StructDelete(Session, "ShoppingCartItems")>
</cflock>
```

*Note:* If you set session variables on a CFML template that uses the `cflocation` tag, ColdFusion might not set the variables. For more information, see TechNote 22712 at [http://www.adobe.com/cfusion/knowledgebase/index.cfm?id=tn_18171](http://www.adobe.com/cfusion/knowledgebase/index.cfm?id=tn_18171).
Accessing and changing session variables

You use the same syntax to access a session variable as for other types of variables. However, you must lock any code that accesses or changes session variables.

For example, to display the number of items in a user's shopping cart, use the following code:

```coldfusion
<cflock timeout=20 scope="Session" type="Exclusive">
    <cfoutput>
        Your shopping cart has #Session.ShoppingCartItems# items.
    </cfoutput>
</cflock>
```

To increase the number of items in the shopping cart, use the following code:

```coldfusion
<cflock timeout=20 scope="Session" type="Exclusive">
    <cfset Session.ShoppingCartItems = Session.ShoppingCartItems + 1>
</cflock>
```

Ending a session

The following rules apply to ending a session and deleting Session scope variables:

- If you use ColdFusion session management, ColdFusion automatically ends sessions and deletes all Session scope variables if the client is inactive for the session time-out period. The session does not end when the user closes the browser.

- If you use J2EE session management, ColdFusion ends the session and deletes all Session scope variables if the client is inactive for the session time-out period. However, the browser continues to send the same session ID, and ColdFusion will reuse this ID for sessions with this browser instance, as long as the browser remains active.

- Logging a user out does not end the session or delete Session scope variables.

- In many cases, you can effectively end a session by clearing the Session scope, as shown in the following line. The following list, however, includes important limitations and alternatives:

  ```coldfusion
  <cfset StructClear(Session)>
  ```

  - Clearing the Session scope does not clear the session ID, and future requests from the browser continue to use the same session ID until the browser exits. It also does not log the user out, even if you use Session scope storage for login information. Always use the `cflogout` tag to log users out.

  - If you use J2EE session management, you can invalidate the session, as follows:

    ```coldfusion
    <cfset getPageContext().getSession().invalidate()>
    ```

    This line creates a pointer to the servlet page context and calls an internal method to reset the session. This clears all session information, including the session ID Session scope variables, and if you are using session login storage, the login information, for future request. However, the session information does remain available until the end of the current request. After you invalidate a session, attempts by the browser to access the application will generate an invalid session exception until the session times out.

**Note:** You cannot destroy the session and create a session on the same request, as creating a new session involves sending session cookies back.

1. If you do not use client cookies, the Session scope and login state is available to your application only as long as you pass the session's CFID, CFTOKEN, and, for J2EE sessions, jsessionid values in the URL query string. After you stop using these values, however, the session data remains in memory until the session time-out period elapses.
Configuring and using application variables

Application variables are available to all pages within an application, that is, pages that have the same application name. Because application variables are persistent, you easily can pass values between pages. You can use application variables for information including the application name, background color, data source names, or contact information.

You set the application name in the `cfapplication` tag, normally on your application's Application.cfm page. The application name is stored in the `Application.applicationName` variable.

Unlike client and session variables, application variables do not require that a client name (client ID) be associated with them. They are available to any clients that use pages in the application.

**Important:** Put code that uses application variables inside `cflock` tags in circumstances that might result in race conditions from multiple accesses to the same variable. For information on using `cflock` tags, see “Locking code with cflock” on page 289.

The following sections describe how to configure and use application variables.

### Configuring and enabling application variables

To use application variables, do the following:

- Ensure that they are enabled in the ColdFusion Administrator. (They are enabled by default.)
- Specify the application name by setting the This.name variable in the initialization code of the Application.cfc or by setting the name attribute of the `cfapplication` tag for the current page.

**Note:** ColdFusion supports unnamed applications for compatibility with J2EE applications. For more information, see “Unnamed ColdFusion Application and Session scopes” on page 933

The ColdFusion Administrator also lets you specify the following information:

- A default variable time-out. If all pages in an application are inactive for the time-out period, ColdFusion deletes all the application variables. The Application.cfc file or `cfapplication` tag can override this value for a specific application. The default value for this time-out is two days.
- A maximum time-out. The application code cannot set a time-out greater than this value. The default value for this time-out is two days.

You can set the time-out period for application variables within a specific application by using the `This.applicationTimeout` variable of Application.cfc or the `applicationTimeout` attribute of the `cfapplication` tag.

### Storing application data in application variables

Application variables are a convenient place to store information that all pages of your application might need, no matter which client is running that application. Using application variables, an application could, for example, initialize itself when the first user accesses any page of that application. This information can then remain available indefinitely, thereby avoiding the overhead of repeated initialization.

Because the data stored in application variables is available to all pages of an application, and remains available until a specific period of inactivity passes or the ColdFusion server shuts down, application variables are convenient for application-global, persistent data.
However, because all clients running an application see the same set of application variables, these variables are not appropriate for client-specific or session-specific information. To target variables for specific clients, use client or session variables.

**Using application variables**

Generally, application variables should hold information that you write infrequently. In most cases, the values of these variables are set once, most often when an application first starts. Then the values of these variables are referenced many times throughout the life of the application or the course of a session.

In circumstances that might result in race conditions from multiple accesses to the same variable, put code that writes to Application scope variables or reads Application scope variables with data that can change inside `cflock` tags.

Because each Application scope variable is shared in memory by all requests in the application, these variables can become bottlenecks if used inappropriately. Whenever a request is reading or writing an Application scope variable, any other requests that use the variable must wait until the code accessing the variable completes. This problem is increased by the processing time required for locking. If many users access the application simultaneously and you use Application scope variables extensively, your application performance might degrade. If your application uses many application variables, consider whether the variables must be in the Application scope or whether they can be Session or Request scope variables.

The application scope has one built-in variable, `Application.applicationName`, which contains the application name you specify in the `cfapplication` tag.

You access and manipulate application variables the same way you use session variables, except that you use the variable prefix `Application`, not `Session`, and specify `Session` as the lock scope. For examples of using session variables see “Creating and deleting session variables” on page 285 and “Accessing and changing session variables” on page 286.

For information on locking write-once read-many application variables efficiently, see “Locking application variables efficiently” on page 295

**Using server variables**

Server variables are associated with a single ColdFusion server. They are available to all applications that run on the server. Use server variables for data that must be accessed across clients and applications, such as global server hit counts.

Server variables do not time out, but they are lost when the server shuts down. You can delete server variables.

Server variables are stored on a single server. As a result, you should not use server variables if you use ColdFusion on a server cluster.

You access and manipulate server variables the same way use Session and application variables, except you use the variable prefix `Server`.

**Important:** Put code that uses server variables inside `cflock` tags in circumstances that might result in race conditions from multiple accesses to the same variable. You do not have to lock access to built-in server variables.

ColdFusion provides the following standard built-in read-only server variables:
Locking code with cflock

The **cflock** tag controls simultaneous access to ColdFusion code. The **cflock** tag lets you do the following:

- Protect sections of code that access and manipulate shared data in the Session, Application, and Server scopes, and in the Request and Variables scopes for applications that use ColdFusion threads.
- Ensure that file updates do not fail because files are open for writing by other applications or ColdFusion tags.
- Ensure that applications do not try to simultaneously access ColdFusion extension tags written using the CFX API that are not thread-safe. This is particularly important for CFX tags that use shared (global) data structures without protecting them from simultaneous access (not thread-safe). However, Java CFX tags can also access shared resources that could become inconsistent if the CFX tag access is not locked.
- Ensure that applications do not try to simultaneously access databases that are not thread-safe. (This is not necessary for most database systems.)

ColdFusion is a multithreaded web application server that can process multiple page requests at a time. As a result, the server can attempt to access the same information or resources simultaneously, as the result of two or more requests.

Although ColdFusion is thread-safe and does not try to modify a variable simultaneously, it does not ensure the correct order of access to information. If multiple pages, or multiple invocations of a page, attempt to write data simultaneously, or read and write it at the same time, the resulting data can be inconsistent, as shown in the following Sample locking scenarios section.

Similarly, ColdFusion cannot automatically ensure that two sections of code do not attempt to access external resources such as files, databases, or CFX tags that cannot properly handle simultaneous requests. Nor can ColdFusion ensure that the order of access to these shared resources is consistent and results in valid data.
By locking code that accesses such resources so that only one thread can access the resource at a time, you can prevent race conditions.

**Sample locking scenarios**

The following examples present scenarios in which you need to lock ColdFusion code. These scenarios show only two of the circumstances where locking is vital.

**Reading and writing a shared variable**

If you have an application-wide value, such as a counter of the total number of tickets sold, you might have code such as the following on a login page:

```coldfusion
<cfset Application.totalTicketsSold = Application.totalTicketsSold + ticketOrder>
```

When ColdFusion executes this code, it performs the following operations:

1. Retrieves the current value of Application.totalTicketsSold from temporary storage.
2. Increments this value.
3. Stores the result back in the Application scope.

Suppose that ColdFusion processes two ticket orders at approximately the same time, and that the value of Application.totalTicketsSold is initially 160. The following sequence might happen:

4. Order 1 reads the total tickets sold as 160.
5. Order 2 reads the total tickets sold as 160.
6. Order 1 adds an order of 5 tickets to 160 to get 165.
7. Order 2 adds an order of 3 tickets to 160 to get 163.
8. Order 1 saves the value 165 to Application.totalTicketsSold
9. Order 2 saves the value 163 to Application.totalTicketsSold

The application now has an inaccurate count of the tickets sold, and is in danger of selling more tickets than the auditorium can hold.

To prevent this from happening, lock the code that increments the counter, as follows:

```coldfusion
<cflock scope="Application" timeout="10" type="Exclusive">
   <cfset Application.totalTicketsSold = Application.totalTicketsSold + ticketOrder>
</cflock>
```

The `cflock` tag ensures that while ColdFusion performs the processing in the tag body, no other threads can access the Application scope. As a result, the second transaction is not processed until the first one completes. The processing sequence looks something like the following:

10. Order 1 reaches the lock tag, which gets an Application scope lock.
11. Order 1 reads the total tickets sold as 160.
12. Order 2 reaches the lock tag. Because there is an active Application scope lock, ColdFusion waits for the lock to free.
13. Order 1 adds an order of 5 tickets to 160 to get 165.
14. Order 1 saves the value 165 to Application.totalTicketsSold.
15. Order 1 exits the lock tag. The Application scope lock is now free.
16. Order 2 gets the Application scope lock and can begin processing.
Order 2 reads the total tickets sold as 165.
Order 2 adds an order of 3 tickets to 165 to get 168.
Order 2 saves the value 168 to Application.totalTicketsSold.
Order 2 exits the lock tag, which frees the Application scope lock. ColdFusion can process another order.
The resulting Application.totalTicketsSold value is now correct.

Ensuring consistency of multiple variables

Often an application sets multiple shared scope variables at one time, such as a number of values submitted by a user on a form. If the user submits the form, clicks the back button, and then resubmits the form with different data, the application might end up with a mixture of data from the two submissions, in much the same manner as shown in the previous section.

For example, an application might store information about order items in a Session scope shopping cart. If the user submits an item selection page with data specifying sage green size 36 shorts, and then resubmits the item specifying sea blue size 34 shorts, the application might end up with a mixture of information from the two orders, such as sage green size 34 shorts.

By putting the code that sets all of the related session variables in a single \texttt{cflock} tag, you ensure that all the variables get set together. In other words, setting all of the variables becomes an \texttt{atomic}, or single, operation. It is similar to a database transaction, where everything in the transaction happens, or nothing happens. In this example, the order details for the first order all get set, and then they are replaced with the details from the second order.

For more examples of using locking in applications, see “Examples of \texttt{cflock}” on page 296.

Using the \texttt{cflock} tag with write-once variables

You do not need to use \texttt{cflock} when you read a variable or call a user-defined function name in the Session, Application, or Server scope if it is set in \texttt{only one place} in the application, and is only read (or called, for a UDF) everywhere else. Such data is called \texttt{write-once}. If you set an Application or Session scope variable in Application.cfm and never set it on any other pages, you must lock the code that sets the variable, but do not have to lock code on other pages that reads the variable's value. If you set the variable in the corresponding start method in Application.cfc (for example, \texttt{onApplicationStart} for Application scope variables), you do not have to lock the code that sets the variable.

However, although leaving code that uses write-once data unlocked can improve application performance, it also has risks. You must ensure that the variables are truly written only once. For example, you must ensure that the variable is not rewritten if the user refreshes the browser or clicks a back button. Also, it can be difficult to ensure that you, or future developers, do not later set the variable in more than one place in the application.

Using the \texttt{cflock} tag

The \texttt{cflock} tag ensures that concurrently executing requests do not run the same section of code simultaneously and thus manipulate shared data structures, files, or CFX tags inconsistently. It is important to remember that \texttt{cflock} protects code sections that access or set data, \texttt{not} the variables themselves.

You protect access to code by surrounding it in a \texttt{cflock} tag; for example:

\begin{verbatim}
<cflock scope="Application" timeout="10" type="Exclusive">
  <cfif not IsDefined("Application.number")>
    <cfset Application.number = 1>
  </cfif>
</cflock>
\end{verbatim}
Lock types

The **cflock** tag offers two modes of locking, specified by the **type** attribute:

**Exclusive locks (the default lock type):** Allow only one request to process the locked code. No other requests can run code inside the tag while a request has an exclusive lock.

Enclose all code that creates or modifies session, application, or server variables in exclusive **cflock** tags.

**Read-only locks:** Allow multiple requests to execute concurrently if no exclusive locks with the same scope or name are executing. No requests can run code inside the tag while a request has an exclusive lock.

Enclose code that only reads or tests session, application, or server variables in read-only **cflock** tags. You specify a read-only lock by setting the **type=“readOnly”** attribute in the **cflock** tag, for example:

```cflock scope=“Application” timeout=“10” type=“readOnly”>
  <cfif IsDefined(“Application.dailyMessage”)>
    <cfoutput>#{Application.dailyMessage}#<br></cfoutput>
  </cfif>
</cflock>
```

Although ColdFusion does not prevent you from setting shared variables inside read-only lock tag, doing so loses the advantages of locking. As a result, you must be careful not to set any session, application, or server variables inside a read-only **cflock** tag body.

**Note:** You cannot upgrade or downgrade a lock from one type to another. In other words, do not nest an exclusive lock in a read-only lock of the same name or scope; the exclusive lock will always time out. Also, do not nest a read-only lock inside an exclusive lock with the same name or scope; doing so has no effect.

Lock scopes and names

The **cflock** tag prevents simultaneous access to sections of code, not to variables. If you have two sections of code that access the same variable, they must be synchronized to prevent them from running simultaneously. You do this by identifying the locks with the same **scope** or **name** attributes.

**Note:** ColdFusion does not require you to identify exclusive locks. If you omit the identifier, the lock is anonymous and you cannot synchronize the code in the **cflock** tag block with any other code. Anonymous locks do not cause errors when they protect a resource that is used in a single code block, but they are bad programming practice. You must always identify read-only locks.

Controlling access to data with the **scope** attribute

When the code that you are locking accesses session, application, or server variables, synchronize access by using the **cflock scope** attribute.

You can set the attribute to any of the following values:

<table>
<thead>
<tr>
<th>Scope</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>All code sections with this attribute on the server share a single lock.</td>
</tr>
<tr>
<td>Application</td>
<td>All code sections with this attribute in the same application share a single lock.</td>
</tr>
<tr>
<td>Session</td>
<td>All code sections with this attribute that run in the same session of an application share a single lock.</td>
</tr>
<tr>
<td>Request</td>
<td>All code sections with this attribute that run in the same request share a single lock. You use this scope only if your application uses the <strong>cftthread</strong> tag to create multiple threads in a single request. Locking the Request scope also locks access to Variables scope data. For more information on locking the Request scope, see &quot;Locking thread data and resource access&quot; on page 306.</td>
</tr>
</tbody>
</table>

If multiple code sections share a lock, the following rules apply:
• When code is running in a `cflock` tag block with the `type` attribute set to `Exclusive`, code in `cflock` tag blocks with the same `scope` attribute is not allowed to run. They wait until the code with the exclusive lock completes.

• When code in a `cflock` tag block with the `type` `readOnly` is running, code in other `cflock` tag blocks with the same `scope` attribute and the `readOnly` type attribute can run, but any blocks with the same `scope` attribute and an `Exclusive` type cannot run and must wait until all code with the read-only lock completes. However, if a read-only lock is active and code with an exclusive lock with the same scope or name is waiting to execute, read-only requests using the same scope or name that are made after the exclusive request is queued must wait until code with the exclusive lock executes and completes.

Controlling locking access to files and CFX tags with the `name` attribute
The `cflock` `name` attribute provides a second way to identify locks. Use this attribute when you use locks to protect code that manages file access or calls non-thread-safe CFX code.

When you use the `name` attribute, specify the same name for each section of code that accesses a specific file or a specific CFX tag.

Controlling and minimizing lock time-outs
You must include a `timeout` attribute in your `cflock` tag. The `timeout` attribute specifies the maximum time, in seconds, to wait to obtain the lock if it is not available. By default, if the lock does not become available within the time-out period, ColdFusion generates a Lock type exception error, which you can handle using `cftry` and `cfcatch` tags.

If you set the `cflock` `throwOnTimeout` attribute to No, processing continues after the time-out at the line after the `</cflock>` end tag. Code in the `cflock` tag body does not run if the time-out occurs before ColdFusion can acquire the lock. Therefore, never use the `throwOnTimeout` attribute for CFML that must run.

Normally, it does not take more than a few seconds to obtain a lock. Very large time-outs can block request threads for long periods of time and radically decrease throughput. Always use the smallest time-out value that does not result in a significant number of time-outs.

To prevent unnecessary time-outs, lock the minimum amount of code possible. Whenever possible, lock only code that sets or reads variables, not business logic or database queries. One useful technique is to do the following:

1. Perform a time-consuming activity outside of a `cflock` tag.
2. Assign the result to a Variables scope variable.
3. Assign the Variables scope variable's value to a shared scope variable inside a `cflock` block.

For example, if you want to assign the results of a query to a session variable, first get the query results using a Variables scope variable in unlocked code. Then, assign the query results to a session variable inside a locked code section. The following code shows this technique:

```cfml
<cfquery name="Variables.qUser" datasource="#request.dsn#">
  SELECT FirstName, LastName
  FROM Users
  WHERE UserID = #request.UserID#
</cfquery>
<cflock scope="Session" timeout="5" type="exclusive">
  <cfset Session.qUser = Variables.qUser>
</cflock>
```
Considering lock granularity

When you design your locking strategy, consider whether you should have multiple locks containing small amounts of code or few locks with larger blocks of code. There is no simple rule for making such a decision, and you might do performance testing with different options to help make your decision. However, you must consider the following issues:

- If the code block is larger, ColdFusion will spend more time inside the block, which might increase the number of times an application waits for the lock to be released.
- Each lock requires processor time. The more locks you have, the more processor time is spent on locking code.

Nesting locks and avoiding deadlocks

Inconsistent nesting of cflock tags and inconsistent naming of locks can cause deadlocks (blocked code). If you are nesting locks, you must consistently nest cflock tags in the same order and use consistent lock scopes (or names).

A deadlock is a state in which no request can execute the locked section of the page. All requests to the protected section of the page are blocked until there is a time-out. The following table shows one scenario that would cause a deadlock:

<table>
<thead>
<tr>
<th>User 1</th>
<th>User 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locks the Session scope.</td>
<td>Locks the Application scope.</td>
</tr>
<tr>
<td>Tries to lock the Application scope, but the Application scope is already locked by User 2.</td>
<td>Tries to lock the Session scope, but the Session scope is already locked by User 1.</td>
</tr>
</tbody>
</table>

Neither user’s request can proceed, because it is waiting for the other to complete. The two are deadlocked.

Once a deadlock occurs, neither of the users can do anything to break the deadlock, because the execution of their requests is blocked until the deadlock is resolved by a lock time-out.

You can also cause deadlocks if you nest locks of different types. An example of this is nesting an exclusive lock inside a read-only lock of the same scope or same name.

In order to avoid a deadlock, lock code sections in a well-specified order, and name the locks consistently. In particular, if you need to lock access to the Server, Application, and Session scopes, you must do so in the following order:

1. Lock the Session scope. In the cflock tag, specify scope="Session".
2. Lock the Application scope. In the cflock tag, specify scope="Application".
3. Lock the Server scope. In the cflock tag, specify scope="Server".
4. Unlock the Server scope.
5. Unlock the Application scope.
6. Unlock the Session scope.

Note: You can skip any pair of lock and unlock steps in the preceding list if you do not need to lock a particular scope. For example, you can omit steps 3 and 4 if you do not need to lock the Server scope.

Copying shared variables into the Request scope

You can avoid locking some shared-scope variables multiple times during a request by doing the following:

1. Copy the shared-scope variables into the Request scope in code with an exclusive lock in the Application.cfc onRequestStart method or the Application.cfm page.
2. Use the Request scope variables on your ColdFusion pages for the duration of the request.

3. Copy the variables back to the shared scope in code with an exclusive lock in the Application.cfc onRequestEnd method on the OnRequestEnd.cfm page.

With this technique the “last request wins.” For example, if two requests run simultaneously, and both requests change the values of data that was copied from the shared scope, the data from the last request to finish is saved in the shared scope, and the data from the previous request is not saved.

**Locking application variables efficiently**

The need to lock application variables can reduce server performance, because all requests that use Application scope variables must wait on a single lock. This issue is a problem even for write-once read-many variables, because you still must ensure the variable exists, and possibly set the value before you can read it.

You can minimize this problem by using a technique such as the following to test for the existence of application variables and set them if they do not exist:

1. Use an Application scope flag variable to indicate if the variable or variables are initialized. In a read-only lock, check for the existence of the flag, and assign the result to a local variable.

2. Outside the cflock block, test the value of the local variable.

3. If it the local variable indicates that the application variables are not initialized, get an exclusive Application scope lock.

4. Inside the lock, again test the Application scope flag, to make sure another page has not set the variables between step one and step four.

5. If the variables are still not set, set them and set the Application scope flag to true.

6. Release the exclusive lock.

The following code shows this technique:

```cfc
define app_is_initialized = False
<cflock scope="application" type="readonly">
  <cfset app_is_initialized = IsDefined("APPLICATION.initialized")>
</cflock>
<cfif not app_is_initialized >
  <cflock scope="application" type="exclusive">
    <cfif not IsDefined("APPLICATION.initialized") >
      <cfset APPLICATION.varible1 = someValue >
      ...
    </cfif>
    <cfset APPLICATION.initialized = "yes">
</cflock>
</cfif>
</cflock>
</cfif>
```
Examples of cflock

The following examples show how to use cflock blocks in a variety of situations.

Example with application, server, and session variables
This example shows how you can use cflock to guarantee the consistency of data updates to variables in the Application, Server, and Session scopes.

This example does not handle exceptions that arise if a lock times out. As a result, users see the default exception error page on lock time-outs.

The following sample code might be part of the Application.cfm file:

```coldfusion
<cfapplication name="ETurtle"
    sessiontimeout=#createtimespan(0,1,30,0)#
    sessionmanagement="yes">
    <!--- Initialize the Session and Application variables that will be used by E-Turtleneck. Use the Session lock scope for the session variables. --->

    <cflock scope="Session"
        timeout="10" type="Exclusive">
        <cfif not IsDefined("session.size")>
            <cfset session.size = ">
        </cfif>
        <cfif not IsDefined("session.color")>
            <cfset session.color = ">
        </cfif>
    </cflock>

    <!--- Use the Application scope lock for the Application.number variable. This variable keeps track of the total number of turtlenecks sold. The following code implements the scheme shown in the Locking Application variables effectively section --->

    <cfset app_is_initialized = "no">
    <cflock scope="Application" type="readonly">
        <cfset app_is_initialized = IsDefined("Application.initialized")>
    </cflock>
    <cfif not app_is_initialized >
        <cflock scope="application" timeout="10" type="exclusive">
            <cfif not IsDefined("Application.initialized") >
                <cfset Application.number = 1>
                <cfset Application.initialized = "yes">
            </cfif>
        </cflock>
    </cfif>
</cflock>

    <!--- Always display the number of turtlenecks sold --->

    <cflock scope="Application"
        timeout="10"
        type = "ReadOnly">
    <cfoutput>
    E-Turtleneck is proud to say that we have sold #Application.number# turtlenecks to date.
    </cfoutput>
</cflock>
```
The remaining sample code could appear inside the application page where customers place orders:

```html
<html>
<head>
<title>cflock Example</title>
</head>

<body>
<h3>cflock Example</h3>

<cfif IsDefined("Form.submit")>

<!--- Lock session variables --->
<!--- Note that we use the automatically generated Session ID as the order ID --->
<cflock scope="Session"
    timeout="10" type="ReadOnly">
    <cfoutput>Thank you for shopping E-Turtleneck. Today you have chosen a turtleneck in size 
    <b>$form.size$</b> and in the color 
    <b>$form.color$</b>. Your order ID is $Session.sessionID$.
</cfoutput>
</cflock>

<!--- Lock session variables to assign form values to them. --->
<cflock scope="Session"
    timeout="10"
    type="Exclusive">
    <cfparam name=Session.size default=#form.size#>
    <cfparam name=Session.color default=#form.color#>
</cflock>

<!--- Lock the Application scope variable application.number to update the total number of turtlenecks sold. --->
<cflock scope="Application"
    timeout="30" type="Exclusive">
    <cfset application.number=application.number + 1>
</cflock>

<!--- Show the form only if it has not been submitted. --->
<cfelse>
<form action="cflock.cfm" method="Post">
<p> Congratulations! You have just selected the longest-wearing, most comfortable turtleneck in the world. Please indicate the color and size you want to buy.</p>
<table cellspacing="2" cellpadding="2" border="0">
<tr>
<td>Select a color.</td>
</tr>
<tr>
<td><select type="Text" name="color">
<option>red</option>
<option>white</option>
<option>blue</option>
<option>turquoise</option>
<option>black</option>
<option>forest green</option>
</select></td>
</tr>
```
```
Note: In this simple example, the Application.cfm page displays the Application.number variable value. Because the Application.cfm file is processed before any code on each ColdFusion page, the number that displays after you click the submit button does not include the new order. One way you can resolve this problem is by using the OnRequestEnd.cfm page to display the value at the bottom of each page in the application.

Example of synchronizing access to a file system

The following example shows how to use a cflock block to synchronize access to a file system. The cflock tag protects acffile tag from attempting to append data to a file already open for writing by the same tag executing on another request.

If an append operation takes more than 30 seconds, a request waiting to obtain an exclusive lock to this code might time out. Also, this example uses a dynamic value for the name attribute so that a different lock controls access to each file. As a result, locking access to one file does not delay access to any other file.

```cflock name=#filename# timeout=30 type="Exclusive">
  <cffile action="Append" file=#fileName# output=#textToAppend#>
</cflock>
```

Example of protecting ColdFusion extensions

The following example shows how you can build a custom tag wrapper around a CFX tag that is not thread-safe. The wrapper forwards attributes to the non-thread-safe CFX tag that is used inside a cflock tag.

```cfparam name="Attributes.AttributeOne" default=""">
<cfparam name="Attributes.AttributeTwo" default=""">
<cfparam name="Attributes.AttributeThree" default="">

<cflock timeout=5 
  type="Exclusive" 
  name="cfx_not_thread_safe">
  <cfx_not_thread_safe attributeone=#attributes.attributeone# 
    attributetwo=#attributes.attributetwo# 
    attributethree=#attributes.attributethree#>
</cflock>
Chapter 17: Using ColdFusion Threads

You can use threads in Adobe ColdFusion to simultaneously run multiple streams of execution in a ColdFusion page or CFC.

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- About ColdFusion threads ................................................................. 300
- Creating and managing ColdFusion threads ................................... 300
- Using thread data ........................................................................ 303
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About ColdFusion threads

Threads are independent streams of execution. Multiple threads on a page or CFC can execute simultaneously and asynchronously, letting you perform asynchronous processing in CFML.

Threads are useful for two broad types of activities:
- When multiple actions can occur simultaneously
- When you do not have to wait for one action to complete before starting the next action

Some typical uses for threads include the following examples:

- An application that aggregates information from multiple external sources that might take significant times to respond has the code that gets information from each source in a separate thread. This way, the application starts all requests quickly and has to wait only until the last response is received, instead of having to wait for a response to each request before the next request can start. One example of such usage is an RSS or Atom feed aggregator.

- A page that sends many mail messages runs the code that sends the mail messages in a separate thread and doesn’t wait for it to complete to continue processing. The thread that sends the mail messages continues processing after the page-level processing is completed and the application starts processing another page.

- An application might do maintenance of user data, such as using update queries, deleting records, and so on, whenever a user logs into the site. If the application does the maintenance in a separate thread, the user gets an immediate response after logging in, without having to wait for the updates to complete.

When ColdFusion processes a page, the page executes in a single thread, called the page thread. The cfthread tag lets you create additional threads that can process independently of the page thread, and lets you synchronize thread processing, for example, by having the page thread wait until threads that you create complete their processing.

Creating and managing ColdFusion threads

You use the cfthread tag and the sleep function to create and manage ColdFusion threads. You manage a thread by doing the following actions:
• Start the thread running.
• Temporarily suspend the thread’s processing. This action is useful if one thread must wait for another thread to do processing, but both threads must continue processing without joining.
• End a thread. You typically end a running thread if there is an error, or if it is still processing after a long time.
• Have the page or a thread wait until one or more other threads have completed processing before proceeding with its processing, called joining the threads. You typically join threads when one thread requires the results from another thread. For example, if a page uses multiple threads to get several news feeds for display, it joins all the feed threads before it displays the results.

Each thread runs the code inside a cfthread tag body and normally exits when the tag body code completes processing.

Starting a thread
You start a thread by using a cfthread tag with an action attribute value of run. CFML code within the cfthread tag body executes on a separate thread while the page request thread continues processing. Only the page thread can create other threads. A thread that you create with a cfthread tag cannot create a child thread, so you cannot have multiple nested threads.

Optionally, when you start the thread, you can specify a priority level of high, normal (the default), or low to specify the relative amount of time that the processor should devote to the thread. Page-level code always runs at normal priority, so you can give your threads more or less processing time than the page.

For more information on using thread attributes, see “The Attributes scope and thread attributes” on page 304.

Suspending a thread
In some cases, one thread must wait until a second thread completes some operations, but should not wait until the second thread completes all processing, so you cannot just join the threads. For example, one thread might do initialization that is required by multiple threads, and then it might continue with additional processing. The other threads could suspend themselves until initialization is complete.

The sleep function and cfthread tag with a sleep action attribute provide two equivalent mechanisms for doing such synchronization. They suspend the thread processing for a specified period of time. A code loop could test a condition variable and sleep for a period before retesting the condition. When the condition is true (or a value is reached, or some other test is valid), the program exits the loop and the thread continues processing.

The following example shows how one thread could use a sleep function to wait for a second thread to perform some actions.

```
<cfthread name="threadB" action="run">
    <cfscript>
        thread.sleepTimes=0;
        thread.initialized=false;
    </cfscript>
</cfthread>
```
while ((threadA.Status != "TERMINATED") && (threadA.j < 400000)) {
    sleep(500);
    thread.sleeptimes++;
}
// Don’t continue processing if threadA terminated abnormally.
If (threadA.Status != "TERMINATED") {
    thread.initialized=true;
    // Do additional processing here.
}
</cfscript>
</cfthread>

<!Join the page thread to thread B. Don’t join to thread A.--->
<cfthread action="join" name="threadB" timeout="10000" />

<!---- Display the thread information. --->
<cfoutput>
current threadA index value: #threadA.j#<br />
threadA status: #threadA.Status#<br>
threadB status: #threadB.Status#<br>
threadB sleepTimes: #threadB.sleepTimes#<br>
Is threadB initialized: #threadB.initialized#<br>
</cfoutput>

### Ending a thread

If a thread never completes processing (is hung), it continues to occupy system resources, so it is good practice to have your application check for hung threads and end them. You should also consider ending threads that take excessive time to process and might significantly reduce the responsiveness of your application or server.

To end a thread, use the `cfthread` tag with an `action` attribute value of `terminate`, as the following code snippet shows.

<![--- Thread1 sleeps to simulate an activity that might hang. --->
<cfthread name="thread1" action="run">
    <cfset thread.j=1>
    <cfset sleep(50000) >
</cfthread>

<![--- Thread2 loops to simulate an activity that takes less time. --->
<cfthread name="thread2" action="run">
    <cfset thread.j=1>
    <cfloop index="i" from="1" to="10">
        <cfset thread.j=thread.j+1>
    </cfloop>
</cfthread>

<![--- The page thread sleeps for 1/2 second to let thread processing complete. --->
<cfset sleep(500) >

<![--- The page thread loops through the threads and terminates any that are still running or never started.
    Note the use of the cfthread scope and associative array notation to reference the dynamically named threads without using the Evaluate function. --->
<cfloop index="k" from="1" to="2">
    <cfset theThread=cfthread["thread#k#"]>
    <cfif ((theThread.Status IS "RUNNING") || (theThread.Status IS "NOT_STARTED"))>
        <cfthread action="terminate" name="thread#k#" />
    </cfif>
</cfloop>
Note: You can also have the ColdFusion Server Monitor automatically check for and terminate hung threads.

**Joining threads**

You use the `cfthread` tag with an `action` attribute value of `join` to join two or more threads. You join threads when one thread depends on one or more other threads completing before it can do some processing. For example, a page can start multiple threads to do processing and join them before it processes the thread results. By default, the `join` action stops the current thread from doing further processing until all the specified threads complete processing.

You can use a `timeout` attribute to specify the number of milliseconds that the current thread waits for the thread or threads being joined to finish. If any thread does not finish by the specified time, the current thread proceeds without waiting for the remaining thread or threads to complete.

The following code, for example, joins three threads to the current thread (often, the main page thread). The current thread waits up to six seconds for the other threads to complete, and continues processing if one or more threads do not complete by then.

```coldfusion
<cfthread action="join" name="t1,t2,t3" timeout="6000"/>
```

If the `timeout` attribute value is 0, the default value, the current thread continues waiting until all joining threads finish. In this case, if the current thread is the page thread, the page continues waiting until the threads are joined, even if you specify a page time-out. As a general rule, you should specify a `timeout` value to limit hung threads.

**Using thread data**

Because multiple threads can process simultaneously within a single request, applications must ensure that data from one thread does not improperly affect data in another thread. ColdFusion provides several scopes that you can use to manage thread data, and a request-level lock mechanism that you use to prevent problems caused by threads that access page-level data. ColdFusion also provides metadata variables that contain any thread-specific output and information about the thread, such as its status and processing time.

**Thread scopes**

Each thread has three special scopes:

- The thread-local scope
- The Thread scope
- The Attributes scope
The thread-local scope

The thread-local scope is an implicit scope that contains variables that are available only to the thread, and exist only for the life of the thread. Any variable that you define inside the cfthread tag body without specifying a scope name prefix is in the thread local scope and cannot be accessed or modified by other threads.

To create a thread-local variable, assign the variable in the cfthread tag body without specifying a scope prefix, as in the following lines:

```cfset var index=1```
```cfset index=1```

These two lines are equivalent, with one exception: If you use the var keyword, the assignment code must immediately follow the cfthread tag, before any other CFML tags.

The Thread scope

The Thread scope contains thread-specific variables and metadata about the thread. Only the owning thread can write data to this scope, but the page thread and all other threads in a request can read the variable values in this scope. Thread scope data remains available until the page and all threads that started from the page finish, even if the page finishes before the threads complete processing.

To create a Thread scope variable, in the cfthread tag body, use the keyword Thread or the name of the thread (for example, myThread) as a prefix. The following examples of creating a Thread scope variable are equivalent:

```cfset Thread.myValue = 27```
```cfset myThread.myValue = 27```

To access a thread's Thread scope variables outside the thread, prefix the variable with the thread's name, as in the following example:

```cfset nextValue=myThread.myValue + 1```

Thread scope variables are only available to the page that created the thread or to other threads created by that page. No other page can access the data. If one page must access another page’s Thread scope data, you must put the data in a database or file and access it from there.

Each thread’s Thread scope is a subscope of a special scope, cfthread, that lasts as long as the request, or until the last thread that it starts completes, whichever is longer. Thus, if you have two threads, myThread1 and myThread2, you can access their Thread scopes as cfthread.myThread1 and cfthread.myThread2 until all threads and the request complete. In most cases, there is no need to use the cfthread scope directly. However, you might use the cfthread scope name in either of the following situations:

1. If you generate the thread name dynamically, you can avoid using the Evaluate function by using the cfthread scope with associative array notation, as the following code snippet shows:

   ```cfset threadname="thread_#N#"```
   ```...```
   ```<cfset threadscopeForNthThread = cfthread[threadname] >```
   ```<cfset threadscopeForNthThread = Evaluate(threadname) >```

2. If you have a thread with the same name as a Variables scope variable, you can access that thread’s Thread scope only by prefacing the Thread name with cfthread. Otherwise, you access the Variables scope variable, or get an error.

The Attributes scope and thread attributes

The Attributes scope contains attributes that are passed to the thread, either individually or in the attributeCollection attribute. The Attributes scope is available only within the thread and only for the life of the thread.
ColdFusion makes a complete (deep) copy of all the attribute variables before passing them to the thread; therefore, the values of the variables inside the thread are independent of the values of any corresponding variables in other threads, including the page thread. For example, if you pass a CFC instance as an attribute to a thread, the thread gets a complete new copy of the CFC, including the contents of its This scope at the time that you create the thread. Any changes made to the original CFC outside the thread, for example, by calling a CFC function, have no effect on the copy that is in the thread. Similarly, any changes to the CFC instance in the thread have no effect on the original CFC instance.

Copying the data ensures that the values passed to threads are thread-safe, because the attribute values cannot be changed by any other thread. If you do not want the data to be duplicated, do not pass it to the thread as an attribute or in the attributeCollection attribute. Instead, keep the data in a scope that the thread can access. An example of an object that should not be passed to the thread as an attribute is a singleton CFC that should never be duplicated. The singleton CFC must be kept in some shared scope and accessed by threads. For more information, see the “Using other scopes” on page 305.

Because ColdFusion copies all attributes by value, you can have multiple threads, for example, threads created dynamically in a loop, that use the same attribute names, but where each thread gets a different value, as shown in the following code excerpt, which creates separate threads to copy each of several files in a directory:

```coldfusion
<cfloop query="dir">
  <cfset threadname = "thread_" & #i#>  
  <cfset i=i+1>
  <cfthread name="#threadname#" filename="#dir.name#">
    <cffile action="COPY" source="#src\#filename#" destination="#dest\#filename#">
  </cfthread>
</cfloop>
```

**Using other scopes**

Threads have access to all the ColdFusion scopes. All the threads run by a page share the same Variables and This scope. All the threads run in a request share the same Form, URL, Request, CGI, Cookie, Session, Application, Server and Client scopes. You must be careful to lock access to these scopes if more than one thread could try to modify the data in the scopes; otherwise you can get deadlocks between threads. For more information, see “Locking thread data and resource access” on page 306.

Although a thread can access all the scopes, it might not be able to write to scopes like Session, Cookie, or Request after the request page processing completes.

**Scope precedence**

If you do not specify a scope prefix on a variable inside a `cfthread` tag body, ColdFusion checks scopes in the following order to find the variable:

1. Function-local, in function definitions in the thread only
2. Thread-local
3. Attributes
4. Variables
5. Thread/cfthread

Other scopes are checked in the standard scope checking order.
Locking thread data and resource access

When an application uses multiple threads, you must be careful to ensure that the threads do not simultaneously attempt to use or modify shared resources that are not themselves thread-safe, including the following items:

- If multiple threads modify a Variables or Request scope variable, use a Request scope lock to control access to the code that uses the variable to prevent deadlocks and race conditions. Similarly, use a Request scope lock around code that accesses built-in data structures or subscopes of the Variables scope, such as the Forms variable, that you change in multiple threads.

- Multiple threads should not try to access any other shared resource simultaneously. For example, you should not use the same FTP connection from multiple threads. To prevent this behavior, place the code that uses the resource in named cflock tags. Use the same name attribute for all cflock tags around code that uses a specific resource.

For more information on locking code, see cflock and “Locking code with cflock” on page 289 in the ColdFusion Developer's Guide.

Metadata variables

The Thread scope contains the following variables that provide information about the thread, called metadata.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elapsedtime</td>
<td>The amount of processor time that has been spent handling the thread.</td>
</tr>
<tr>
<td>Error</td>
<td>A ColdFusion error structure that contains the keys that you can access in a cfcatch tag. This variable has a value only if an unhandled error occurred during thread processing. For information on handling thread errors, see “Handling ColdFusion thread errors” on page 308.</td>
</tr>
<tr>
<td>Name</td>
<td>The thread name.</td>
</tr>
<tr>
<td>Output</td>
<td>Output text that is generated by the thread. Threads cannot display output directly. For more information see “Handling thread output” on page 308.</td>
</tr>
<tr>
<td>Priority</td>
<td>The thread processing priority, as specified when you created the thread.</td>
</tr>
<tr>
<td>StartTime</td>
<td>The time at which the thread began processing.</td>
</tr>
<tr>
<td>Status</td>
<td>The current status of the thread. For information on using the Status in an application, see “Using the thread status” on page 307.</td>
</tr>
</tbody>
</table>

As with other variables in the Thread scope, thread metadata is available to all of a page's threads by specifying the thread name as a variable prefix. For example, the page thread can get the current elapsed time of the myThread1 thread from the myThread1.ElapsedTime variable.

The metadata is available from the time that you create the thread until the time when the page and all threads started on the page complete processing, even if the page finishes before the threads finish. This way, you can get thread output, error information, and processing information during and after the time when the thread is processing.

Working with threads

Multithreaded applications use several building blocks, including the following:

- Starting threads in loops
- Getting information about the thread processing status
- Displaying thread results
• Handling thread errors
• Using database transactions with threads

Starting threads inside loops
Because threads run asynchronously, page level variables can change during thread execution. As a result of this behavior, if you start threads inside a cfloop, and code inside the threads uses the value of the loop iterator (the index variable, query name, list item, etc.), you must pass the loop iterator to the thread as an attribute.

The following example shows the use of threads inside a loop. It uses an indexed cfloop tag to start five threads. Each thread gets the current loop index value in a threadIndex attribute. The thread adds an array entry with the thread's threadIndex attribute value and the current value of the page cfloop index, pageIndex. After joining the threads, the page displays the array contents. When you run the example, particularly if you run it multiple times, you see that at the time the thread saves data to the array, the value of pageIndex has incremented past the threadIndex value, and multiple threads often have the same pageIndex value; but the multiple threads always have the correct threadIndex value.

```
<cfloop index="pageIndex" from="1" to="5">
    <cfthread name="thr#pageIndex#" threadIndex="#pageIndex#" action="run">
        <cfset Variables.theOutput[threadIndex]="Thread index attribute: " & threadIndex & " &nbsp;&nbsp; Page index value: " & pageIndex>
    </cfthread>
</cfloop>
<cfthread action="join" name="thr1,thr2,thr3,thr4,thr5" timeout=2000/>
<cfloop index="j" from="1" to="5">
    <cfoutput>#theOutput[j]# <br /></cfoutput>
</cfloop>
```

Using the thread status
The Thread scope status metadata variable lets the page, or any other thread started by the page, determine the status of any thread. The page processing code can then take a necessary action, for example, if the thread has terminated abnormally or might be hung. The status variable can have the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT_STARTED</td>
<td>The thread has been queued but is not processing yet.</td>
</tr>
<tr>
<td>RUNNING</td>
<td>The thread is running normally.</td>
</tr>
<tr>
<td>TERMINATED</td>
<td>The thread stopped running as a result of one of the following actions:</td>
</tr>
<tr>
<td></td>
<td>• A cfthread tag with a terminate action stopped the thread.</td>
</tr>
<tr>
<td></td>
<td>• An error occurred in the thread that caused it to terminate.</td>
</tr>
<tr>
<td></td>
<td>• A ColdFusion administrator stopped the thread from the Server Monitor.</td>
</tr>
<tr>
<td>COMPLETED</td>
<td>The thread ended normally.</td>
</tr>
<tr>
<td>WAITING</td>
<td>The thread has run a cfthread tag with action=&quot;join&quot;, and one or more of the threads being joined have not yet completed.</td>
</tr>
</tbody>
</table>
Applications can check the thread status to manage processing. For example, an application that requires results from a thread might specify a time-out when it joins the thread; in this case, it can check for the COMPLETED status to ensure that the thread has completed processing and the join did not just result from a time-out. Similarly, an application can check the status value of threads that might not start or might not complete normally, and terminate it if necessary. The example in “Ending a thread” on page 302 checks thread status and terminates any threads with RUNNING or NOT_STARTED status.

**Handling thread output**

To prevent conflicts, only the page thread displays output. Therefore, named threads have the following limitations:

- ColdFusion puts all output that you generate inside a thread, such as HTML and plain text, or the generated output of a `cfoutput` tag, in the Thread scope `output` metadata variable. The page-level code can display the contents of this variable by accessing the `threadName.output` variable.

- All tags and tag actions that directly send output to the client (instead of generating page text such as HTML output), do not work inside the thread. For example, to use the `cfdocument` or `cfreport` tags in a thread, you must specify a `filename` attribute; to use a `cfpresentation` tag, you must use a `directory` attribute.

**Handling ColdFusion thread errors**

If an error occurs in a thread, page-level processing is not affected, and ColdFusion does not generate an error message. If you do not handle the error by using a try/catch block in the thread code, the thread with the error terminates and the page-level code or other threads can get the error information from the thread metadata `Error` variable and handle the error appropriately.

You cannot use page- or application-based error handling techniques to manage errors that occur during thread execution. For that reason, you cannot use the `cferror` tag or the `onError` application event handler for thread errors. Instead, use either of the following techniques:

1. Use `cftry/cfcatch` tags or `try/catch` CFScript statements in the `cfthread` body to handle the errors inside the thread.

2. Handle the error outside the thread by using the thread error information that is available to the page and other threads in the Thread scope `threadName.Error` variable. Application code can check this variable for error information. For example, after you join to a thread that might have had an error, you could check the `threadName.status` variable for a value of `terminated`, which indicates that the thread terminated abnormally. You could then check the `threadName.Error` variable for information on the termination cause.

**Handling database transactions**

Database transactions cannot span threads. For example, consider a page with the following structure:

```cfc
<cftransaction>
  <cfthread name=“t1” ...>
    <cfquery name=“q1” ...>

    ...</cfquery>
  </cfthread>
  <cfquery name=“q2” ...>

    ...</cfquery>
  <cfthread action=“join” name=“t1” ... />
</cftransaction>
```
In this case, query \( q_1 \) is not included in the transaction that contains query \( q_2 \). To include both queries in the transaction, you must put the complete transaction in a single thread, using a structure such as the following:

```html
<cfthread name="t1" ...>
  <cftransaction>
    <cfquery name="q1" ...>
      ...
    </cfquery>
    <cfquery name="q2" ...>
      ...
    </cfquery>
  </cftransaction>
<cfthread action="join" name="t1" ... />
```

### Using ColdFusion tools to control thread use

The ColdFusion Administrator and Server Monitor let you control the number of active threads, view information about active threads, and end slow or hung threads.

#### Using the Administrator to limit threads

The Tag Limit Settings section of the ColdFusion Administrator Server Settings > Request Tuning page lets you specify a maximum number of `cfthread`-started threads that can run at one time. When ColdFusion reaches this maximum, it queues additional `cfthread` requests and starts the queued threads when running threads end.

#### Using the Server Monitor to view and end threads

You can use the Server Monitor to view information about active threads and to end threads that might be impairing server performance, as follows:

- The Server Monitor displays information about all active ColdFusion threads on the Statistics > Active ColdFusion Threads page. Displayed information includes the thread names, pages that started the threads, and the thread processing time. Use this page to manually end any thread.

- If you select the Enabled option on the Server Monitor Alerts > Alerts Configuration page Unresponsive Server tab, you can specify a threshold based on the number of threads that have been executing longer than a specific time. If the number of threads that have run longer than the Busy Thread Time exceeds the Hung Thread Count, you can have ColdFusion take one or more actions, including ending any threads that have run longer than a specified number of seconds.

- If you select the Enabled option on the Server Monitor Alerts > Alerts Configuration page Slow Server tab, you can specify an server response time threshold value. If ColdFusion exceeds the threshold, you can have it take one or more actions, including ending any threads that have run longer than a specified number of seconds.

For more information on using the Server Monitor, see the Server Monitor online Help.
**Example: getting multiple RSS feeds**

The following example uses three threads to get the results of three RSS feeds. The user must submit the form with all three feeds specified. The application joins the threads with a time-out of 6 seconds, and displays the feed titles and the individual item titles as links.

```coldfusion
<!--- Run this code if the feed URL form has been submitted. --->
<cfif isDefined("Form.submit")>
  <cfloop index="i" from="1" to="3">
    <!--- Use array notation and string concatenation to create a variable for this feed. --->
    <cfset theFeed = Form["Feed"&i]>
    <cfif theFeed NEQ ">
      <!--- Use a separate thread to get each of the feeds. --->
      <cfthread action="run" name="t#i#" feed="#theFeed#">
        <cffeed source="#feed#" 
          properties="thread.myProps" 
          query="thread.myQuery">
      </cfthread>
    <cfelse>
      <!--- If the user didn't fill all fields, show an error message. --->
      <h3>This example requires three feeds.<br />
      Click the Back button and try again.</h3>
      <cfabort>
    </cfif>
  </cfloop>
  <!--- Join the three threads. Use a 6 second timeout. --->
  <cfthread action="join" name="t1,t2,t3" timeout="6000" />
  <!--- Use a loop to display the results from the feeds. --->
  <cfloop index="i" from="1" to="3">
    <!--- Use the cfthread scope and associative array notation to get the Thread scope. --->
    <cfset feedResult=cfthread["t#i#"]>
    <!--- Display feed information only if you got items, for example, the feed must complete before the join. --->
    <cfif isDefined("feedResult.myQuery")>
      <cfoutput><h2>#feedResult.myProps.title#</h2></cfoutput>
      <cfoutput query="feedResult.myQuery">
        <p><a href="#RSSLINK#">#TITLE#</a></p>
      </cfoutput>
    </cfif>
  </cfloop>
</cfif>

<!--- The form for entering the feeds to aggregate. --->
<form>
  <h3>Enter three RSS Feeds</h3>
  <cfinput type="text" size="100" name="Feed1" validate="url" value="http://rss.adobe.com/events.rss?locale=en"><br />
  <cfinput type="text" size="100" name="Feed2" validate="url" value="http://weblogs.macromedia.com/dev_center/index.rdf"><br />
  <cfinput type="text" size="100" name="Feed3" validate="url" value="http://rss.adobe.com/studio.rss?locale=en"><br />
  <cfinput type="submit" name="submit">
</form>
```
Chapter 18: Securing Applications

Resource security (ColdFusion Standard) or sandbox security (ColdFusion Enterprise) restricts access to specific resources, such as tags and files. You use the ColdFusion Administrator to configure sandbox or resource security, and structure an application to take advantage of this security.

User security depends on a user identity. You can implement user security in ColdFusion applications.

For detailed information on using Administrator-controlled security features, see Configuring and Administering ColdFusion.

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ColdFusion security features

ColdFusion provides scalable, granular security for building and deploying your ColdFusion applications.

ColdFusion provides the following types of security resources:

Development: ColdFusion Administrator is protected by a password. Additionally, you can specify a password for access to data sources from Dreamweaver. For more information on configuring Administrator security passwords, see the ColdFusion Administrator online Help.

CFML features: The CFML language includes specific features that you can use to enhance application security. These include the following features:

- The cfqueryparam tag This tag helps prevent users from injecting malicious SQL expressions. For more information on using this tag for database security, see “Enhancing security with cfqueryparam” on page 398.
- Scriptprotect setting This setting helps protect against cross-site scripting attacks. You can set this value with the ColdFusion Administrator Enable Global Script Protection setting, in the Application.cfc This.scriptprotect variable, or in the corresponding cfapplication tag scriptprotect attribute. For more information on this feature, see cfapplication in the CFML Reference. For information on Application.cfc see “Defining the application and its event handlers in Application.cfc” on page 224.
- Encryption and hashing functions The Encrypt, Decrypt, and Hash functions let you select a secure algorithm for encrypting and decrypting data or generating a hash “fingerprint.” You can select from among several secure algorithms that are supported by the underlying Java security mechanisms; for encryption, these include, AES, Blowfish, DES and Triple DES. For more information, see the Encrypt, Decrypt, and Hash, functions in the CFML Reference.
Data validation tools ColdFusion includes a variety of tools for validating form input and other data values, including ways to ensure that users do not submit malicious form data. For information on data validation see “Validating Data” on page 553; for specific information on security and validation, see “Security considerations” on page 556.

Resource/Sandbox: The ColdFusion Administrator can limit access to ColdFusion resources, including selected tags and functions, data sources, files, and host addresses. In the Standard Edition, you configure a single set of resource limitations that apply to all your ColdFusion applications.

In the Enterprise Edition, you can have multiple sandboxes, based on the location of your ColdFusion pages, each with its own set of resource limitations. You can confine applications to secure areas, thereby flexibly restricting the access that the application has to resources.

User: ColdFusion applications can require users to log in to use application pages. You can assign users to roles (sometimes called groups); ColdFusion pages can determine the logged-in user’s roles or ID and selectively determine what to do based on this information. User security is also called authentication and authorization security.

Note: You can also use the cfencode utility, located in the cf_root/bin directory, to obscure ColdFusion pages that you distribute. Although this technique cannot prevent persistent hackers from determining the contents of your pages, it does prevent inspection of the pages. The cfencode utility is not available on OS X.

About resource and sandbox security

ColdFusion provides two levels of resource-based security:

- ColdFusion Standard refers to its resource-based security as resource security. It lets you specify a single set of limitations on access to ColdFusion resources that apply to all ColdFusion applications.

- ColdFusion Enterprise refers to its resource-based security as sandbox security. Sandbox security is a superset of resource security. Sandbox security lets you create multiple sandboxes, each corresponding to a different directory. For each sandbox, you specify a set of resource limitations that apply to all ColdFusion pages in the sandbox directory and its subdirectories. If you create a sandbox that is a subdirectory of a sandbox, the subdirectory’s rules override the parent directory’s rules.

The ColdFusion Administrator Resource Security page (in Standard) and Sandbox Security page (in Enterprise) let you enable resource-based security. In ColdFusion Standard, the page lets you configure the resource settings that apply to all your ColdFusion applications. In ColdFusion Enterprise, the page lets you create sandboxes and configure the resource limitations for each sandbox individually.

Resource control

ColdFusion lets you control access to the following resources:
Sandbox security

In ColdFusion Enterprise, sandbox security lets you apply different sets of rules to different directory structures. You can use it to partition a shared hosting environment so that a number of applications with different purposes, and possibly different owners, run securely on a single server. When multiple applications share a host, you set up a separate directory structure for each application, and apply rules that let each application access only its own data sources and files.

Sandbox security also lets you structure and partition an application to reflect the access rights that are appropriate to different functional components. For example, if your application has both employee inquiry functions and HR functions that include creating, accessing, and modifying sensitive data, you could structure the application as follows:

- HR pages go in one directory with access rules that enable most activities.
- Employee pages go in another directory whose rules limit the files they can modify and the tags they can use.
- Pages required for both HR and employee functions go in a third directory with appropriate access rules.

About user security

User security lets your application use security rules to determine what it shows. It has two elements:

Authentication: Ensures that a valid user is logged-in, based on an ID and password provided by the user. ColdFusion (or, in some cases if you use web server authentication, the web server) maintains the user ID information while the user is logged-in.

Note: For more information on configuring resource and sandbox security, see Configuring and Administering ColdFusion and the ColdFusion Administrator online Help.
Authorization: Ensures that the logged-in user is allowed to use a page or perform an operation. Authorization is typically based on one or more roles (sometimes called groups) to which the user belongs. For example, in an employee database, all users could be members of either the employee role or the contractor role. They could also be members of roles that identify their department, position in the corporate hierarchy, or job description. For example, someone could be a member of some or all of the following roles:

- Employees
- Human Resources
- Benefits
- Managers

Roles enable you to control access in your application resources without requiring the application to maintain knowledge about individual users. For example, suppose you use ColdFusion for your company’s intranet. The Human Resources department maintains a page on the intranet on which all employees can access timely information about the company, such as the latest company policies, upcoming events, and job postings. You want everyone to be able to read the information, but you want only certain authorized Human Resources employees to be able to add, update, or delete information.

Your application gets the user’s roles from the user information data store when the user logs in, and then enables access to specific pages or features based on the roles. Typically, you store user information in a database, LDAP directory, or other secure information store.

You can also use the user ID for authorization. For example, you might want to let employees view customized information about their salaries, job levels, and performance reviews. You certainly would not want one employee to view sensitive information about another employee, but you would want managers to be able to see, and possibly update, information about their direct reports. By employing both user IDs and roles, you can ensure that only the appropriate people can access or work with sensitive data.

The following image shows a typical flow of control for user authentication and authorization. Following sections expand on this diagram to describe how you implement user security in ColdFusion.
Authenticating users

You can use either, or both, of the following forms of authentication to secure your ColdFusion application:

- Web server authentication, where the web server authenticates the user and does not allow access to the website by users without valid login IDs
- Application authentication, where the ColdFusion application authenticates the user and does not allow access to the application by users without valid login IDs

About web server authentication

All major web servers support basic HTTP authentication. Some web servers also support other authentication methods, including Digest HTTP authentication and Microsoft NTLM authentication.
Note: Dreamweaver and Studio MX do not support NTLM security with RDS. Therefore, you cannot use RDS with these applications if the ColdFusion RDS servlet (cf_root/CFIDE/main/ide.cfm) is in a directory that is protected using NTLM security.

In web server authentication, the web server requires the user to log in to access pages in a particular directory, as follows:

1. When the user first requests a page in the secured directory, the web server notifies the browser that the requested page requires credentials (a user ID and password).
   
   Basic HTTP authentication sends the user ID and password in a base64-encoded string with each request. Use SSL (Secure Sockets Layer) for all page transactions, to protect the user ID and password from unauthorized access. For more information on SSL and the keytool utility, see “About LDAP Server Security” on page 458.

2. The browser prompts the user for the credentials.

3. The user supplies the credentials and the browser send the information back to the web server along with the original request.

4. The web server checks the user ID and password, using its own user authentication mechanism.

5. If the user logs in successfully, the browser caches the authentication information and sends it in an HTTP Authorization header with every subsequent page request from the user.

6. The web server processes the requested page and all future page requests from the browser that contain the HTTP Authorization header, if it is valid for the requested page.

You can use web server authentication without using any ColdFusion security features. In this case, you configure and manage all user security through the web server's interfaces.

You can also use web server authentication with ColdFusion application authentication, and thus you can use ColdFusion security for authorization. If the web server uses basic HTML authentication, the ColdFusion cflogin tag provides access to the user ID and password that the user entered to log in to the web server. If the web server uses Digest or NTLM authentication, the cflogin tag normally gets the user ID, but not the password.

As a result, your application can rely on the web server to authenticate the user against its user and password information, and does not have to display a login page. You use the cflogin and cfloginuser tags to log the user into the ColdFusion user security system, and use the IsUserInAnyRole and GetAuthUser functions to ensure user authorization. For more information on this form of security, see “A web server authentication security scenario” on page 322.

Note: If a user has logged in using web server authentication and has not logged in using ColdFusion application authentication, the GetAuthUser tag returns the web server user ID. You could use this feature to combine web server authentication with application authentication based on the user’s ID.

About application authentication

With application authentication, you do not rely on the web server to enforce application security. The application performs all user authentication and authorization. The application displays a login page, checks the user's identity and login against its own authorization store, such as an LDAP directory or database, and logs the user into ColdFusion using the cfloginuser tag. The application can then use the IsUserInAnyRole and GetAuthUser functions to check the user's roles or identity for authorization before running a ColdFusion page or specific code on a page. For an example of application authentication use, see “An application authentication security scenario” on page 322.
ColdFusion authentication storage and persistence
How ColdFusion application authentication information is maintained by the browser and ColdFusion, and therefore how long it is available, depends on the following:

- Whether the user's browser enables cookies
- Whether the application supports the Session scope for login storage

**Note:** For detailed information on Session scope, see "Configuring and using session variables" on page 282. Cookie scope contains the cookies that are sent by the browser; for more information on using cookies, see *cfcookie* in the CFML Reference.

Authentication and cookies
Because HTTP is connectionless, a login can last beyond a single web page viewing only if the browser provides a unique identifier that software on the server can use to confirm that the current user is authenticated. Normally, this is done by using memory-only cookies that are automatically destroyed when the user closes all open browser windows. The specific cookies and how they are used depend on whether the application supports the Session scope for login storage.

**Note:** For information on user logins without cookies, see "Using ColdFusion security without cookies" on page 317.

Using the Session scope
If you do the following, ColdFusion maintains login information in the Session scope instead of the Cookie scope:

- Enable the Session scope in the ColdFusion Administrator and the Application.cfc initialization code or *cfapplication* tag.
- Specify `loginStorage="Session"` in the Application.cfc initialization code or *cfapplication* tag.

When ColdFusion maintains login information in the Session scope, it stores the authentication details in a Session.cfauthorization variable, and ColdFusion uses the session cookie information to identify the user. Session-based authentication has the following advantages over less persistent login storage:

- After the user logs in, the user ID and password are not passed between the server and the browser.
- The login information and the session share a single time-out. There is no need to manually synchronize sessions and logins.
- If you use server clusters, the Session scope login ID can be available across the cluster. For more information on server clustering, see *Configuring and Administering ColdFusion*.

If you do not enable the Session scope, the authentication information is not kept in a persistent scope. Instead, the detailed login information is put in a memory-only cookie (`CFAUTHORIZATION_applicationName`) with a base64-encoded string that contains the user name, password, and application name. The client sends this cookie to the web server each time it makes a page request while the user is logged-in. Use SSL for all page transactions to protect the user ID and password from unauthorized access.

Using ColdFusion security without cookies
You can implement a limited-lifetime form of ColdFusion security if the user’s browser does not support cookies. In this case you do not use the *cflogin* tag, only the *cfloginuser* tag. It is the only time you should use the *cfloginuser* tag outside a *cflogin* tag.

Without browser cookies, the effect of the *cfloginuser* tag is limited to a single HTTP request. You must provide your own authentication mechanism and call *cfloginuser* on each page on which you use ColdFusion login identification.
Using ColdFusion security tags and functions

ColdFusion provides the following tags and functions for user security:

<table>
<thead>
<tr>
<th>Tag or function</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>cflogin</td>
<td>A container for user authentication and login code. The body of the tag runs only if the user is not logged in. When using application-based security, you put code in the body of the cflogin tag to check the user-provided ID and password against a data source, LDAP directory, or other repository of login identification. The body of the tag includes a cffunction or a ColdFusion page that contains a cfloginuser tag to establish the authenticated user's identity in ColdFusion.</td>
</tr>
<tr>
<td>cfloginuser</td>
<td>Identifies (logs in) a user to ColdFusion. Specifies the user's ID, password, and roles. This tag is typically used inside a cflogin tag. The cfloginuser tag requires three attributes, name, password, and roles, and does not have a body. The roles attribute is a comma-delimited list of role identifiers to which the logged-in user belongs. All spaces in the list are treated as part of the role names, so you should not follow commas with spaces. While the user is logged-in to ColdFusion, security functions can access the user ID and role information.</td>
</tr>
<tr>
<td>cflogout</td>
<td>Logs out the current user. Removes knowledge of the user ID and roles from the server. If you do not use this tag, the user is automatically logged out as described in “Logging out users” on page 321. The cflogout tag does not take any attributes, and does not have a body.</td>
</tr>
<tr>
<td>cfNTauthenticate</td>
<td>Authenticates a user name and password against the NT domain on which ColdFusion server is running, and optionally retrieves the user's groups.</td>
</tr>
<tr>
<td>cffunction</td>
<td>If you include a roles attribute, the function executes only when there is a logged-in user who belongs to one of the specified roles.</td>
</tr>
<tr>
<td>IsUserInAnyRole</td>
<td>Returns True if the current user is a member of the specified role.</td>
</tr>
<tr>
<td>GetAuthUser</td>
<td>Returns the ID of the currently logged-in user. This tag first checks for a login made with cfloginuser tag. If none exists, it checks for a web server login (cgi.remote_user).</td>
</tr>
</tbody>
</table>

Using the cflogin tag

The cflogin tag executes only if there is no currently logged-in user. It has the following three optional arguments that control the characteristics of a ColdFusion login:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>idleTimeout</td>
<td>If no page requests occur during the idleTimeout period, ColdFusion logs out the user. The default is 1800 seconds (30 minutes). This is ignored if login information is stored in the Session scope.</td>
</tr>
<tr>
<td>applicationToken</td>
<td>Limits the login validity to a specific application as specified by a ColdFusion page's cfapplication tag. The default value is the current application name.</td>
</tr>
<tr>
<td>cookieDomain</td>
<td>Specifies the domain of the cookie used to mark a user as logged-in. You use cookieDomain if you have a clustered environment (for example, x.acme.com, x2.acme.com, and so on). This lets the cookie work for all the computers in the cluster.</td>
</tr>
</tbody>
</table>
Login identification scope and the applicationToken attribute
The login identification created by the cflogin tag is valid only for pages within the directory that contains the page that uses the cflogin tag and any of its subdirectories. Therefore, if a user requests a page in another directory tree, the current login credentials are not valid for accessing those pages. This security limitation lets you use the same user names and passwords for different sections of your application (for example, a UserFunctions tree and a SecurityFunctions tree) and enforce different roles to the users depending on the section.

ColdFusion uses the applicationToken value to generate a unique identifier that enforces this rule. The default applicationToken value is the current application name, as specified by a cfapplication tag or Application.cfc unitization code. In normal use, you do not need to specify an applicationToken value in the cflogin tag.

Specifying the Internet domain
Use the cookieDomain attribute to specify the domain of the cookie used to mark a user as logged-in. You use cookieDomain if you have a clustered environment (for example, www.acme.com, www2.acme.com, and so on). This lets the cookie work for all computers in the cluster. For example, to ensure that the cookie works for all servers in the acme.com domain, specify cookieDomain=".acme.com". To specify a domain name, start the name with a period.

Important: Before setting the cookie domain, consider the other applications or servers in the broader domain might have access to the cookie. For example, a clustered payroll application at payroll1.acme.com, payroll2.acme.com, and so on, might reveal sensitive information to the test computer at test.acme.com, if the cookie domain is broadly set to .acme.com.

Getting the user ID and password
The cflogin tag has a built-in cflogin structure that contains two variables, cflogin.username and cflogin.password, if the page is executing in response to any of the following:

- Submission of a login form that contains input fields with the names j_username and j_password.
- A request that uses HTTP Basic authentication and, therefore, includes an Authorization header with the user name and password.
- A message from the Flash Remoting gatewayConnection object that has the setCredentials method set.
- A request that uses NTLM or Digest authentication. In this case, the user name and password are hashed using a one-way algorithm before they are put in the Authorization header; ColdFusion gets the user name from the web server and sets the cflogin.password value to the empty string.

You use the first three techniques with application authentication, and the last technique with web server authentication. The cflogin structure provides a consistent interface for determining the user’s login ID and password, independent of the technique that you use for displaying the login form.

Important: Login forms send the user name and password without encryption. Basic HTTP authentication sends the user name and password in a base64-encoded string with each request; this format can easily be converted back to plain text. Use these techniques only with https requests, or when you are not concerned about password security.

The following sections describe how you provide login information to your application for authentication

Using a login form to get user information
When you build an application that gets the User ID and password using a login form, the cflogin tag checks for the existence of a cflogin structure containing the user's login information. If the structure does not exist, it displays a login form, typically using a cfinclude tag on a login page; the following code shows this use.
In the Application.cfc `onRequestStart` method, or a ColdFusion page or CFC method called by the method, you have the following:

```cfml
<cflogin>
  <cfif NOT IsDefined("cflogin")>
    <cfinclude template="loginform.cfm">
  </cfif>
  <cfabort>
  <cfelse>
    <!--- Code to authenticate the user based on the cflogin.user and cflogin.password values goes here. --->
    <!--- If User is authenticated, determine any roles and use a line like the following to log in the user. --->
    <cfloginuser name="#cflogin.name#" Password="#cflogin.password#" roles="#loginQuery.Roles#">
  </cfelse>
</cflogin>
```

A simple login form looks like the following:

```cfml
<cfform name="loginform" action="#CGI.script_name?#CGI.query_string#" method="Post">
<table>
<tr>
  <td>user name:</td>
  <td><cfinput type="text" name="j_username" required="yes" message="A user name is required"></td>
</tr>
<tr>
  <td>password:</td>
  <td><cfinput type="password" name="j_password" required="yes" message="A password is required"></td>
</tr>
</table>
<br>
<input type="submit" value="Log In">
</cfform>
```

### Using a browser dialog box to get user information

Application authentication does not require you to use a login form; you can rely on the browser to display its standard login dialog box, instead. To do so, your `cflogin` tag body returns an HTTP status 401 to the browser if the user is not logged in or if the login fails; that is, if it does not have a valid `cflogin` structure. The browser displays its login dialog box. When the user clicks the login button on the dialog box, the browser returns the login information as an HTTP Authorization header to ColdFusion, which puts the information in the `cflogin` tag's `cflogin` structure.

This technique has the advantage of simplicity; you do not need a login form and the user gets a familiar-looking login page. You must be careful of security issues, however. The browser sends the user name and password in a base64-encoded string, not just when the user logs in, but with each request. Use SSL (Secure Sockets Layer) for all page transactions to protect the user ID and password from unauthorized access.

**Note:** You must ensure that your web server is configured correctly to support browser-based login forms for this use. For example, in IIS 5, you must enable anonymous access and might have to disable Basic authentication and Integrated Windows authentication.

The following `cflogin` tag tells the browser to display a login form if the user has not logged in:

```cfml
<cflogin>
  <cfif NOT IsDefined("cflogin")>
    <cfheader statuscode="401">
```
<cfheader name="www-Authenticate" value="Basic
realm=""MM Wizard #args.authtype# Authentication"">
</cfif>
<cfabort>
<cfelse>
<!--- code to authenticate the user based on the cflogin.user and
    cflogin.password values goes here. --->
</cflogin>

Logging in a user using Flash Remoting

If you are developing a Rich Internet Application with Flash and Flash Remoting, your ColdFusion application does not need to be coded specially for a Flash login. The Flash Remoting gateway makes the user ID and password available to the cflogin tag in the cflogin structure.

In your Flash code, you use the ActionScript SetCredentials method to send login information to ColdFusion. Your Flash SWF file displays the user ID and password fields, and uses their contents in the setCredentials method, as follows:

```java
if (inited == null)
{
    inited = true;
    NetServices.setDefaultGatewayUrl("http://localhost/flashservices/gateway");
    gatewayConnection = NetServices.createGatewayConnection();
    gatewayConnection.setCredentials(userID, password);
    myService = gatewayConnection.getService("securityTest.thecfc", this);
}
```

For more information on using Flash Remoting, see “Using the Flash Remoting Service” on page 674 and “Using Flash Remoting Update” on page 688.

Logging out users

After a user logs in, the ColdFusion user authorization and authentication information remains valid until any of the following happens:

- The application uses a cflogout tag to log out the user, usually in response to the user clicking a log-out link or button.
- If your application uses the Session scope for login information, the session ends.
- If your application does not use the Session scope for login information, the user does not request a new page for the cflogin tag idleTimeout period.
- If your application does not use Session scope for login information, or if you use J2EE-based session identification, the user closes all browser windows.

Logging a user out by using the cflogout tag does not close the user’s session, but if you use session login storage, it does remove the login information (the Session.cfauthorization variable) from the Session scope. For more information on ending sessions, see “Ending a session” on page 286.

**Important:** If you use web server–based authentication or any form authentication that uses a Basic HTTP Authorization header, the browser continues to send the authentication information to your application until the user closes the browser, or in some cases, all open browser windows. As a result, after the user logs out and your application uses the cflogout tag, until the browser closes, the cflogin structure in the cflogin tag will contain the logged-out user’s UserID and password. If a user logs out and does not close the browser, another user might access pages with the first user’s login.
Security scenarios

The following sections provide two detailed security scenarios. The first scenario uses the web server to perform the authentication against its user and password database. The second scenario uses ColdFusion for all authentication and authorization.

A web server authentication security scenario

An application that uses web server authentication might work as follows. The example in “Web server–based authentication user security example” on page 326 implements this scenario.

1 When the user requests a page from a particular directory on the server for the first time after starting the browser, the web server displays a login page and logs in the user. The web server handles all user authentication.

2 Because the user requested a ColdFusion page, the web server hands the request to ColdFusion.

3 When ColdFusion receives a request for a ColdFusion page, it instantiates the Application.cfc and runs onRequestStart method. If you use an Application.cfm page in place of the Application.cfc, it runs the contents of the Application.cfm page before it runs the requested page. The onRequestStart method or Application.cfm page contains a cflogin tag. ColdFusion executes the cflogin tag body if the user is not logged into ColdFusion. The user is logged in if the cfloginuser tag has run successfully for this application and the user has not been logged out.

4 Code in the cflogin tag body uses the user ID and password from the browser login, contained in the cflogin.name and cflogin.password variables, as follows. (With Digest or NTLM web server authentication, the cflogin.password variable is the empty string.)

   a It checks the user's name against information it maintains about users and roles. In a simple case, the application might have two roles, one for users and one for administrators. The CFML assigns the Admin role to any user logged on with the user ID Admin and assigns the User role to all other users.

   b It calls the cfloginuser tag with the user's ID, password, and roles, to identify the user to ColdFusion.

5 Application.cfc or the Application.cfm page completes processing, and ColdFusion processes the requested application page.

6 The application uses the IsUserInAnyRole function to check whether the user belongs to a role before it runs protected code that must be available only to users in that role.

7 The application can use the GetAuthUser function to determine the user ID; for example, to display the ID for personalization. It can also use the ID as a database key to get user-specific data.

Important: If you use web server–based authentication or any form authentication that uses a Basic HTTP Authentication header, the browser continues to send the authentication information to your application until the user closes the browser, or in some cases, all open browser windows. As a result, after the user logs out and your application uses the cflogout tag, until the browser closes, the cflogin structure in the cflogin tag will contain the logged-out user's UserID and password. If a user logs out and does not close the browser, another user might access pages with the first user's login.

An application authentication security scenario

An application that does its own authentication might work as follows. The example in "Application-based user security example" on page 328 implements this scenario.
Whenever ColdFusion receives a request for a ColdFusion page, it instantiates the Application.cfc and runs the `onRequestStart` method. If you use an Application.cfm page in place of Application.cfc, ColdFusion runs the contents of the Application.cfm page before it runs the requested page. The `onRequestStart` method or Application.cfm page contains the `cflogin` tag. ColdFusion executes the `cflogin` tag body if the user is not logged in. A user is logged in if the `cfloginuser` tag has run during the current session and the user had not been logged out by a `cflogout` tag.

Code in the `cflogin` tag body checks to see if it has received a user ID and password, normally from a login form.

If there is no user ID or password, the code in the `cflogin` tag body displays a login form that asks for the user's ID and password.

The form posts the login information back to the originally requested page, and the `cflogin` tag in the `onRequestStart` method or the Application.cfm page runs again. This time, the `cflogin` tag body code checks the user name and password against a database, LDAP directory, or other policy store, to ensure that the user is valid and get the user's roles.

If the user name and password are valid, the `cflogin` tag body code calls the `cfloginuser` tag with the user's ID, password, and roles, to identify the user to ColdFusion.

When the user is logged in, application pages use the `IsUserInAnyRole` function to check whether the user belongs to a role before they run protected code that must be available only to users in that role.

The application can use the `GetAuthUser` function to determine the user ID; for example, to display the ID for personalization. It can also use the ID as a database key to get user-specific data.

Each application page displays a link to a logout form that uses the `cflogout` tag to log out the user. Typically, the logout link is in a page header that appears in all pages. The logout form can also be in the Application.cfc (for example, in the `onRequestStart` or `onRequestEnd` method) or on the Application.cfm page.

Although this scenario shows one method for implementing user security, it is only an example. For example, your application could require users to log in for only some pages, such as pages in a folder that contains administrative functions. When you design your user security implementation, remember the following:

- Code in the `cflogin` tag body executes only if there is no user logged in.
- With application authentication, you write the code that gets the identification from the user and tests this information against a secure credential store.
- After you have authenticated the user, you use the `cfloginuser` tag to log the user into ColdFusion.

The following image shows this flow of control. For simplicity, it omits the log-out option.
Implementing user security

The following sections provide several examples of ways to implement security.

Using the Dreamweaver Login Wizard
ColdFusion installs a Login Wizard command in the Dreamweaver Commands menu that generates a skeleton set of pages for managing user authentication and authorization.

The wizard asks you to select how to authenticate the login information. You can select one of the following options:

- **Simple** You specify a single user ID and password in the wizard. All users must enter this information to log in. You can use this option for testing, or you can use the generated files as a template where you can replace the authentication code with more complex code; for example, to verify the ID and password against a database.

- **NT domain** You specify an NT domain in the wizard, and the wizard generates code that queries the domain.

- **LDAP** You specify the LDAP server and port, the user name and password required to access the login data, and the distinguished name to use to start the search for the user name. The wizard generates the code to query the LDAP server with the user ID and password.

The wizard asks you to select one of the following options for displaying the request for login information:

- **Browser Dialog Box**
- **ColdFusion Login Form**

Structure code generated by the Login Wizard
The wizard generates or modifies the following files in the directory or site that you specify:
**Application.cfc:** If this file does not exist, the wizard creates it with a single `onRequestStart` method; it does not specify an application name or any other methods. If the file exists, but does not have an `onRequestStart` method, it adds the method. If Application.cfc and the `onRequestStart` method exist, the wizard inserts the required code at the beginning of the method. The resulting `onRequestStart` method has a `cfinclude` tag that specifies `mm_wizard_application_include.cfm`; it also has a simple form with a logout button, which will display at the top of each page in the application.

*Note:* If the wizard creates the Application.cfc file, you should, at least, change the file to specify the application name. For more information on Application.cfc, see "Designing and Optimizing a ColdFusion Application" on page 218.

**mm_wizard_application_include.cfm:** The Login Wizard uses the information specified in the wizard fields to set several CFC method arguments. It then uses them to invoke the performlogin method of the master login CFC, `mm_wizard.authenticate`.

**mm_wizard_authenticate.cfc:** This CFC contains all of the user authentication and login logic. The CFC consists of the following methods:

- The `ntauth`, `ldapauth`, and `simpleauth` authentication methods check the user's name and ID against the valid login information, and return information about whether the user is authenticated. For the details of how they authenticate the user and the specific return values, see the methods.
- The `performLogin` method is the master login method. It contains the `cflogin` tag, which displays the login form and calls the required authentication method. If the authentication method's return argument indicates a valid user, the method logs the user in.
- The `logout` method logs a user out. If you specified Browser Dialog Box as the login page type, it also calls the `closeBrowser` method to close the browser window. This behavior is necessary because the browser continues to send the old login credentials after the user logs out, and the `cflogin` tag will automatically use them and log the user in again.
- The `closeBrowser` method closes the browser window or tells the user to close the browser window to complete the logout, depending on the browser type.

**mm_wizard_login.cfm:** This file contains a ColdFusion login form. The wizard generates this file for all options, but does not use it if you specify Browser Dialog login.

**index.cfm or mm_wizard_index.cfm:** The wizard generates an index.cfm page if the directory does not have one; otherwise, creates an `mm_wizard_index.cfm` page. These pages let you test the generated login code before you implement your application, or without using any of your standard application pages. To test your login, open the index.cfm page in your browser.

**Modifying the login code for your application**

The Login Wizard creates a basic framework for authenticating a user. You must customize this framework to meet your application's needs. Typical security-related changes include the following:

- Providing user-specific role information in the `cflogin` tag
- Authenticating users against a database

**Providing user-specific role information**

The Login Wizard sets all users in a single role. In `mm_wizard_authenticate.cfc`, the `performlogin` method is hard-coded to set the role to "user." The authentication routines handle roles differently. (For the details, see the `mm_wizard_authenticate.cfc` code.) If your application uses roles for authorization, you must change the authentication method to get and return valid role information, and change the `performlogin` method to use the information in the `roles` attribute of its `cfloginuser` tag.
Authenticating users against a database

If you use a database to maintain user IDs and passwords, you can create your login framework by specifying simple authentication, and modify the code to use the database. The following instructions describe a simple way to change the code to use a database. They do not include all the cleanup work (particularly, removing the hard-coded user name and password), that you should do for a well-formatted application.

Replace the following code:

```cfscript
<cfif sUserName eq uUserName AND sPassword eq uPassword>
    <cfset retargs.authenticated="YES">
<cfelse>
    <cfset retargs.authenticated="NO">
</cfif>
<cfreturn retargs>
```

With code similar to the following:

```cfscript
<cfquery name="loginQuery" dataSource="#Application.DB#" >
    SELECT *
    FROM Users
    WHERE UserName = <cfqueryparam value="#uUserName#" CFSEQLType= 'CF_SQL_VARCHAR' AND password = <cfqueryparam value="#uPassword#" CFSEQLType= 'CF_SQL_VARCHAR'>
</cfquery>

<cfif loginQuery.recordcount gt 0>
    <cfset retargs.authenticated="YES">
    <cfset retargs.roles=loginQuery.roles>
<cfelse>
    <cfset retargs.authenticated="NO">
</cfif>
<cfreturn retargs>
```

Note: For greater security, consider using a hashed password. Do not store the password directly in the database; instead, use the `Hash` function to create a secure password fingerprint, and store it in the database. When the user provides a password, use the `Hash` function on the submitted string and compare it with the value in the database.

Web server–based authentication user security example

The example in this section shows how you might implement user security using web-server–based basic authentication and two roles, user and administrator.

This example has two ColdFusion pages:

1. The Application.cfc page logs the user into the ColdFusion security system and assigns the user to specific roles based on the user's ID.

   This page also includes the one-button form and logic for logging out a user, which appears at the top of each page.

2. The securitytest.cfm page is a sample application page. It displays the logged-in user's roles.

This simple example does not provide a user log-out interface. You can test the security behavior by adding your own pages to the same directory as the Application.cfc page.

Example: Application.cfc

The Application.cfc page consists of the following:

```cfcomponent>
```
<cfset This.name = "Orders">
<cffunction name="OnRequestStart">
    <cfargument name = "request" required="true" />
    <cflogin>
        <cfif IsDefined("cflogin")>
            <cfif cflogin.name eq "admin">
                <cfset roles = "user,admin">
            </cfifelse>
            <cfset roles = "user">
        </cfif>
        <cfloginuser name = "#cflogin.name#" password = "#cflogin.password#"
            roles = "#roles#" />
    </cfifelse>
    <!--- This should never happen. --->
    <h4>Authentication data is missing.</h4>
    Try to reload the page or contact the site administrator.
    <cfabort>
    </cfif>
</cflogin>
</cffunction>
</cfcomponent>

Reviewing the code
The Application.cfc onRequestStart method executes before the code in each ColdFusion page in an application. For more information on the Application.cfc page and when it is executed, see “Designing and Optimizing a ColdFusion Application” on page 218.

The following table describes the CFML code in Application.cfc and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfset This.name = &quot;Orders&quot;&gt;</td>
<td>Identifies the application and starts the onRequestStart method that runs at the starts of each request. The login information on this page only applies to this application.</td>
</tr>
<tr>
<td>&lt;cffunction name=&quot;OnRequestStart&quot;&gt;</td>
<td>Execute if there is no logged-in user.</td>
</tr>
<tr>
<td>&lt;cfargument name = &quot;request&quot; required=&quot;true&quot; /&gt;</td>
<td>Makes sure the user is correctly logged in by the web server. (Otherwise, there would be no cflogin variable.)</td>
</tr>
<tr>
<td>&lt;cflogin&gt;</td>
<td>Sets a roles variable based on the user's ID. Assigns users named &quot;admin&quot; to the admin role. Assigns all other users to the users role.</td>
</tr>
</tbody>
</table>
| <cfloginuser name = "#cflogin.name#" password = "#cflogin.password#"
    roles = "#roles#" />                                            | Logs the user into the ColdFusion security system and specifies the user's password, name, and roles. Gets the password and name directly from the cflogin structure. |
| <cfelse>                                                           | This code should never run, but if the user somehow got to this page without logging in to the web server, this message would display and ColdFusion would stop processing the request. |
| <!--- This should never happen. --->
| <h4>Authentication data is missing.</h4>
| Try to reload the page or contact the site administrator.          |                                                                                                       |
| <cfabort>                                                           |                                                                                                       |
| </cfif>                                                             |                                                                                                       |
| </cflogin>                                                          |                                                                                                       |
| </cffunction>                                                      |                                                                                                       |
| </cfcomponent>                                                     |                                                                                                       |

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>End the if/else block.</td>
<td></td>
</tr>
<tr>
<td>End the cflogin tag body.</td>
<td></td>
</tr>
<tr>
<td>End the onRequestStart method.</td>
<td></td>
</tr>
<tr>
<td>End the Application component.</td>
<td></td>
</tr>
</tbody>
</table>
Example: securitytest.cfm

The securitytest.cfm page shows how any application page can use ColdFusion user authorization features. The web server ensures the existence of an authenticated user, and the Application.cfc page ensures that the user is assigned to roles the page content appears. The securitytest.cfm page uses the IsUserInAnyRole and GetAuthUser functions to control the information that is displayed.

The securitytest.cfm page consists of the following:

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">
<html>
<head>
  <title>Basic authentication security test page</title>
</head>
<body>
<cfoutput>
<h2>Welcome #GetAuthUser()#!</h2>
</cfoutput>

ALL Logged-in Users see this message.<br>
<br>
<cfscript>
  if (IsUserInRole("admin"))
    WriteOutput("Users in the admin role see this message.<br><br>");
  if (IsUserInRole("user"))
    WriteOutput("Everyone in the user role sees this message.<br><br>");
</cfscript>
</body>
</html>
```

Reviewing the code

The following table describes the securitytest.cfm page CFML code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<cfoutput>`
  `<h2>Welcome #GetAuthUser()#!</h2>`
  `<cfoutput>` | User is already logged in by Application.cfc. Displays a welcome message that includes the user's login ID. |
| `ALL Logged-in Users see this message.<br>`
  `<br>` | Displays this message in all cases. The page does not display until a user is logged in. |
| `<cfscript>`
  `if (IsUserInRole("admin"))`
    `WriteOutput("Users in the admin role see this message.<br><br>");`
  `if (IsUserInRole("user"))`
    `WriteOutput("Everyone in the user role sees this message.<br><br>");`
  `<cfscript>` | Tests whether the user belongs to each of the valid roles. If the user is in a role, displays a message with the role name. The user sees one message per role to which the user belongs. |

Application-based user security example

The example in this section shows how you might implement user security by authenticating users and then allowing users to see or use only the resources that they are authorized to access.

This example has three ColdFusion pages:
• The Application.cfc page contains the authentication logic that checks whether a user is logged in, requests the login page if the user is not logged in, and authenticates the data from the login page. If the user is authenticated, it logs the user in.

This page also includes the one-button form and logic for logging out a user, which appears at the top of each page.

• The loginform.cfm page displays the login form. The code on this page could also be included in Application.cfc.

• The securitytest.cfm page is a sample application page. It displays the logged-in user's roles.

You can test the security behavior by adding your own pages to the same directory as the Application.cfc page.

The example gets user information from the LoginInfo table of the cfdocexamples database that is installed with ColdFusion. You can replace this database with any database containing UserID, Password, and Roles fields. The sample database contains the following data:

<table>
<thead>
<tr>
<th>UserID</th>
<th>Password</th>
<th>Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>BobZ</td>
<td>Ads10</td>
<td>Employee,Sales</td>
</tr>
<tr>
<td>JaniceF</td>
<td>Qwer12</td>
<td>Contractor,Documentation</td>
</tr>
<tr>
<td>RandalQ</td>
<td>ImMe</td>
<td>Employee,Human Resources,Manager</td>
</tr>
</tbody>
</table>

Because spaces are meaningful in roles strings, you should not follow the comma separators in the Roles fields with spaces.

**Example: Application.cfc**

The Application.cfc page consists of the following:

```coldfusion
<cfcomponent>
<cfset This.name = "Orders">
<cfset This.Sessionmanagement="True">
<cfset This.loginstorage="session">

<cffunction name="OnRequestStart">
  <cfargument name = "request" required="true"/>
  <cfif IsDefined("Form.logout")>
    <cflogout>
  </cfif>
  <cflogin>
  <cfif NOT IsDefined("cflogin")>
    <cfinclude template="loginform.cfm">
    <cfabort>
  <cfelse>
    <cfif cflogin.name IS "" OR cflogin.password IS ">
      <cfoutput>
        <h2>You must enter text in both the User Name and Password fields.</h2>
      </cfoutput>
    </cfif>
    <cfquery name="loginQuery" dataSource="cfdocexamples">
      SELECT UserID, Roles
      FROM LoginInfo
      WHERE UserID = '#cflogin.name#'
    </cfquery>
    <cfinclude template="loginform.cfm">
    <cfabort>
  <cfelse>
    <cfquery name="loginQuery" dataSource="cfdocexamples">
      SELECT UserID, Roles
      FROM LoginInfo
      WHERE UserID = '#cflogin.name#'
    </cfquery>
    <cfinclude template="loginform.cfm">
    <cfabort>
```
AND Password = '#cflogin.password#'
</cfquery>
<cfif loginQuery.Roles NEQ "">
  <cfloginuser name="#cflogin.name#" Password = '#cflogin.password#" roles="#loginQuery.Roles#">
  <cfelse>
    <cfoutput>
      <H2>Your login information is not valid.<br>Please Try again</H2>
      <cfinclude template="loginform.cfm">
      <cfabort>
    </cfif>
    </cfif>
  </cfif>
</cflogin>

<cfif GetAuthUser() NEQ "">
  <cfoutput>
    <form action="securitytest.cfm" method="Post">
      <input type="submit" Name="Logout" value="Logout">
    </form>
  </cfoutput>
</cfif>
</cffunction>
</cfcomponent>

**Reviewing the code**

The Application.cfc page executes before the code in each ColdFusion page in an application. For more information on the Application.cfc page and when it is executed, see “Designing and Optimizing a ColdFusion Application” on page 218.

The following table describes the CFML code in Application.cfc and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfcomponent&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;cfset This.name = &quot;Orders&quot;&gt;</td>
<td>Identifies the application, enables session management, and enables storing login information in the Session scope.</td>
</tr>
<tr>
<td>&lt;cfset This.Sessionmanagement=&quot;True&quot;&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;cffunction name=&quot;OnRequestStart&quot;&gt;</td>
<td>Begins the definition of the onRequestStart method that runs at the starts of each request.</td>
</tr>
<tr>
<td>&lt;cfargument name = &quot;request&quot; required=&quot;true&quot;/&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;cfif IsDefined(&quot;Form.logout&quot;)&gt;</td>
<td>If the user just submitted the logout form, logs out the user. The following cflogin tag runs as a result.</td>
</tr>
<tr>
<td>&lt;cflogin&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;cfif NOT IsDefined(&quot;cflogin&quot;)&gt;</td>
<td>Executes if there is no logged-in user.</td>
</tr>
<tr>
<td>&lt;cfinclude template=&quot;loginform.cfm&quot;&gt;</td>
<td>Tests to see if the user has submitted a login form. If not, uses cfinclude to display the form. The built-in cflogin variable exists and contains the user name and password only if the login form used j_username and j_password for the input fields.</td>
</tr>
<tr>
<td>&lt;cfabort&gt;</td>
<td>The cfabort tag prevents processing of any code that follows on this page.</td>
</tr>
</tbody>
</table>
Example: loginform.cfm

The loginform.cfm page consists of the following:

```html
<H2>Please Log In</H2>
<form action="#CGI.script_name#?#CGI.query_string#" method="Post">
<table>
    <tr>
        <td>User name:</td>
        <td><input type="text" name="j_username"></td>
    </tr>
    <cfelse>
    <cfif cflogin.name IS "" OR cflogin.password IS "">
    <cfoutput>
    <H2>You must enter text in both the User Name and Password fields</H2>
    </cfoutput>
    <cfinclude template="loginform.cfm">
    <cfabort>
    End of login query.Roles test code.
    End of form entry empty value test.
    End of form entry existence test.
    End of cflogin tag body.
    </cfif>
    </cfelse>
    </cfif>
    </cfoutput>
</form>
</cffunction>
```
<td>password:</td>
<td><input type="password" name="j_password"></td>
</tr>
</table>
<br>
<input type="submit" value="Log In">
</form>
</cfoutput>

Reviewing the code
The following table describes the loginform.cfm page CFML code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;H2&gt;Please Log In&lt;/H2&gt; &lt;cfoutput&gt; &lt;form action=&quot;#CGI.script_name#?#CGI.query_string#&quot; method=&quot;Post&quot;&gt; &lt;table&gt; &lt;tr&gt; &lt;td&gt;user name:&lt;/td&gt; &lt;td&gt;&lt;input type=&quot;text&quot; name=&quot;j_username&quot;&gt;&lt;/td&gt; &lt;/tr&gt; &lt;tr&gt; &lt;td&gt;password:&lt;/td&gt; &lt;td&gt;&lt;input type=&quot;password&quot; name=&quot;j_password&quot;&gt;&lt;/td&gt; &lt;/tr&gt; &lt;br&gt; &lt;input type=&quot;submit&quot; value=&quot;Login&quot;&gt; &lt;/form&gt; &lt;/cfoutput&gt;</td>
<td>Displays the login form.</td>
</tr>
</tbody>
</table>

Constructs the form action attribute from CGI variables, with a ? character preceding the query string variable. This technique works because loginform.cfm is accessed by a cfinclude tag on Application.cfc, so the CGI variables are those for the originally requested page.

The form requests a user ID and password and posts the user's input to the page specified by the newurl variable.

Uses the field names j_username and j_password. ColdFusion automatically puts form fields with these values in the cflogin.name and cflogin.password variables inside the cflogin tag.

Example: securitytest.cfm
The securitytest.cfm page shows how any application page can use ColdFusion user authorization features. Application.cfc ensures the existence of an authenticated user before the page content appears. The securitytest.cfm page uses the IsUserInAnyRole and GetAuthUser functions to control the information that is displayed.

The securitytest.cfm page consists of the following:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">
<html>
<head>
  <title>Security test page</title>
</head>
<body>
  <cfoutput>
    <h2>Welcome #GetAuthUser()#!</h2>
    ALL Logged-in Users see this message.<br>
    <cfscript>
      if (IsUserInRole("Human Resources"))
        WriteOutput("Human Resources members see this message.<br>";
    </cfscript>
  </cfoutput>
</body>
</html>
```
if (IsUserInRole("Documentation"))
    WriteOutput("Documentation members see this message.<br><br>");
if (IsUserInRole("Sales"))
    WriteOutput("Sales members see this message.<br><br>");
if (IsUserInRole("Manager"))
    WriteOutput("Managers see this message.<br><br>");
if (IsUserInRole("Employee"))
    WriteOutput("Employees see this message.<br><br>");
if (IsUserInRole("Contractor"))
    WriteOutput("Contractors see this message.<br><br>");

</cfscript>

</body>
</html>

Reviewing the code
The following table describes the securitytest.cfm page CFML code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| <cfoutput>
<h2>Welcome #GetAuthUser()#!</h2>
</cfoutput> | Displays a welcome message that includes the user's login ID. |
| <cfscript>
  if (IsUserInRole("Human Resources"))
      WriteOutput("Human Resources members see this message.<br><br>");
  if (IsUserInRole("Documentation"))
      WriteOutput("Documentation members see this message.<br><br>");
  if (IsUserInRole("Sales"))
      WriteOutput("Sales members see this message.<br><br>");
  if (IsUserInRole("Manager"))
      WriteOutput("Managers see this message.<br><br>");
  if (IsUserInRole("Employee"))
      WriteOutput("Employees see this message.<br><br>");
  if (IsUserInRole("Contractor"))
      WriteOutput("Contractors see this message.<br><br>");
</cfscript> | Tests whether the user belongs to each of the valid roles. If the user is in a role, displays a message with the role name. The user sees one message per role to which he or she belongs. |

Using an LDAP directory for security information
LDAP directories are often used to store security information. The following example of a cflogin tag checks an LDAP directory to authenticate the user and retrieve the user's roles.

For more information on using LDAP directories with ColdFusion, see “Managing LDAP Directories” on page 434.

<cfapplication name="Orders" sessionmanagement="Yes" loginstorage="Session">
<cflogin>
  <cfif isDefined("cflogin")>
      <!--- setting basic attributes --->
      <cfset LDAP_root = "o=mycompany.com">
      <cfset LDAP_server = "ldap.mycompany.com">
      <cfset LDAP_port = "389">
      <!--- Create the prefix and suffix parts of the user's DN. --->
      <cfset userPrefix = "cn=">


<cfset userSuffix = ",ou=Users,o=mycompany.com">

<!--- Concatenate the user's DN and use it to authenticate. --->
<cfset LDAP_username = userPrefix&cflogin.name&userSuffix>

<!--- This filter will look for groups containing the user's ID. --->
<cfset userfilter = "(&(objectClass=groupOfUniqueNames)(uniqueMember=#LDAP_username#))">

<!--- Search for groups containing the user's DN. The groups represent the user's roles. NOTE: Your LDAP permissions must allow authenticated users to search. groups. --->
<cftry>
<cfldap action="QUERY"
    name="auth"
    attributes="cn"
    referral="yes"
    start="#LDAP_root#"
    scope="SUBTREE"
    server="#LDAP_server#"
    port="#LDAP_port#"
    filter="#userfilter#"
    username="#LDAP_username#"
    password="#cflogin.password#"
>
<cfcatch type="any">
    <cfif FindNoCase("Invalid credentials", cfcatch.detail)>
        <cfoutput>
            <script>alert("User ID or Password invalid for user: #cflogin.name#")</script>
        </cfoutput>
        <cfabort>
    <cfelse>
        <cfoutput>
            <script>alert("Unknown error for user: #cflogin.name# #cfcatch.detail#")</script>
        </cfoutput>
        <cfabort>
    </cfif>
</cfcatch>
</cftry>

<!--- If the LDAP query returned a record, the user is valid. --->
<cfif auth.recordcount>
    <cfloginuser name="#cflogin.name#" password="#cflogin.password#"
        roles="#valueList(auth.cn)#"/>
</cfif>
</cfif>
</cflogin>

**Reviewing the code**

The following table describes the code and its function. Comments and some tab characters have been removed for brevity.
### Code

```xml
<cflogin>
  <cfif isDefined("cflogin")>
    <!--- setting basic attributes --->
    <cfset LDAP_root = "o=mycompany.com">
    <cfset LDAP_server = "ldap.mycompany.com">
    <cfset LDAP_port = "389">
    <cfset userPrefix = "cn=" />
    <cfset userSuffix = ",ou=Users,o=mycompany.com">
    <cfset LDAP_username = userPrefix & cflogin.name & userSuffix>
    <cfset userfilter = "(&(objectClass=groupOfUniqueNames)
                   (uniqueMember=#LDAP_username#))">
    <cfldap action="QUERY" name="auth" attributes="cn"
            referral="yes" start="#LDAP_root#" scope="SUBTREE"
            server="#LDAP_server#" port="#LDAP_port#"
            username="#LDAP_username#"
            password="#cflogin.password#">
  <cftry>
    <cfldap action="QUERY" name="auth" attributes="cn"
            referral="yes" start="#LDAP_root#" scope="SUBTREE"
            server="#LDAP_server#" port="#LDAP_port#"
            username="#LDAP_username#"
            password="#cflogin.password#">
      <cfcatch type="any">
        <cfif FindNoCase("Invalid credentials",
                        cfcatch.detail)>
          <cfoutput>
            <script>alert("User ID or Password invalid for user:
                           #cflogin.name#")</script>
          </cfoutput>
          <cfabort>
        </cfif>
      </cfcatch>
    </cftry>
    <cfif auth.recordcount>
      <cfloginuser name="#cflogin.name#"
                   password="#cflogin.password#"
                   roles="#valueList(auth.cn)#">
      <cfif>
      </cfif>
      </cfif>
  </cfif>
</cflogin>
```

### Description

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cflogin&gt;</code></td>
<td>Starts the <code>cflogin</code> tag body. Sets several variables to the values used as attributes in the <code>cfldap</code> tag.</td>
</tr>
<tr>
<td><code>&lt;cfif isDefined(&quot;cflogin&quot;)&gt;</code></td>
<td>Sets prefix and suffix values used to create a distinguished name (dn) for binding to the LDAP server.</td>
</tr>
<tr>
<td><code>&lt;!--- setting basic attributes ---&gt;</code></td>
<td>Creates the user's bind dn by concatenating the prefix and suffix with <code>cflogin.name</code>. This variable is used for authenticating the user to the LDAP server.</td>
</tr>
<tr>
<td><code>&lt;cfset LDAP_root = &quot;o=mycompany.com&quot;&gt;</code></td>
<td>Sets the filter used to search the directory and retrieve the user's group memberships. The group membership represents the user's roles within the organization.</td>
</tr>
<tr>
<td><code>&lt;cfset LDAP_server = &quot;ldap.mycompany.com&quot;&gt;</code></td>
<td>In a <code>cftry</code> block, uses the user's concatenated dn to authenticate to the LDAP server and retrieve the common name (cn) attribute for groups to which the user is a member. If the authentication fails the LDAP server returns an error.</td>
</tr>
</tbody>
</table>
| `<cfset LDAP_port = "389">
    <cfset userPrefix = "cn=" />
    <cfset userSuffix = ",ou=Users,o=mycompany.com">
    <cfset LDAP_username = userPrefix & cflogin.name & userSuffix>` | Note: The LDAP permissions must allow an authenticated user to read and search groups in order for the query to return results. |
| `<cfset userfilter = "(&(objectClass=groupOfUniqueNames)
                   (uniqueMember=#LDAP_username#))">` | Catches any exceptions. |
| `<cfldap action="QUERY" name="auth" attributes="cn"
            referral="yes" start="#LDAP_root#" scope="SUBTREE"
            server="#LDAP_server#" port="#LDAP_port#"
            username="#LDAP_username#"
            password="#cflogin.password#">
      <cftry>` | Tests to see if the error information includes the string "invalid credentials", which indicates that either the dn or password is invalid. If so, displays a dialog box with an error message indicating the problem. |
| `<cfcatch type="any">
        <cfif FindNoCase("Invalid credentials",
                        cfcatch.detail)>
          <cfoutput>
            <script>alert("User ID or Password invalid for user:
                           #cflogin.name#")</script>
          </cfoutput>
          <cfabort>
        </cfif>` | Otherwise, displays a general error message. |
| `<cfelse>` | If an error is caught, the `cfabort` tag ends processing of the request after displaying the error description. |
| `<cfoutput>` | End of `cfcatch` and `cftry` blocks. |
| `<script>alert(">Unknown error for user:
                           #cflogin.name#")</script>` | If the authorization query returns a valid record, logs in the user. Uses the `valueList` function to create a comma-separated list of the users retrieved group memberships, and passes them in the `cfloginuser` roles attribute. |
| `<cfabort>` | Ends the initial `isDefined("cflogin")` `cfif` block. |
| `<cfif auth.recordcount>` | Ends the `cflogin` tag body. |
Chapter 19: Developing Globalized Applications

ColdFusion lets you develop dynamic applications for the Internet. Many ColdFusion applications are accessed by users from different countries and geographical areas. One design detail that you must consider is the globalization of your application so that you can best serve customers in different areas.

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Introduction to globalization

Globalization lets you create applications for all of your customers in all the languages that you support. In some cases, globalization can let you accept data input using a different character set than the one you used to implement your application. For example, you can create a website in English that lets customers submit form data in Japanese. Or, you can allow a request URL to contain parameter values entered in Korean.

Your application also can process data containing numeric values, dates, currencies, and times. Each of these types of data can be formatted differently for different countries and regions.

You can also develop applications in languages other than English. For example, you can develop your application in Japanese so that the default character encoding is Shift-JIS, your ColdFusion pages contain Japanese characters, and your interface displays in Japanese.

Globalizing your application requires that you perform one or more of the following actions:

• Accept input in more than one language.
• Process dates, times, currencies, and numbers formatted for multiple locales.
• Process data from a form, database, HTTP connection, e-mail message, or other input formatted in multiple character sets.
• Create ColdFusion pages containing text in languages other than English.

Defining globalization

You will probably find several different definitions for globalization. For this chapter, globalization is defined as an architectural process where you put as much application functionality as possible into a foundation that can be shared among multiple languages.

Globalization is composed of the following two parts:
**Internationalization:** Developing language-neutral application functionality that can recognize, process, and respond to data regardless of its representation. That is, whatever the application can do in one language, it can also do in another. For example, think of copying and pasting text. A copy and paste operation should not be concerned with the language of the text it operates on. For a ColdFusion application, you might have processing logic that performs numeric calculations, queries a database, or performs other operations, independent of language.

**Localization:** Taking shared, language-neutral functionality, and applying a locale-specific interface to it. Sometimes this interface is referred to as a skin. For example, you can develop a set of menus, buttons, and dialog boxes for a specific language, such as Japanese, that represents the language-specific interface. You then combine this interface with the language-neutral functionality of the underlying application. As part of localization, you create the functionality to handle input from customers in a language-specific manner and respond with appropriate responses for that language.

**Importance of globalization in ColdFusion applications**

The Internet has no country boundaries. Customers can access websites from anywhere in the world, at any time, or on any date. Unless you want to lock your customers into using a single language, such as English, to access your site, you should consider globalization issues.

One reason to globalize your applications is to avoid errors and confusion for your customers. For example, a date in the form 1/2/2003 is interpreted as January 2, 2003 in the United States, but as February 1, 2003 in European countries.

Another reason to globalize your applications is to display currencies in the correct format. Think of how your customers would feel when they find out the correct price for an item is 15,000 American dollars, not 15,000 Mexican pesos (about 1600 American dollars).

Your website can also accept customer feedback or some other form of text input. You might want to support that feedback in multiple languages using a variety of character sets.

**How ColdFusion supports globalization**

ColdFusion is implemented in Java. As a Java application, ColdFusion uses Java globalization features. For example, ColdFusion stores all strings internally using the Unicode character set. Because it uses Unicode, ColdFusion can represent any text data from any language.

In addition, ColdFusion includes many tags and functions designed to support globalizing your applications. You can use these tags and functions to set locales, convert date and currency formats, control the output encoding of ColdFusion pages, and perform other actions.

**Character sets, character encodings, and locales**

When you discuss globalization issues, two topics that you must consider are the character sets or character encodings recognized by the application and the locales for which the application must format data.

A **character set** is a collection of characters. For example, the Latin alphabet is the character set that you use to write English, and it includes all of the lower- and upper-case letters from A to Z. A character set for French includes the character set used by English, plus special characters such as “é,” “à,” and “ç.”

The Japanese language uses three alphabets: Hiragana, Katakana, and Kanji. Hiragana and Katakana are phonetic alphabets that each contain 46 characters plus two accents. Kanji contains Chinese ideographs adapted to the Japanese language. The Japanese language uses a much larger character set than English because Japanese supports more than 10,000 different characters.
In order for a ColdFusion application to process text, the application must recognize the character set used by the text. The **character encoding** maps between a character set definition and the digital codes used to represent the data.

In general use, the terms character set (or charset) and character encoding are often used interchangeably, and most often a specific character encoding encodes one character set. However, this is not always true; for example, there are multiple encodings of the Unicode character set. For more information on character encodings, see "About character encodings" on page 353.

**Note:** ColdFusion uses the term **charset** to indicate character encoding in some attribute names, structure field keys, and function parameter names.

A **locale** identifies the exact language and cultural settings for a user. The locale controls how dates and currencies are formatted, how to display time, and how to display numeric data. For example, the locale English (US) determines that a currency value displays as:

$100,000.00

while a locale of Portuguese (Brazilian) displays the currency as:

R$ 100.000

In order to correctly display date, time, currency, and numeric data to your customers, you must know the customer's locale. For more information on locales, see "Locales" on page 355.

### About character encodings

A **character encoding** maps each character in a character set to a numeric value that can be represented by a computer. These numbers can be represented by a single byte or multiple bytes. For example, the ASCII encoding uses seven bits to represent the Latin alphabet, punctuation, and control characters.

You use Japanese encodings, such as Shift-JIS, EUC-JP, and ISO-2022-JP, to represent Japanese text. These encodings can vary slightly, but they include a common set of approximately 10,000 characters used in Japanese.

The following terms apply to character encodings:

- **SBCS**: Single-byte character set; a character set encoded in one byte per character, such as ASCII or ISO 8859-1.
- **DBCS**: Double-byte character set; a method of encoding a character set in no more than two bytes, such as Shift-JIS. Many character encoding schemes that are referred to as double-byte, including Shift-JIS, allow mixing of single-byte and double-byte encoded characters. Others, such as UCS-2, use two bytes for all characters.
- **MBCS**: Multiple-byte character set; a character set encoded with a variable number of bytes per character, such as UTF-8.

The following table lists some common character encodings; however, there are many additional character encodings that browsers and web servers support:
The World Wide Web Consortium maintains a list of all character encodings supported by the Internet. You can find this information at www.w3.org/International/O-charset.html.

Computers often must convert between character encodings. In particular, the character encodings most commonly used on the Internet are not used by Java or Windows. Character sets used on the Internet are typically single-byte or multiple-byte (including DBCS character sets that allow single-byte characters). These character sets are most efficient for transmitting data, because each character takes up the minimum necessary number of bytes. Currently, Latin characters are most frequently used on the web, and most character encodings used on the web represent those characters in a single byte.

Computers, however, process data most efficiently if each character occupies the same number of bytes. Therefore, Windows and Java both use double-byte encoding for internal processing.

### The Java Unicode character encoding

ColdFusion uses the Java Unicode Standard for representing character data internally. This standard corresponds to UCS-2 encoding of the Unicode character set. The Unicode character set can represent many languages, including all major European and Asian character sets. Therefore, ColdFusion can receive, store, process, and present text from all languages supported by Unicode.

The Java Virtual Machine (JVM) that is used to processes ColdFusion pages converts between the character encoding used on a ColdFusion page or other source of information to UCS-2. The page or data encodings that ColdFusion supports depend on the specific JVM, but include most encodings used on the web. Similarly, the JVM converts between its internal UCS-2 representation and the character encoding used to send the response to the client.

By default, ColdFusion uses UTF-8 to represent text data sent to a browser. UTF-8 represents the Unicode character set using a variable-length encoding. ASCII characters are sent using a single byte. Most European and Middle Eastern characters are sent as two bytes, and Japanese, Korean, and Chinese characters are sent as three bytes. One advantage of UTF-8 is that it sends ASCII character set data in a form that can be recognized by systems designed to process only single-byte ASCII characters, while it is flexible enough to handle multiple-byte character representations.

While the default format of text data returned by ColdFusion is UTF-8, you can have ColdFusion return a page to any character set supported by Java. For example, you can return text using the Japanese language Shift-JIS character set. Similarly, ColdFusion can handle data that is in many different character sets. For more information, see “Determining the page encoding of server output” on page 358.

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII</td>
<td>SBCS</td>
<td>7-bit encoding used by English and Indonesian Bahasa languages</td>
</tr>
<tr>
<td>Latin-1</td>
<td>SBCS</td>
<td>8-bit encoding used for many Western European languages</td>
</tr>
<tr>
<td>Shift_JIS</td>
<td>DBCS</td>
<td>16-bit Japanese encoding. <strong>Note:</strong> You must use an underscore character (_), not a hyphen (-) in the name in CFML attributes.</td>
</tr>
<tr>
<td>EUC-KR</td>
<td>DBCS</td>
<td>16-bit Korean encoding</td>
</tr>
<tr>
<td>UCS-2</td>
<td>DBCS</td>
<td>Two-byte Unicode encoding</td>
</tr>
<tr>
<td>UTF-8</td>
<td>MBCS</td>
<td>Multibyte Unicode encoding. ASCII is 7-bit; non-ASCII characters used in European and many Middle Eastern languages are two-byte; and most Asian characters are three-byte</td>
</tr>
</tbody>
</table>
Character encoding conversion issues
Because different character encodings support different character sets, you can encounter errors if your application gets text in one encoding and presents it in another encoding. For example, the Windows Latin-1 character encoding, Windows-1252, includes characters with hexadecimal representations in the range 80-9F, while ISO 8859-1 does not include characters in that range. As a result, under the following circumstances, characters in the range 80-9F, such as the euro symbol (€), are not displayed properly:

• A file encoded in Windows-1252 includes characters in the range 80-9F.
• ColdFusion reads the file, specifying the Windows-1252 encoding in the \texttt{cffile} tag.
• ColdFusion displays the file contents, specifying ISO-8859 in the \texttt{cfcontent} tag.

Similar issues can arise if you convert between other character encodings; for example, if you read files encoded in the Japanese Windows default encoding and display them using Shift-JIS. To prevent these problems, ensure that the display encoding is the same as the input encoding.

Locales

A locale identifies the exact language and cultural settings to use for a user. The locale controls how to format the following:

• Dates
• Times
• Numbers
• Currency amounts

ColdFusion supports all locales supported by the JVM that it uses.

\textbf{Note:} Current JVM versions (through 1.4.2) do not support localized numbers such as Arabic-hindic numbers used in Arabic locales or hindic digits used in Hindi locales. ColdFusion uses Arabic numbers in all locales.

Locale names

ColdFusion supports two formats for specifying locale names: the standard Java locale names and the ColdFusion naming convention that was required through ColdFusion 6.1.

• You can specify all locales using a name consisting of the following:
  • Two lowercase letters to identify the language; for example, en for English, or zh for Chinese.
  • Optionally, an underscore and a two uppercase letters to identify the regional variant of the language; for example, US for the United States, or HK for Hong Kong.

For example, en_US represents United States English and es_MX represents Mexican Spanish. For a list of the Java locale identifiers supported in the Sun 1.4.2 JVM and their meanings, see \url{http://java.sun.com/j2se/1.4.2/docs/guide/intl/locale.doc.html}.

Prior to ColdFusion MX 7, ColdFusion supported a limited set of locales, and used identifiers that consisted of the name of the language, followed, for most languages, by a regional identifier in parentheses, such as English (US) or German (Standard). ColdFusion continues to support these names; for a list, see \texttt{SetLocale} in the \textit{CFML Reference}.

The \texttt{Server.coldfusion.supportedlocales} variable is a comma-delimited list of the locale names that you can specify.
ColdFusion also includes a `GetLocaleDisplayName` function that returns a locale name in a format that is meaningful to users. It lets you display the locale using words in the user’s language; for example, français (France).

**Determining the locale**

ColdFusion determines the locale value as follows:

- By default, ColdFusion uses the JVM locale, and the default JVM locale is the operating system locale. You can set the JVM locale value explicitly in ColdFusion in the JVM Arguments field on the Java and JVM Settings page in the ColdFusion Administrator; for example:
  ```
  -Duser.language=de -Duser.country=DE.
  ```
- A locale set using the `SetLocale` function persists for the current request or until it is reset by another `SetLocale` function in the request.
- If a request has multiple `SetLocale` functions, the current locale setting affects how locale-sensitive ColdFusion tags and functions (such as the functions that start with `LS`) format data. The last `SetLocale` function that ColdFusion processes before sending a response to the requestor (typically the client browser) determines the value of the response `Content-Language` HTTP header. The browser that requested the page displays the response according to the rules for the language specified by the `Content-Language` header.
- ColdFusion ignores any `SetLocale` functions that follow a `cfflush` tag.

**Using the locale**

The `SetLocale` function determines the default formats that ColdFusion uses to output date, time, number, and currency values. You use the `GetLocale` function to determine the current locale setting of ColdFusion, or you can use the `GetLocaleDisplayName` function to get the locale name in a format that is meaningful to users. If you have not made a call to `SetLocale`, `GetLocale` returns the locale of the JVM.

The current locale has two effects:

- When ColdFusion formats date, time, currency, or numeric output, it determines how to format the output. You can change the locale multiple times on a ColdFusion page to format information according to different locale conventions. This enables you to output a page that properly formats different currency values, for example.
- When ColdFusion returns a page to the client, it includes the HTTP `Content-Language` header. ColdFusion uses the last locale setting on the page for this information.

**Note:** In earlier versions of ColdFusion, the default locale was always English, not the operating system’s locale. For the Japanese version of ColdFusion, the default was Japanese.

The following example uses the `LSCurrencyFormat` function to output the value 100,000 in monetary units for all the ColdFusion-supported locales. You can run this code to see how the locale affects the data returned to a browser.

```cfml
<p>LSCurrencyFormat returns a currency value using the locale convention.
</p> <!--- loop through list of locales; show currency values for 100,000 units --->
<cffile LIST = "#Server.Coldfusion.SupportedLocales#"
  index = "locale" delimiters = ",">
  <cfset oldlocale = SetLocale(locale)>
  <cfoutput><p><b><I>#locale#</I></b><br>
    Local: #LSCurrencyFormat(100000, "local")#<br>
    International: #LSCurrencyFormat(100000, "international")#<br>
    None: #LSCurrencyFormat(100000, "none")#<br>
  <hr noshade>
  </cfoutput>
</cffile>
```
This example uses the ColdFusion variable `Server.Coldfusion.SupportedLocales`, which contains a list of all supported ColdFusion locales.

### Processing a request in ColdFusion

When ColdFusion receives an HTTP request for a ColdFusion page, ColdFusion resolves the request URL to a physical file path and reads the file contents to parse it. A ColdFusion page can be encoded in any character encoding supported by the JVM used by ColdFusion, but might need to be specified so that ColdFusion can identify it.

The following image shows an example of a client making a request to ColdFusion:

![Diagram](image)

The content of the ColdFusion page on the server can be static data (typically HTML and plain text not processed by ColdFusion), and dynamic content written in CFML. Static content is written directly to the response to the browser, and dynamic content is processed by ColdFusion.

The default language of a website might be different from that of the person connecting to it. For example, you could connect to an English website from a French computer. When ColdFusion generates a response, the response must be formatted in the way expected by the customer. This includes both the character set of the response and the locale.

The following sections describe how ColdFusion determines the character set of the files that it processes, and how it determines the character set and locale of its response to the client.

### Determining the character encoding of a ColdFusion page

When a request for a ColdFusion page occurs, ColdFusion opens the page, processes the content, and returns the results back to the browser of the requestor. In order to process the ColdFusion page, though, ColdFusion has to interpret the page content.

One piece of information used by ColdFusion is the Byte Order Mark (BOM) in a ColdFusion page. The BOM is a special character at the beginning of a text stream that specifies the order of bytes in multibyte characters used by the page. The following table lists the common BOM values:

<table>
<thead>
<tr>
<th>Encoding</th>
<th>BOM signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTF-8</td>
<td>EF BB BF</td>
</tr>
<tr>
<td>UTF-16 Big Endian</td>
<td>FE FF</td>
</tr>
<tr>
<td>UTF-16 Little Endian</td>
<td>FF FE</td>
</tr>
</tbody>
</table>
To insert a BOM character in a CFML page easily, your editor must support BOM characters. Many web page development tools support insertion of these characters, including Dreamweaver, which automatically sets the BOM based on the Page Properties Document Encoding selection.

If your page does not contain a BOM, you can use the `cfprocessingdirective` tag to set the character encoding of the page. If you insert the `cfprocessingdirective` tag on a page that has a BOM, the information specified by the `cfprocessingdirective` tag must be the same as for the BOM; otherwise, ColdFusion issues an error.

The following procedure describes how ColdFusion recognizes the encoding format of a ColdFusion page.

**Determine the page encoding (performed by ColdFusion)**

1. Use the BOM, if specified on the page.
   
   Adobe recommends that you use BOM characters in your files.

2. Use the `pageEncoding` attribute of the `cfprocessingdirective` tag, if specified. For detailed information on how to use this attribute, see the `cfprocessingdirective` tag in the CFML Reference.

3. Default to the JVM default file character encoding. By default, this is the operating system default character encoding.

**Determining the page encoding of server output**

Before ColdFusion can return a response to the client, it must determine the encoding to use for the data in the response. By default, ColdFusion returns character data using the Unicode UTF-8 format.

ColdFusion pages (.cfm pages) default to using the Unicode UTF-8 format for the response, even if you include the HTML `meta` tag in the page. Therefore, the following example will not modify the character set of the response:

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Untitled Document</title>
<meta http-equiv="Content-Type"
   content="text/html; charset="Shift_JIS">
</head>
...
```

In this example, the response will still use the UTF-8 character set. Use the `cfcontent` tag to set the output character set.

However, within a ColdFusion page you can use the `cfcontent` tag to override the default character encoding of the response. Use the `type` attribute of the `cfcontent` tag to specify the MIME type of the page output, including the character set, as follows:

```cfcontent type="text/html charset=EUC-JP">
```

**Note:** ColdFusion also provides attributes that let you specify the encoding of specific elements, such as HTTP requests, request headers, files, and mail messages. For more information, see "Tags and functions for controlling character encoding" on page 359 and "Handling data in ColdFusion" on page 361.

The rest of this chapter describes ColdFusion tags and functions that you use for globalization, and discusses specific globalization issues.
Tags and functions for globalizing applications

ColdFusion supplies many tags and functions that you can use to develop globalized applications.

Tags and functions for controlling character encoding

The following tags and functions let you specify the character encoding of text that ColdFusion generates and interprets:

<table>
<thead>
<tr>
<th>Tag or function</th>
<th>Attribute or parameter</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfcontent</td>
<td>type</td>
<td>Specifies the encoding in which to return the results to the client browser. For more information, see “Determining the page encoding of server output” on page 358.</td>
</tr>
<tr>
<td>cffile</td>
<td>charset</td>
<td>Specifies how to encode data written to a file, or the encoding of a file being read. For more information, see “File data” on page 363.</td>
</tr>
<tr>
<td>cfheader</td>
<td>charset</td>
<td>Specifies the character encoding in which to encode the HTTP header value.</td>
</tr>
<tr>
<td>cfhttp</td>
<td>charset</td>
<td>Specifies the character encoding of the HTTP request.</td>
</tr>
<tr>
<td>cfhtpparam</td>
<td>mimeType</td>
<td>Specifies the MIME media type of a file; can positionally include the file's character encoding.</td>
</tr>
<tr>
<td>cfmail</td>
<td>charset</td>
<td>Specifies the character encoding of the mail message, including the headers.</td>
</tr>
<tr>
<td>cfmailpart</td>
<td>charset</td>
<td>Specifies the character encoding of one part of a multipart mail message.</td>
</tr>
<tr>
<td>cfprocessingdirective</td>
<td>pageEncoding</td>
<td>Identifies the character encoding of the contents of a page to be processed by ColdFusion. For more information, see “Determining the character encoding of a ColdFusion page” on page 357.</td>
</tr>
<tr>
<td>CharsetDecode</td>
<td>encoding</td>
<td>Converts a string in the specified encoding to a binary object.</td>
</tr>
<tr>
<td>CharsetEncode</td>
<td>encoding</td>
<td>Converts a binary object to a string in the specified encoding.</td>
</tr>
<tr>
<td>GetEncoding</td>
<td></td>
<td>Returns the character encoding of text in the Form or URL scope.</td>
</tr>
<tr>
<td>SetEncoding</td>
<td>charset</td>
<td>Specifies the character encoding of text in the Form or URL scope. Used when the character set of the input to a form, or the character set of a URL, is not in UTF-8 encoding.</td>
</tr>
<tr>
<td>ToBase64</td>
<td>encoding</td>
<td>Specifies the character encoding of the string being converted to Base 64.</td>
</tr>
<tr>
<td>ToString</td>
<td>encoding</td>
<td>Returns a string encoded in the specified character encoding.</td>
</tr>
<tr>
<td>URLDecode</td>
<td>charset</td>
<td>Specifies the character encoding of the URL being decoded.</td>
</tr>
<tr>
<td>URLEncodedFormat</td>
<td>charset</td>
<td>Specifies the character encoding to use for the URL.</td>
</tr>
</tbody>
</table>

Functions for controlling and using locales

ColdFusion provides the following functions that let you specify and identify the locale and format text based on the locale:
Note: Many functions that have names starting with LS have corresponding functions that do not have this prefix: DateFormat, IsDate, IsNumeric, NumberFormat, ParseDateTime, and TimeFormat. These functions use English (US) locale rules.

If you do not precede calls to the LS functions with a call to the SetLocale function, they use the locale defined by the JVM, which typically is the locale of the operating system.

The following example uses the LSDateFormat function to display the current date in the format for each locale supported by ColdFusion:

```html
<!--- This example shows LSDateFormat --->
<html>
<head>
<title>LSDateFormat Example</title>
</head>
<body>
<h3>LSDateFormat Example</h3>
<p>Format the date part of a date/time value using the locale convention.
</p>
<!--- loop through a list of locales; show date values for Now() --->
<cfloop list = "#Server.Coldfusion.SupportedLocales#" index = "locale" delimiters = ",">
<cfset oldlocale = SetLocale(locale)>
<cfoutput><p><B><I>#locale#</I></B><br>
#LSDateFormat(Now(), "mmm-dd-yyyy")#<br>
#LSDateFormat(Now(), "mmmm d, yyyy")#</cfoutput>
</cfloop>
</body>
</html>
```
Additional globalization tags and functions

In addition to the tags and functions that are specifically for globalized applications, you might find the following useful when writing a globalized application:

- All string manipulation functions. For more information, see the String functions list in “ColdFusion Functions” on page 636 in the CFML Reference.
- The GetTimeZoneInfo function, which returns the time zone of the operating system.

Handling data in ColdFusion

Many of the issues involved with globalizing applications deal with processing data from the various sources supported by ColdFusion, including the following:

- General character encoding issues
- Locale-specific content
- Input data from URLs and HTML forms
- File data
- Databases
- E-mail
- HTTP
- LDAP
- WDDX
- COM
- CORBA
- Searching and indexing

General character encoding issues

Applications developed for earlier versions of ColdFusion that assumed that the character length of a string was the same as the byte length might produce errors in ColdFusion. The byte length of a string depends on the character encoding.
Locale-specific content
The following sections provide information on how to handle locale-specific content in pages that support multiple locales, and how to handle euro values.

Generating multilocal content
In an application that supports users in multiple locales and produces output that is specific to multiple locales, you call the `SetLocale` function in every request to set the locale for that specific request. When processing has completed, the locale should be set back to its previous value. One useful technique is to save the user's desired locale in a Session variable once the user has selected it, and use the Session variable value to set the locale for each user request during the session.

Supporting the euro
The euro is the currency of many European countries, and ColdFusion supports the reading and writing of correctly formatted euro values. Unlike other supported currencies, the euro is not tied to any single country (or locale). The `LSCurrencyFormat` and `LSParseCurrency` functions rely on the underlying JVM for their operations, and the rules used for currencies depend on the JVM. For Sun JVMs, the 1.3 releases did not support euros and used the older country-specific currencies. The 1.4 releases use euros for all currencies that are in the euro zone as of 2002. If you are using a JVM that does not support the euro, use the `LSEuroCurrencyFormat` and `LSParseEuroCurrency` functions to format and parse euro values in locales that use euros as their currency.

Input data from URLs and HTML forms
A web application server receives character data from request URL parameters or as form data.

The HTTP 1.1 standard only allows US-ASCII characters (0-127) for the URL specification and for message headers. This requires a browser to encode the non-ASCII characters in the URL, both address and parameters, by escaping (URL encoding) the characters using the “%xx” hexadecimal format. URL encoding, however, does not determine how the URL is used in a web document. It only specifies how to encode the URL.

Form data uses the message headers to specify the encoding used by the request (Content headers) and the encoding used in the response (Accept headers). Content negotiation between the client and server uses this information.

There are several techniques for handling both URL and form data entered in different character encodings.

Handling URL strings
URL requests to a server often contain name-value pairs as part of the request. For example, the following URL contains name-value pairs as part of the URL:

http://company.com/prod_page.cfm?name=Stephen;ID=7645

As discussed previously, URL characters entered using any character encoding other than US-ASCII are URL-encoded in a hexadecimal format. However, by default, a web server assumes that the characters of a URL string are single-byte characters.

One common method used to support non-ASCII characters within a URL is to include a name-value pair within the URL that defines the character encoding of the URL. For example, the following URL uses a parameter called `encoding` to define the character encoding of the URL parameters:

http://company.com/prod_page.cfm?name=Stephen;ID=7645;encoding=Latin-1

Within the prod_page.cfm page, you can check the value of the encoding parameter before processing any of the other name-value pairs. This guarantees that you will handle the parameters correctly.
You can also use the `SetEncoding` function to specify the character encoding of URL parameters. The `SetEncoding` function takes two parameters: the first specifies a variable scope and the second specifies the character encoding used by the scope. Since ColdFusion writes URL parameters to the URL scope, you specify "URL" as the scope parameter to the function.

For example, if the URL parameters were passed using Shift-JIS, you could access them as follows:

```cfscript>
setEncoding("URL", "Shift_JIS");
writeoutput(URL.name);
writeoutput(URL.ID);
</cfscript>

**Note:** To specify the Shift-JIS character encoding, use the Shift_JIS attribute, with an underscore (_), not a hyphen (-).

**Handling form data**

The HTML `form` tag and the ColdFusion `cfform` tag let users enter text on a page, then submit that text to the server. The form tags are designed to work only with single-byte character data. Since ColdFusion uses two bytes per character when it stores strings, ColdFusion converts each byte of the form input into a two-byte representation.

However, if a user enters double-byte text into the form, the form interprets each byte as a single character, rather than recognize that each character is two bytes. This corrupts the input text, as the following example shows:

1. A customer enters three double-byte characters in a form, represented by six bytes.
2. The form returns the six bytes to ColdFusion as six characters. ColdFusion converts them to a representation using two bytes per input byte for a total of twelve bytes.
3. Outputting these characters results in corrupt information displayed to the user.

To work around this issue, use the `SetEncoding` function to specify the character encoding of input form text. The `SetEncoding` function takes two parameters: the first specifies the variable scope and the second specifies the character encoding used by the scope. Since ColdFusion writes form parameters to the Form scope, you specify "Form" as the scope parameter to the function. If the input text is double-byte, ColdFusion preserves the two-byte representation of the text.

The following example specifies that the form data contains Korean characters:

```cfscript>
setEncoding("FORM", "EUC-KR");
</cfscript>
<h1> Form Test Result </h1>
<strong>Form Values : </strong>
<cfset text = "String = #form.input1# , Length = #len(Trim(form.input1))#">
<cfoutput>#text#</cfoutput>

**File data**

You use the `cffile` tag to write to and read from text files. By default, the `cffile` tag assumes that the text that you are reading, writing, copying, moving, or appending is in the JVM default file character encoding, which is typically the system default character encoding. For `cffile action="Read"`, ColdFusion also checks for a byte order mark (BOM) at the start of the file; if there is one, it uses the character encoding that the BOM specifies.

Problems can arise if the file character encoding does not correspond to JVM character encoding, particularly if the number of bytes used for characters in one encoding does not match the number of bytes used for characters in the other encoding.
For example, assume that the JVM default file character encoding is ISO 8859-1, which uses a single byte for each character, and the file uses Shift-JIS, which uses a two-byte representation for many characters. When reading the file, the `cffile` tag treats each byte as an ISO 8859-1 character, and converts it into its corresponding two-byte Unicode representation. Because the characters are in Shift-JIS, the conversion corrupts the data, converting each two-byte Shift-JIS character into two Unicode characters.

To enable the `cffile` tag to correctly read and write text that is not encoded in the JVM default character encoding, you can pass the `charset` attribute to it. Specify as a value the character encoding of the data to read or write, as the following example shows:

```xml
<cffile action="read"
       charset="EUC-KR"
       file = "c:\web\message.txt"
       variable = "Message" >
```

### Databases

ColdFusion applications access databases using drivers for each of the supported database types. The conversion of client native language data types to SQL data types is transparent and is done by the driver managers, database client, or server. For example, the character data (SQL CHAR, VARCHAR) you use with JDBC API is represented using Unicode-encoded strings.

Database administrators configure data sources and usually are required to specify the character encodings for character column data. Many of the major vendors, such as Oracle, Sybase, and Informix, support storing character data in many character encodings, including Unicode UTF-8 and UTF-16.

The database drivers supplied with ColdFusion correctly handle data conversions from the database native format to the ColdFusion Unicode format. You should not have to perform any additional processing to access databases. However, you should always check with your database administrator to determine how your database supports different character encodings.

### E-mail

ColdFusion sends e-mail messages using the `cfmail`, `cfmailparam`, and `cfmailpart` tags.

By default, ColdFusion sends mail in UTF-8 encoding. You can specify a different default encoding on the Mail page in the ColdFusion Administrator, and you can use the `charset` attribute of the `cfmail` and `cfmailpart` tags to specify the character encoding for a specific mail message or part of a multipart mail message.

### HTTP

ColdFusion supports HTTP communication using the `cfhttp` and `cfhttpparam` tags and the `GetHttpRequestData` function.

The `cfhttp` tag supports making HTTP requests. The `cfhttp` tag uses the Unicode UTF-8 encoding for passing data by default, and you can use the `charset` attribute to specify the character encoding. You can also use the `cfhttpparam` tag `mimeType` attribute to specify the MIME type and character set of a file.

### LDAP

ColdFusion supports LDAP (Lightweight Directory Access Protocol) through the `cfldap` tag. LDAP uses the UTF-8 encoding format, so you can mix all retrieved data with other data and safely manipulated it. No extra processing is required to support LDAP.
WDDX
ColdFusion supports the cfwddx tag. ColdFusion stores WDDX (Web Distributed Data Exchange) data as UTF-8 encoding, so it automatically supports double-byte character encodings. You do not have to perform any special processing to handle double-byte characters with WDDX.

COM
ColdFusion supports COM through the cfobject type="com" tag. All string data used in COM interfaces is constructed using wide characters (wchars), which support double-byte characters. You do not have to perform any special processing to interface with COM objects.

CORBA
ColdFusion supports CORBA through the cfobject type="corba" tag. The CORBA 2.0 interface definition language (IDL) basic type “String” used the Latin-1 character encoding, which used the full 8-bits (256) to represent characters.

As long as you are using CORBA later than version 2.0, which includes support for the IDL types wchar and wstring, which map to Java types char and string respectively, you do not have to do anything to support double-byte characters.

However, if you are using a version of CORBA that does not support wchar and wstring, the server uses char and string data types, which assume a single-byte representation of text.

Searching and indexing
ColdFusion supports Verity search through the cfindex, cfcollection, and cfsearch tags. To support multilingual searching, the ColdFusion product CD-ROM includes the Verity language packs that you install to support different languages.
Chapter 20: Debugging and Troubleshooting Applications

ColdFusion provides detailed debugging information to help you resolve problems with your application. You configure ColdFusion to provide debugging information, and use the cftrace and cftimer tags to provide detailed information on code execution. You can also use tools for validating your code before you run it and troubleshoot particular problems.

Note: Adobe Dreamweaver provides integrated tools for displaying and using ColdFusion debugging output. For information on using these tools, see the Dreamweaver online Help.

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Using debugging information from browser pages ........................................................................ 353
Controlling debugging information in CFML ............................................................................. 361
Using the cftrace tag to trace execution .................................................................................... 362
Using the cftimer tag to time blocks of code ............................................................................. 366
Using the Code Compatibility Analyzer ..................................................................................... 367
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Configuring debugging in the ColdFusion Administrator

ColdFusion can provide important debugging information for every application page requested by a browser. The ColdFusion Administrator lets you specify which debugging information to make available and how to display it. The following sections briefly describe the Administrator settings. For more information, see the online Help for the Debugging pages.

Debugging Settings page
In the Administrator, the following options on the Debugging Settings page determine the information that ColdFusion displays in debugging output:
The following image shows a sample debugging output using the classic output format:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| Enable Robust Exception Information | Enables the display of the following information when ColdFusion displays the exception error page. (Cleared by default.)
  - Path and URL of the page that caused the error
  - Line number and short snippet of the code where the error was identified
  - Any SQL statement and data source
  - Java stack trace                                                                 |
| Enable Debugging           | Enables debugging output. When this option is cleared, no debugging information is displayed, including all output of cftag and cfoutput calls. (Cleared by default.)
  You should disable debugging output on production servers. Doing so increases security by ensuring that users cannot see debugging information. It also improves server response times. You can also limit debugging output to specific IP addresses; for more information, see “Debugging IP addresses page” on page 353. |
| Select Debugging Output Format | Determines how to display debugging output:
  - The classic.cfm template (the default) displays information as plain HTML text at the bottom of the page.
  - The dockable.cfm template uses DHTML to display the debugging information using an expanding tree format in a separate window. This window can be either a floating pane or docked to the browser window. For more information on the dockable output format, see “Using the dockable.cfm output format” on page 360. |
| Report Execution Times     | Lists ColdFusion pages that run as the result of an HTTP request and displays execution times. ColdFusion also highlights in red pages with processing times greater than the specified value, and you can select between a summary display or a more detailed, tree structured, display. |
| General Debug Information  | Displays general information about the request: ColdFusion Version, Template, Time Stamp, User Locale, User Agent, User IP, and Host Name.                                                                     |
| Database Activity          | Displays debugging information about access to SQL data sources and stored procedures. (Selected by default.)                                                                                                  |
| Exception Information      | Lists all ColdFusion exceptions raised in processing the request. (Selected by default.)                                                                                                                    |
| Tracing information        | Displays an entry for each cftrace tag. When this option is cleared, the debugging output does not include tracing information, but the output page does include information for cftrace tags that specify inline="Yes". (Selected by default.)
  For more information on using the cftrace tag, see “Using the cftrace tag to trace execution” on page 362. |
| Variables                  | Enables the display of ColdFusion variable values. When this option is cleared, disables display of all ColdFusion variables in the debugging output. (Selected by default.)
  When enabled, ColdFusion displays the values of variables in the selected scopes. You can select to display the contents of any of the ColdFusion scopes except Variables, Attributes, Caller, and ThisTag. To enhance security, Application, Server, and Request variable display is disabled by default. |
| Enable Performance Monitoring | Allows the standard NT Performance Monitor application to display information about a running ColdFusion application server.                                                                                       |
| Enable CFSTAT              | Enables you to use of the cfstat command line utility to monitor real-time performance. This utility displays the same information that ColdFusion writes to the NT System Monitor, without using the System Monitor application. For information on the cfstat utility, see Configuring and Administering ColdFusion. |
Debugging Information

ColdFusion Server Evaluation 6.0.0.44589
Template /MYStuff/NeoDocs/debugsimplepage.cfm
Time Stamp 11-Apr-02 12:33 PM
Locale English (US)
User Agent Mozilla/4.0 (compatible; MSIE 5.5; Windows NT 4.0; T312461)
Remote IP 127.0.0.1
Host Name localhost

Execution Time (average time over 250 ms)

<table>
<thead>
<tr>
<th>Total Time</th>
<th>Avg Time</th>
<th>Count</th>
<th>Template</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 ms</td>
<td>60 ms</td>
<td>1</td>
<td>C:\CFusionMX\wwwroot\MYStuff\NeoDocs\debugsimplepage.cfm</td>
</tr>
<tr>
<td>0 ms</td>
<td>0 ms</td>
<td>1</td>
<td>C:\CFusionMX\wwwroot\MYStuff\NeoDocs\debugApplication.cfm</td>
</tr>
<tr>
<td>70 ms</td>
<td></td>
<td></td>
<td>STARTUP, PARSING, COMPILING, LOADING, &amp; SHUTDOWN</td>
</tr>
</tbody>
</table>

SQL Queries

myQuery (Datasource=CompanyInfo, Time=One, Records=1, Cached Query) in C Q 12:33:03.003

Select *
From Employee
Where Emp_10=1

Debugging IP addresses page

By default, when you enable debugging output, the output is visible only to local users (that is, via IP address 127.0.0.1). You can specify additional IP addresses whose users can see debugging output, or even disable output to local users. In the Administrator, use the Debugging IPs page to specify the addresses that can receive debugging messages.

Note: If you must enable debugging on a production server, for example to help locate the cause of a difficult problem, use the Debugging IP Addresses page to limit the output to your development systems and prevent clients from seeing the debugging information.

Using debugging information from browser pages

The ColdFusion debugging output that you configure in the Administrator displays whenever an HTML request completes. It represents the server conditions at the end of the request. For information on displaying debugging information while a request is processed, see “Using the cfttrace tag to trace execution” on page 362.

The following image shows a sample collapsed debugging output using the dockable.cfm debugging output format. The next sections show each of the debugging sections and describe how you can use the information they display.
General debugging information

ColdFusion displays general debugging information. In the classic.cfm output format, the information is at the top of the debugging output. In the dockable.cfm output format, it looks like the following image:

(In the classic.cfm output format, the section is first in the debugging output and has no heading.)

The general debugging information includes the following values. The table lists the names used in the classic output template view.
Execution Time

The Execution Time section displays the time required to process the request. It displays information about the time required to process all pages required for the request, including the Application.cfc, Application.cfm, and OnRequestEnd.cfm pages, if used, and any CFML custom tags, pages included by the cfinclude tag, and any ColdFusion component (CFC) pages.

To display execution time for a specific block of code, use the cftimer tag.

You can display the execution time in two formats:

- **Summary**
- **Tree**

Note: Execution time decreases substantially between the first and second time you use a page after creating it or changing it. The first time ColdFusion uses a page it compiles the page into Java bytecode, which the server saves and loads into memory. Subsequent uses of unmodified pages do not require recompilation of the code, and therefore are substantially faster.

### Summary execution time format

The summary format displays one entry for each ColdFusion page processed during the request. If a page is processed multiple times it appears only once in the summary. For example, if a custom tag gets called three times in a request, it appears only once in the output. In the classic.cfm output format, the summary format looks like the following image:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColdFusion</td>
<td>The ColdFusion version.</td>
</tr>
<tr>
<td>Template</td>
<td>The requested template. (In the dockable.cfm format, this appears in the Page Overview section and is called Page.)</td>
</tr>
<tr>
<td>TimeStamp</td>
<td>The time the request was completed. (In the dockable.cfm format, this appears in the Page Overview section and is called Date.)</td>
</tr>
<tr>
<td>Locale</td>
<td>The locality and language that determines how information is processed, particularly the message language.</td>
</tr>
<tr>
<td>User Agent</td>
<td>The identity of the browser that made the HTTP request.</td>
</tr>
<tr>
<td>Remote IP</td>
<td>The IP address of the client system that made the HTTP request.</td>
</tr>
<tr>
<td>Host Name</td>
<td>The name of the host running the ColdFusion server that executed the request.</td>
</tr>
</tbody>
</table>

### Execution Time

<table>
<thead>
<tr>
<th>Total Time</th>
<th>Avg Time</th>
<th>Count</th>
<th>Template</th>
</tr>
</thead>
<tbody>
<tr>
<td>1032 ms</td>
<td>1032 ms</td>
<td>1</td>
<td>C:\CFusionMX\wwwroot\tests\debug\cf-tryinclude.cfm</td>
</tr>
<tr>
<td>797 ms</td>
<td>399 ms</td>
<td>2</td>
<td>C:\CFusionMX\wwwroot\tests\debug\usytag1.cfm</td>
</tr>
<tr>
<td>610 ms</td>
<td>203 ms</td>
<td>3</td>
<td>C:\CFusionMX\wwwroot\tests\debug\usytag2.cfm</td>
</tr>
<tr>
<td>63 ms</td>
<td>63 ms</td>
<td>1</td>
<td>C:\CFusionMX\wwwroot\tests\debug\include.cfm</td>
</tr>
<tr>
<td>0 ms</td>
<td>0 ms</td>
<td>1</td>
<td>C:\CFusionMX\wwwroot\tests\debug\Application.cfm</td>
</tr>
<tr>
<td>137 ms</td>
<td></td>
<td></td>
<td>STARTUP, PARSING, COMPIILING, LOADING, &amp; SHUTDOWN</td>
</tr>
<tr>
<td>1235 ms</td>
<td></td>
<td></td>
<td>TOTAL EXECUTION TIME</td>
</tr>
</tbody>
</table>

red = over 250 ms average execution time

The following table describes the display fields:
Any page with an average processing time that exceeds the highlight value that you set on the Debugging Settings page in the ColdFusion Administrator appears in red.

The next to last line of the output displays the time that ColdFusion took to parse, compile, and load pages, and to start and end page processing. This image is not included in the individual page execution times. The last line shows the sum of all the time it took to process the request.

**Tree execution time format**

The tree execution time format is a hierarchical, detailed view of how ColdFusion processes each page. If a page includes or calls second page, the second page appears below and indented relative to the page that uses it. Each page appears once for each time it is used. Therefore, if a page gets called three times in processing a request, it appears three times in the tree. Therefore the tree view displays both processing times and an indication of the order of page processing.

The tree format looks as follows in the dockable.cfm output format:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Time</td>
<td>The total time required to process all instances of the page and all pages that it uses. For example, if a request causes a page to be processed two times, and the page includes another page, the total time includes the time required to process both pages twice.</td>
</tr>
<tr>
<td>Avg Time</td>
<td>The average time for processing each instance of this page and the pages that it uses. The Avg Time multiplied by the Count equals the Total Time.</td>
</tr>
<tr>
<td>Count</td>
<td>The number of times the page is processed for the request.</td>
</tr>
<tr>
<td>Template</td>
<td>The path name of the page.</td>
</tr>
</tbody>
</table>

As in the summary view, the execution times (in parentheses) show the times to process the listed page and all pages required to process the page, that is, all pages indented below the page in the tree.

By looking at this output in this image you can determine the following information:

- ColdFusion took 0 ms to process an Application.cfm page as part of the request.
• The requested page was tryinclude.cfm. It took 203 ms to process this page and all pages required to execute it. The code directly on this page took 71 milliseconds (203 - 93 - 16 - 23) to process.

• The mytag2.cfm page was processed three times. All processing took 93 milliseconds, and the average processing time was 31 milliseconds. (This page does not call any other pages.)

• The mytag1.cfm page was processed two times. All processing took 78 milliseconds, and the average processing time was 39 milliseconds. This time included the time to process mytag2.cfm (this tag calls the mytag2 custom tag); therefore, the code directly on the page took an average of 8 milliseconds and a total of 16 milliseconds to process.

• The includeme.cfm page took about 62 ms to process. This processing time includes the time to process the mytag1.cfm, and therefore also the time to process mytag2.cfm once. Therefore the code directly on the page took 23 milliseconds (62 - 39) to process.

• ColdFusion took 125 ms for processing that was not associated with a specific page.

• The total processing time was 328 milliseconds, the sum of 125 + 203.

**Database Activity**

In the Administrator, when Database Activity is selected on the Debugging Settings page, the debugging output includes information about database access.

**SQL Queries**

The SQL Queries section provides information about tags that generate SQL queries or result in retrieving a cached database query: `cfquery`, `cfinsert`, `cfgridupdate`, and `cfupdate`. The section looks like the following image in the dockable.cfm output format:

The output displays the following information:

• Page on which the query is located.

• The time when the query was made.

• Query name.

• An indicator if the result came from a cached query.
• SQL statement, including the results of processing any dynamic elements such as CFML variables and cfqueryparam tags. This information is particularly useful because it shows the results of all ColdFusion processing of the SQL statement.
  • Data source name.
  • Number of records returned; 0 indicates no match to the query.
  • Query execution time.
  • Any query parameters values from cfqueryparam tags.

**Stored Procedures**
The stored procedures section displays information about the results of using the cfstoredproc tag to execute a stored procedure in a database management system.

The following image shows the Stored Procedures section in the classic.cfm output format:

```
Stored Procedures

usp_emp (DataSource=Test, Time=13) in C:/ColdFusion/wwwroot/test/cfstoreproc.cfm
  0 15:17:13.013

<table>
<thead>
<tr>
<th>parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>CFSQLType</td>
</tr>
<tr>
<td>value</td>
<td>variable</td>
</tr>
<tr>
<td>dbVarName</td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>CF_SQL_VARCHAR</td>
</tr>
<tr>
<td>OUT</td>
<td>CF_SQL_INTEGER</td>
</tr>
<tr>
<td></td>
<td>numberOfEmployeesMinus10 = -2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>results</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>resultset</td>
</tr>
<tr>
<td>sql</td>
<td>1</td>
</tr>
</tbody>
</table>
```

The output displays the following information:
• Stored procedure name
• Data source name
• Query execution time
• Page on which the query is located.
• The time when the query was made.
• A table displaying the procedure parameters sent and received, as specified in the cfprocparam tags, including the ctype, CFSQLType, value variable, and dbVarName attributes. The variable information for OUT and INOUT parameters includes the returned value.
• A table listing the procedure result sets returned, as specified in the cfprocresult tag.

**Exceptions**
In the Administrator, when Exception Information is selected on the Debugging Settings page, the debugging output includes a list of all ColdFusion exceptions raised in processing the application page. This section looks like the following image when displaying information about an exception thrown by the cfthrow tag using the dockable.cfm output format:
Exceptions represent events that disrupt the normal flow of an application. You should catch and, whenever possible, recover from foreseeable exceptions in your application, as described in “Handling Errors” on page 246. However, you might also want to be alerted to caught exceptions when you are debugging your application. For example, if a file is missing, your application can catch the \texttt{cffile} exception and use a backup or default file instead. If you enable exception information in the debugging output, you can immediately see when this happens.

**Trace points**

In the Administrator, when Tracing Information is selected on the Debugging Settings page, the debugging output includes the results of all \texttt{cftrace} tags, including all tags that display their results in-line. Therefore, the debugging output contains a historical record of all trace points encountered in processing the request. The following image shows this section when you use the classic.cfm output format:

```
<table>
<thead>
<tr>
<th>Trace Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>[16:52:55.955 C @ line -1][90 ms (1st trace)], [current tag] [DebugCount = 36556] [Checkpoint 3, in child tag]</td>
</tr>
<tr>
<td>[16:52:55.956 C[Password:91597d06debugTag]:cfm @ line 26],[359 ms (250 ms)], [current tag] [Checkpoint 3 in recalculation algorithm]</td>
</tr>
<tr>
<td>[16:52:55.956 C[Password:91597d06debugTag]:cfm @ line 24],[111 ms (256 ms)], [current tag] [DebugCount = 50347] [Shouldn’t get here]</td>
</tr>
<tr>
<td>[16:52:55.956 C @ line -1],[351 ms (249 ms)], [current tag] [DebugCount = 36554] [Checkpoint 3, in child tag]</td>
</tr>
</tbody>
</table>
```

For more information on using the \texttt{cftrace} tag, see “Using the \texttt{cftrace} tag to trace execution” on page 362.

**Scope variables**

In the Administrator, when the Variables option and one or more variable scopes are selected on the Debugging Settings page, the debugging output displays the values of all variables in the selected scopes. The debugging output displays the values that result after all processing of the current page.

By displaying selected scope variables you can determine the effects of processing on persistent scope variables, such as application variables. This can help you locate problems that do not generate exceptions.

The Form, URL, and CGI scopes are useful for inspecting the state of a request. They let you inspect parameters that affect page behavior, as follows:

- **URL variables**: Identify the HTTP request parameters.
- **Form variables**: Identify the form fields posted to an action page.
- **CGI variables**: Provide a view of the server environment following the request.
Similarly, the Client, Session, Application, and Server scope variables show the global state of the application, and can be useful in tracing how each page affects the state of the ColdFusion persistent variables.

**Using the dockable.cfm output format**

The dockable.cfm output format has several features that are not included in the classic.cfm debugging display, as the following image of a docked debug pane shows:

![Docked Debug Pane](image)

**Application page selections**

ColdFusion displays two buttons at the bottom of each page, as described in the following table:

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debug This page</td>
<td>Tells ColdFusion to display the debugging information for the selected frame. Refreshes the debug pane if you select it for the current frame (or the application does not use frames).</td>
</tr>
<tr>
<td>Floating/Docked debug pane</td>
<td>Toggles the display between a floating window and a pane docked to the left of the selected frame.</td>
</tr>
</tbody>
</table>

**Debug pane features**

The debug pane has the following features:

- You can expand and collapse each debugging information category, such as Exceptions, by clicking on the plus or minus sign (+ or -) in front of each category heading. You can also expand and collapse each scope data type display in the Scoped Variables section.
- The top of the debug pane displays the URL of the application page being debugged (as identified by the cgi.script_name variable). Click this link to refresh the page and display the debugging information that results. (You can also refresh the page and debugging information by using your browser's Refresh button or key.)
- The debug pane also displays a box where you can enter a page pathname or URL. When you click the Go button, ColdFusion processes the page and the debug pane is updated with the debugging information for the new page.
Controlling debugging information in CFML

The following sections describe how you can use CFML tags and functions to display or hide debugging and tracing information.

Generating debugging information for an individual query

In the Administrator, the `cfquery` tag `debug` attribute overrides the Database Activity setting on the Debugging Settings page. The `debug` attribute has an effect only when debugging output is enabled on the Debugging Settings page, as follows:

- If Database Activity is selected in the Administrator, specify `debug="No"` to prevent ColdFusion from displaying the query's SQL and statistics in the debugging output.
- If Database Activity is not selected in the Administrator, specify `debug="Yes"` or `debug` to have ColdFusion display the query's SQL and statistics in the debugging output.

For example, if Database Activity is not selected in the Administrator, you can use the following code to show the query execution time, number of records returned, ColdFusion page, timestamp, and the SQL statement sent to the data source for this query only:

```cfquery name="TestQuery" datasource="cfdocexamples" debug>
   SELECT * FROM TestTable
</cfquery>
```

The `debug` attribute can be useful to disable query debugging information generated by queries in custom tags that you call frequently, so that you only see the debugging information for queries in pages that call the tags.

You can also view stored procedure-specific debugging information by specifying the `debug` attribute in the `cfstoredproc` tag.

Controlling debugging output with the `cfsetting` tag

Use the `cfsetting` tag `showDebugOutput` attribute to turn off debugging output for a specific page. The attribute controls debugging output only if the Debugging Settings page in the ColdFusion Administrator enables debugging output. The attribute's default value is `Yes`. The following tag suppresses all debugging output for the current page:

```cfsetting showDebugOutput="No">
```

You can put this tag in the initialization code of the Application.cfc file or on your Application.cfm page to suppress all debugging output for an application, and override it on specific pages by setting `showDebugOutput="Yes"` in `cfsetting` tags on those pages. Conversely, you can leave debugging on for the application, and use the `cfsetting showDebugOutput="No"` tag to suppress debugging on individual pages where the output could cause errors or confusion.

You can also use the `showDebugOutput` attribute to control debugging output if you do not have access to the ColdFusion Administrator, but only if the Administrator enables debugging.

Using the `IsDebugMode` function to run code selectively

The `IsDebugMode` function returns `True` if debugging is enabled. You can use this function in a `cfif` tag condition to selectively run code only when debugging output is enabled. The `IsDebugMode` function lets you tell ColdFusion to run any code in debug mode, so it provides more flexibility than the `cftrace` tag for processing and displaying information.
You can use the `IsDebugMode` function to selectively log information only when debugging is enabled. Because you control the log output, you have the flexibility of silently logging information without displaying trace information in the browser. For example, the following code logs the application page, the current time, and the values of two variables to the log file MyAppSilentTrace.log when debugging is enabled:

```coldfusion
<cfquery name="MyDBQuery" datasource="cfdocexamples">
    SELECT *
    FROM Employee
</cfquery>
<cfif IsDebugMode()>
    <cflog file="MyAppSilentTrace" text="Page: #cgi.script_name#, completed query MyDBQuery; Query Execution time: #cfquery.ExecutionTime# Status: #Application.status#">
</cfif>
```

If you use `cfdump` tags frequently for debugging, put them in `cfif IsDebugMode() `tags; for example `cfif IsDebugMode()><cfdump var=#myVar#></cfif`. This way you ensure that if you leave any `cfdump` tags in production code, they are not displayed when you disable debugging output.

### Using the `cftrace` tag to trace execution

The `cftrace` tag displays and logs debugging data about the state of your application at the time the `cftrace` tag executes. You use it to provide "snapshots" of specific information as your application runs.

#### About the `cftrace` tag

The `cftrace` tag provides the following information:

- A severity identifier specified by the `type` attribute
- A timestamp indicating when the `cftrace` tag executed
- The time elapsed between the start of processing the request and when the current `cftrace` tag executes.
- The time between any previous `cftrace` tag in the request and the current one. If this is the first `cftrace` tag processed for the request, the output indicates “1st trace”. ColdFusion does not display this information in inline trace output, only the log and in the standard debugging output.
- The name of the page that called the `cftrace` tag
- The line on the page where the `cftrace` call is located
- A trace category specified by the `category` attribute
- A message specified by the `text` attribute
- The name and value, at the time the `cftrace` call executes, of a single variable specified by the `var` attribute

A typical `cftrace` tag might look like the following:

```coldfusion
<cftrace category="UDF End" inline = "True" var = "MyStatus" text = "GetRecords UDF call has completed">
```

You can display the `cftrace` tag output in either or both of the following ways:

- **As a section in the debugging output:** To display the trace information in the debugging output, in the Administrator, select Tracing Information on the Debugging Settings page.
• **In-line in your application page:** When you specify the `inline` attribute in a `cftrace` tag, ColdFusion displays the trace output on the page at the `cftrace` tag location. (An inline `cftrace` tag does not display any output if it is inside a `cfsilent` tag block.)

The `cftrace` tag executes only if you select Enable Debugging on the ColdFusion Administrator Debugging Settings page. To display the trace results in the debugging output, you must also specify Tracing Information on the Debugging Settings page; otherwise, the trace information is logged and inline traces are displayed, but no trace information appears in the debugging output.

**Note:** When you use in-line trace tags, ColdFusion sends the page to the browser after all page processing is completed, but before it displays the debugging output from the debug template. As a result, if an error occurs after a trace tag but before the end of the page, ColdFusion might not display the trace for that tag.

The following images shows an in-line trace messages:

![In-line trace messages](image)

The following table lists the displayed information:

<table>
<thead>
<tr>
<th>Entry</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Trace type" /></td>
<td>Trace type (severity) specified in the <code>cftrace</code> call; in this case, Information.</td>
</tr>
<tr>
<td><img src="image" alt="Time when the cftrace tag executed." /></td>
<td>Time when the <code>cftrace</code> tag executed.</td>
</tr>
<tr>
<td><img src="image" alt="Time taken for processing the current request to the point of the cftrace tag." /></td>
<td>Time taken for processing the current request to the point of the <code>cftrace</code> tag.</td>
</tr>
<tr>
<td><img src="image" alt="Path in the web server of the page that contains the cftrace tag." /></td>
<td>Path in the web server of the page that contains the <code>cftrace</code> tag.</td>
</tr>
<tr>
<td><img src="image" alt="The line number of the cftrace tag." /></td>
<td>The line number of the <code>cftrace</code> tag.</td>
</tr>
<tr>
<td><img src="image" alt="Value of the cftrace tag category attribute." /></td>
<td>Value of the <code>cftrace</code> tag category attribute.</td>
</tr>
<tr>
<td><img src="image" alt="GetRecords UDF call has completed" /></td>
<td>The <code>cftrace</code> tag text attribute with any variables replaced with their values.</td>
</tr>
<tr>
<td><img src="image" alt="MyStatus Success" /></td>
<td>Name and value of the variable specified by the <code>cftrace</code> tag <code>var</code> attribute.</td>
</tr>
</tbody>
</table>

ColdFusion logs all `cftrace` output to the file `logs\cftrace.log` in your ColdFusion installation directory.

A log file entry looks like the following:

```
"Information","web-29","04/01/02","13:21:11","MyApp","[501 ms (1st trace)]
[C:\CFusion\wwwroot\MYStuff\mydocs\tractest.cfm @ line:14] - [UDF End] GetRecords UDF call has completed 
MyStatus Success"
```

This entry is in standard ColdFusion log format, with comma-delimited fields inside double-quote characters. The information displayed in the trace output is in the last, message, field.

The following table lists the contents of the trace message and the log entries. For more information on the log file format, see “Logging errors with the `cflog` tag” on page 256.
Using tracing

As its name indicates, the `cftrace` tag is designed to help you trace the execution of your application. It can help you do any of several things:

- You can time the execution of a tag or code section. This capability is particularly useful for tags and operations that can take substantial processing time. Typical candidates include all ColdFusion tags that access external resources, including `cfquery`, `cfldap`, `cfftp`, `cffile`, and so on. To time execution of any tag or code block, call the `cftrace` tag before and after the code you want to time.
- You can display the values of internal variables, including data structures. For example, you can display the raw results of a database query.
- You can display an intermediate value of a variable. For example, you could use this tag to display the contents of a raw string value before you use string functions to select a substring or format it.
- You can display and log processing progress. For example, you can put a `cftrace` call at the head of pages in your application or before critical tags or calls to critical functions. (Doing this could result in massive log files in a complex application, so you should use this technique with care.)
- If a page has many nested `cfif` and `cfelseif` tags you can put `cftrace` tags in each conditional block to trace the execution flow. When you do this, you should use the condition variable in the message or `var` attribute.
- If you find that the ColdFusion server is hanging, and you suspect a particular block of code (or call to a cfx tag, COM object, or other third-party component), you can put a `cftrace` tag before and after the suspect code, to log entry and exit.
### Calling the cftrace tag

The `cftrace` tag takes the following attributes. All attributes are optional.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>abort</code></td>
<td>A Boolean value. If you specify True, ColdFusion stops processing the current request immediately after the tag. This attribute is the equivalent of placing a <code>cfabort</code> tag immediately after the <code>cftrace</code> tag. The default is False. If this attribute is True, the output of the <code>cftrace</code> call appears only in the <code>cftrace.log</code> file. The line in the file includes the text &quot;[ABORTED]&quot;.</td>
</tr>
<tr>
<td><code>category</code></td>
<td>A text string specifying a user-defined trace type category. This attribute lets you identify or process multiple trace lines by categories. For example, you could sort entries in a log according to the category. The <code>category</code> attribute is designed to identify the general purpose of the trace point. For example, you might identify the point where a custom tag returns processing to the calling page with a &quot;Custom Tag End&quot; category. You can also use finer categories; for example, by identifying the specific custom tag name in the category. You can include simple ColdFusion variables, but not arrays, structures, or objects, in the category text by enclosing the variable name in number signs (#).</td>
</tr>
<tr>
<td><code>inline</code></td>
<td>A Boolean value. If you specify True, ColdFusion displays trace output in-line in the page. The default is False. The <code>inline</code> attribute lets you display the trace results at the place that the <code>cftrace</code> call is processed. This provides a visual cue directly in the ColdFusion page display. Trace output also appears in a section in the debugging information display.</td>
</tr>
<tr>
<td><code>text</code></td>
<td>A text message describing this trace point. You can include simple ColdFusion variables, but not arrays, structures, or objects, in the text output by enclosing the variable name in number signs (#).</td>
</tr>
<tr>
<td><code>type</code></td>
<td>A ColdFusion logging severity type. The inline trace display and dockable.cfm output format show a symbol for each type. The default debugging output shows the type name, which is also used in the log file. The type name must be one of the following:</td>
</tr>
<tr>
<td></td>
<td>Information (default)</td>
</tr>
<tr>
<td></td>
<td>Warning</td>
</tr>
<tr>
<td></td>
<td>Error</td>
</tr>
<tr>
<td></td>
<td>Fatal Information</td>
</tr>
<tr>
<td><code>var</code></td>
<td>The name of a single variable that you want displayed. This attribute can specify a simple variable, such as a string, or a complex variable, such as a structure name. Do not surround the variable name in number signs. Complex variables are displayed in inline output in <code>cfdump</code> format; the debugging display and log file report the number of elements in the complex variable, instead of any values. You can use this attribute to display an internal variable that the page does not normally show, or an intermediate value of a variable before the page processes it further. To display a function return value, put the function inside the message. Do not use the function in the <code>var</code> attribute, because the attribute cannot evaluate functions.</td>
</tr>
</tbody>
</table>

**Note:** If you specify inline trace output, and a `cftrace` tag is inside a `cfsilent` tag block, ColdFusion does not display the trace information in line, but does include it in the standard debugging display.

The following `cftrace` tag displays the information in the example output and log entry in "About the cftrace tag" on page 362:

```xml
<cftrace abort="False" category="UDF End" inline = "True" text = "GetRecords UDF call has completed" var = "MyStatus"/>
```
Using the cftimer tag to time blocks of code

The cftimer tag displays execution time for a specified section of CFML code.

Using timing

Use this tag to determine how long it takes for a block of code to execute. This is particularly useful when ColdFusion debugging output indicates excessive execution time, but does not pinpoint the long-running block of code.

To use this tag, you must enable debugging in the ColdFusion Administrator Debugging Settings page. In the Debugging Settings page, you must also specifically enable usage of the cftimer tag by checking the Timer Information check box.

If you enable debugging for the cftimer tag only and display timing information in an HTML comment, you can generate timing information without disturbing production users.

Calling the cftimer tag

You can control where the cftimer tag displays timing information, as follows:

- **Inline**: Displays timing information following the </cftimer> tag.
- **Outline**: Displays timing information at the beginning of the timed code and draws a box around the timed code. (This requires browser support for the HTML FIELDSET attribute.)
- **Comment**: Displays timing information in an HTML comment in the format <!-- label: elapsed-time ms -->. The default label is cftimer.
- **Debug**: Displays timing information in the debugging output under the heading CFTimer Times.

The following example calls the cftimer tag multiple times, each time using a different type attribute:

```html
<html>
<body>
<h1>CFTIMER test</h1>
<!-- type="inline" -->
  <cftimer label="Query and Loop Time Inline" type="inline">
    <cfquery name="empquery" datasource="cfdocexamples">
      select * from Employees
    </cfquery>
    <cfloop query="empquery">
      <cfoutput>#lastname#, #firstname#</cfoutput><br>
    </cfloop>
  </cftimer>
  <hr><br>
<!-- type="outline" -->
  <cftimer label="Query and CFOUTPUT Time with Outline" type="outline">
    <cfquery name="coursequery" datasource="cfdocexamples">
      select * from CourseList
    </cfquery>
    <cfloop query="coursequery">
      <cfoutput>Course_ID#, CorName#</cfoutput><br>
    </cfloop>
  </cftimer>
  <hr><br>
</body>
</html>
```
Using the Code Compatibility Analyzer

The Code Compatibility Analyzer has two purposes:

- It can validate your application's CFML syntax. To do so, the analyzer runs the ColdFusion compiler on your pages, but does not execute the compiled code. It reports errors that the compiler encounters.
- It can identify places where ColdFusion might behave differently than previous versions. The analyzer identifies the following kinds of features:
  - **No longer supported**: Their use results in errors. For example, ColdFusion now generates an error if you use the cflog tag with the thread="Yes" attribute.
  - **Deprecated**: They are still available, but their use is not recommended and they might not be available in future releases. Deprecated features might also behave differently now than in previous releases. For example, the cfsservlet tag is deprecated.
• **Modified behavior:** They might behave differently than in previous versions. For example, the
  `StructKeyList` function no longer lists the structure key names in alphabetical order.

  The analyzer provides information about the incompatibility and its severity, and suggests a remedy where one
  is required.

You can run the Code Compatibility Analyzer from the ColdFusion Administrator. Select Code Analyzer from the
list of Debugging & Logging pages.

**Note:** The CFML analyzer does not execute the pages that it checks. Therefore, it cannot detect invalid attribute combi-
nations if the attribute values are provided dynamically at runtime.

For more information on using the Code Compatibility Analyzer, see *Migrating ColdFusion 5 Applications.*

**Troubleshooting common problems**

This section describes a few common problems that you might encounter and ways to resolve them.

For more information on troubleshooting ColdFusion, see the ColdFusion Support Center Testing and Trouble-
shooting page at http://www.adobe.com/support/coldfusion/troubleshoot.html. For common tuning and precau-
tionary measurements that can help you prevent technical problems and improve application performance, see the
ColdFusion tech tips article, TechNote number 13810. A link to the article is located near the top of the Testing and
Troubleshooting page.

**CFML syntax errors**

**Problem:** You get an error message such as the following:

`Encountered "function or tag name" at line 12, column 1.
Encountered """ at line 37, column 20.
Encountered "," at line 24, column 61.
Unable to scan the character '"' which follows "" at line 38, column 53.`

These errors typically indicate that you have unbalanced <, ",", or # characters. One of the most common coding errors
is to forget to close quoted code, number sign-delimited variable names, or opening tags. Make sure the code in the
identified line and previous lines do not have missing characters.

The line number in the error message often does not identify the line that causes the error. Instead, it identifies the
first line where the ColdFusion compiler encountered code that it could not handle as a result of the error.

**Problem:** You get an error message you do not understand.

Make sure all your CFML tags have matching end tags where appropriate. It is a common error to omit the end tag
for the `cfquery`, `cfoutput`, `cftable`, or `cfif` tag.

As with the previous problem, the line number in the error message often does not identify the line that causes the
error, but the first line where the ColdFusion compiler encounters code that it could not handle as a result of the
error. Whenever you have an error message that does not appear to report a line with an error, check the code that
precedes it for missing text.

**Problem:** Invalid attribute or value.

If you use an invalid attribute or attribute values, ColdFusion returns an error message. To prevent such syntax
errors, use the CFML Code Analyzer. Also see "Using the cftrace tag to trace execution" on page 362.
Problem: You suspect that there are problems with the structure or contents of a complex data variable, such as a structure, array, query object, or WDDX-encoded variable.

Use the `cfdump` tag to generate a table-formatted display of the variable's structure and contents. For example, to dump a structure named `relatives`, use the following line. You must surround the variable name with number signs (#).

```coldfusion
<cfdump var=#relatives#>
```

**Data source access and queries**

Problem: You cannot make a connection to the database.

You must create the data source before you can connect. Connection errors can include problems with the location of files, network connections, and database client library configuration.

Create data sources before you refer to them in your application source files. Verify that you can connect to the database by clicking the Verify button on the Data Sources page of the ColdFusion Administrator. If you are unable to make a simple connection from that page, you might need to consult your database administrator to help solve the problem.

Also, check the spelling of the data source name.

Problem: Queries take too long.

Copy and paste the query from the Queries section of the debugging output into your database's query analysis tool. Then retrieve and analyze the execution plan generated by the database server's query optimizer. (The method for doing this varies from dbms to dbms.) The most common cause of slow queries is the lack of a useful index to optimize the data retrieval. In general, avoid table scans (or "clustered index" scans) whenever possible.

**HTTP/URL**

Problem: ColdFusion cannot correctly decode the contents of your form submission.

The `method` attribute in forms sent to the ColdFusion server must be `Post`, for example:

```html
<form action="test.cfm" method="Post">
```

Problem: The browser complains or does not send the full URL string when you include spaces in URL parameters.

Some browsers automatically replace spaces in URL parameters with the `%20` escape sequence, but others might display an error or just send the URL string up to the first character (as does Netscape 4.7).

URL strings cannot have embedded spaces. Use a plus sign (+) or the standard HTTP space character escape sequence, (%20) wherever you want to include a space. ColdFusion correctly translates these elements into a space.

A common scenario in which this error occurs is when you dynamically generate your URL from database text fields that have embedded spaces. To avoid this problem, include only numeric values in the dynamically generated portion of URLs.

Or, you can use the `URLEncodedFormat` function, which automatically replaces spaces with `%20` escape sequences. For more information on the `URLEncodedFormat` function, see the *CFML Reference*. 
Chapter 21: Using the ColdFusion Debugger

Adobe ColdFusion provides debugging information for individual pages. However, for complex development tasks, you require a robust and interactive debugger. ColdFusion provides a line debugger that you can use when developing ColdFusion applications in Eclipse or Adobe Flex Builder. You can set breakpoints, step over, into, or out of code, and inspect variables. You can also view ColdFusion log files.

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About the ColdFusion Debugger

The ColdFusion Debugger is an Eclipse plugin. It runs in the Eclipse Debug perspective. You can use the ColdFusion Debugger to perform debugging tasks, including the following:

- Setting breakpoints
- Viewing variables
- Stepping over, into, and out of function calls

Installing and uninstalling the ColdFusion Debugger

To use the ColdFusion Debugger, you must have the following software installed:

- Eclipse version 3.1.2, Eclipse version 3.2, or Flex Builder 2
- ColdFusion 8

To install the ColdFusion Debugger, you install the ColdFusion Eclipse plugins. For more information, see Installing and Using ColdFusion.

Setting up ColdFusion to use the Debugger

Before you can use the Debugger, you must enable debugging in the ColdFusion Administrator.
**Set up ColdFusion to use the Debugger**

1. In the ColdFusion Administrator, select Debugging & Logging > Debugger Settings.
2. Enable the Allow Line Debugging option.
3. Specify the port to use for debugging if different from the default that appears.
4. Specify the maximum number of simultaneous debug session if different from the default.
5. Click Submit Changes.
6. You may have to increase the time after which requests time-out by doing the following:
   a. Select Server Settings > Settings.
   b. Enable the Timeout Requests After (Seconds) option.
   c. Enter 300 or other appropriate number in the text box.
7. Restart ColdFusion. If you are running the J2EE configuration of ColdFusion, you must restart the server in debug mode with the debug port as specified.
8. To modify the debug settings, in Eclipse, select Window > Preferences > ColdFusion > Debug Settings. You can specify the home page URL, which points to the page that appears in the Debug Output Buffer of the debugger when you click the Home button. You can also specify the extensions of the types of files that you can debug and variable scopes that you want the Debugger to recognize. To improve performance when debugging large files, deselect all scopes for which you do not require information.

**Note:** To ensure that the debugger stops in the template you are debugging on the line that causes a ColdFusion error, you must select Preferences > ColdFusion > Debug Settings and select the Enable Robust Exception Information checkbox.

9. To configure an RDS server, in Eclipse, select Window > Preferences > ColdFusion > RDS Configuration.
   
   If you are running ColdFusion on the same computer as Eclipse, localhost is configured by default. To use any additional RDS servers, you must enter the configuration information.
10. If ColdFusion and Eclipse are not running on the same computer, in Eclipse, select Window > Preferences > ColdFusion > Debug Mappings. Then specify the path that Eclipse uses to open files on the ColdFusion server and the path that ColdFusion uses to find the files that you are editing in Eclipse.

   Mapping ensures that Eclipse and ColdFusion are working on the same file. For example, you may be editing files in an Eclipse project that points to D:\MyCoolApp. Then, when you deploy the files to the ColdFusion server, you copy them to W:\websites\MyCoolSite, which the ColdFusion server recognizes as D:\Shared\websites\MyCoolSite. The mapping in Eclipse specifies that the Eclipse directory is D:\MyCoolApp and the server is D:\Shared\websites\MyCoolSite. Eclipse translates the file path (D:\MyCoolApp\index.cfm) to a path that the ColdFusion server recognizes (D:\Shared\websites\MyCoolSite\index.cfm). To see more information about the interaction between the client and the server, add the following to the JVM arguments in the ColdFusion Administrator:

   -DDEBUGGER_TRACE=true

11. If you are not running the server configuration of ColdFusion, you must specify Java debugging parameters in the configuration file or startup script of the application server you are running. The parameters should look like the following:

   -xdebug -Xrunjdwp:transport=dt_socket,server=y,suspend=n,address=<port_number>

   Ensure that the port number you specify is the same port number specified on the Debugger Settings page of ColdFusion Administrator.
If you are running the server configuration, ColdFusion writes these debugging parameters to the jvm.config file when you use the Debugger Settings page of the ColdFusion Administrator.

12 If you are not running the server configuration and your application server is not running on JRE 1.6, you must copy the tools.jar file of the JDK version that your application server is running to the \lib folder of ColdFusion. For example, if you are running JRun that runs on JRE 1.4, copy the tools.jar file of JDK 1.4 to the \lib folder of ColdFusion.

13 If you are running the server version of ColdFusion and you specify a JRE version other than JRE 1.6 in the jvm.config file, you must copy the tools.jar file of the JDK version specified in your jvm.config file to the \lib folder of ColdFusion.

**Note:** To debug ColdFusion applications running on the multiserver configuration, you must start the ColdFusion server from the command line using the following command:

```
jrun -config <path_to_jvm_config> -start <server_name>
```

### About the Debug perspective

After you install the ColdFusion Plugin, enable the debugger in ColdFusion, and configure Eclipse, you can use the ColdFusion Debugger in Eclipse. It is available in the Eclipse Debug perspective.

The Debug perspective includes the following:

- **Debug pane**, which keeps the results of each completed session. The following buttons appear at the top of this pane:
  - Resume - Resumes a debugging session
  - Suspend - Pauses a debugging session
  - Terminate - Stops a debugging session
  - Disconnect - Disconnects the debugger from the selected debug target when debugging remotely
  - Remove All Terminated Launches - Clears all terminated debug targets from the display
  - Step Into - Executes code line by line, including included code, UDFs, CFCs, and the like
  - Step Over - Executes code line by line, excluding included code, UDFs, CFCs, and the like
  - Step Return - Returns to the original page from which you entered the included code, UDF, CFC, or the like
  - Drop to Frame - Reenters a specified stack frame, which is analogous to going in reverse and restarting your program partway through
  - Use Step Filters/Step Debug - Ensures that all step functions apply step filters
  - Menu - Displays the menu that lets you manage the view, show system threads, show qualified names, and show monitors
- **Variables pane**, which shows the current variables, including the variable scope. The following buttons appear at the top of this pane:
  - Show Type Names - Displays the type of the variables
  - Show Logical Structure - This button is not supported
  - Collapse All - Collapses the information in the panel to show only variable types
• Breakpoints pane - Lists breakpoints in the ColdFusion application. The following buttons appear at the top of this pane:
  • Remove Selected Breakpoints - Removes a breakpoint
  • Remove All Breakpoints - Removes all breakpoints
  • Show Breakpoints Supported by Selected Targets - Displays the breakpoints for what you are currently debugging
  • Go to File for Breakpoint - Goes to the file in which the selected breakpoint is set
  • Skip All Breakpoints - Ignores all breakpoints
  • Expand All - Expands the information in the pane
  • Collapse All - Collapses the information in the pane
  • Link with Debug View - Highlights the selected breakpoint when the application stops execution in the Debug View
  • Add Java Exception Breakpoint - Lets you specify which Java exception to throw when you reach the selected breakpoint
  • Menu - Lets you specify the type of information to display in the Breakpoints pane
  • Debug Output Buffer - Contains two panes: Browser, which displays what appears in the browser during application execution; Server Output Buffer, which displays the debug output.
  • Edit pane, which displays the stacked source panes, one for each source file you have open.
  • Outline pane, which displays the current source file’s content in outline form

Using the ColdFusion Debugger

After you enabled the debugger in the ColdFusion Administrator and configure Eclipse, you can debug ColdFusion pages that are in an Eclipse project. You can use the ColdFusion Debugger to do the following tasks:
  • Setting a breakpoint
  • Executing code line by line
  • Inspecting variables

Begin debugging a ColdFusion application
1 Open the file in the Eclipse project to debug.
   You do not have to create an Eclipse project in the same folder as CFML source. You can create a project in a different folder, create a folder under that project, and then link it to the folder where CFML sources reside.
2 Click Debug in the upper-right corner of the Eclipse workbench to go to the Debug perspective.
3 Select Window > Show View > Debug Output Buffer to be able to see the output from your application and how your application appears in a browser.
4 Select Window > Preferences and specify the home page for your debugging session, the extensions of the file types that you can debug, and the variable scopes of the variables to show in the Variables pane. Click OK.
   The home page is the page that appears in the Debug Output Buffer pane when you click the Home button in the Debug Output Buffer pane.
5  To begin debugging the file whose source appears in the Edit pane, click the Debug icon in the Eclipse toolbar.

6  Click New to create a new debugging configuration.

7  Specify the home page for the active debug session.

   This is the page that appears in the Debug Output Buffer pane when you click the Debug Session Home button in the Debug Output Buffer pane.

8  Click Debug to start the debug session.

   Note: If you are in the process of debugging a template and then try to browse to or refresh that page, doing so can result in unexpected behavior in the Debugger.

Setting a breakpoint

You can set breakpoints in your CFML file to stop execution of the page at particular points. When you set a breakpoint on a line, execution of the CFML stops just before that line. For example, if you set a breakpoint on the third line in the following CFML page, execution stops before `<cfset myName = "Wilson">`.

```cfml
<cfset yourName = "Tuckerman">
<cfoutput>Your name is #yourName#.</cfoutput>
<cfset myName = "Wilson"
```

You should execute the page that you want to debug before setting any breakpoints to compile it before debugging it. This improves performance during debugging. You cannot set a breakpoint in a file that is not part of a project.

Set a breakpoint

1  In Eclipse, open the file in which you want to set a breakpoint.

2  While highlighting the line where you want to set the breakpoint, do one of the following:

   •  Double-click in the marker bar that appears to the left of the editor area.

   •  Right click, and then select Toggle Breakpoint.

   •  Press Alt+Shift+B.

   A blue dot appears before the line on which you set the breakpoint.

Also, you can view a list of breakpoints set in the current Eclipse project in the Breakpoints panel.

ColdFusion breakpoints have four states in the Eclipse debugger:

   •  Enabled and Valid - This is a breakpoint at a valid location. It is represented by a solid blue circle and stops code execution when encountered.

   •  Unresolved - ColdFusion sets the breakpoint for the page that is loaded in its memory. If you modify the page and do not execute it, the source is not in sync with the page that ColdFusion sees on the server. In this situation, ColdFusion may consider the line where you want to set breakpoint to be invalid. However, you have not yet executed the page; when you do so, that line may be valid. This type of breakpoint is represented by a question mark (?) icon.

   For performance reasons, ColdFusion does not try to resolve unresolved breakpoints every time you execute the page. It tries to resolve them when you modify the page and execute it. If you think that the line at which ColdFusion shows an unresolved breakpoint is valid, delete the breakpoint and set it again.

   •  Invalid - If ColdFusion determines that the CFML that you edit in Eclipse is the same as the CFML in its memory, and that the breakpoint you have set is at an invalid line, the breakpoint appears as a red X.

   •  Disabled.
Executing code line by line
You can use the Step Into, Step Over, and Step Return buttons to proceed through your CFML application line by line. Use Step Into to proceed into included files, such as UDFs or CFCs. Use the Step Over button to proceed through your CFML application, bypassing included files, such as UDFs or CFCs. Use the Step Return button to return to the original page from which you entered the included file, such as UDFs or CFCs.

For the stepping process to work properly, you must clear the cache of compiled classes. To do so, recompile all CFML pages compiled with an earlier version of ColdFusion. In large files, you might find that stepping and breakpoints are slow. To improve performance, in Eclipse, select Windows > Preferences > ColdFusion > Debug Settings and deselect all scopes for which you do not require information.

You should avoid using Step In on CFML instructions such as the `cfset` tag. Step In is more performance intensive than Step Over. You can use Step In for UDFs, CFCs, custom tags and included files.

When stepping into functions, tags, and files, Eclipse expects the file to be displayed in one of the open projects. The file that you are stepping in must be in an open Eclipse project.

Sometimes Eclipse 3.2.1 does not show the stack trace, and step buttons are disabled, even though the debugger has stopped at a line. To enable the step buttons, click the debugger server instance in the Debug window. To see the stack trace, click either Step In or Step Out.

Inspecting variables
As you observe execution of your code, you can see the values and scope of variables in the Variables panel. The Variables panel displays the scope and value of variables as the CFML code executes. Only variables whose scopes are those you selected in the Preferences dialog box appear in the Variables pane.

Viewing ColdFusion log files
You can easily see the contents of all the log files that ColdFusion generates by using the Log File Viewer.

View the ColdFusion log files
1 In Eclipse, select Window > Show View > Other > ColdFusion > CF Log Viewer.
2 To view details of a log file, double-click the name of the file.
3 To include the log files in another folder, click the Add Log Folder button, select the folder, and then click OK.
4 To remove a folder from the list, without deleting it from the computer’s file system, click the Delete Log File button, select the folder, and then click OK.
5 To remove a log file from the computer’s file system, click the Delete Log File button.
6 To remove the contents of the detail pane, click the Menu button, and then click Clear Log.
7 To update the contents of the detail pane, click the Menu button, and then click Refresh Log.
Part 4: Accessing and Using Data

This part contains the following topics:

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Chapter 22: Introduction to Databases and SQL

ColdFusion lets you create dynamic applications to access and modify data stored in a database. You do not require a thorough knowledge of databases to develop ColdFusion applications, but you must know some basic database and SQL concepts and techniques.

Each database server (such as SQL Server, Oracle, or DB2) has unique capabilities and properties. For more information, see the documentation that ships with your database server.

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What is a database?

A database defines a structure for storing information. Databases are typically organized into tables, which are collections of related items. You can think of a table as a grid of columns and rows. ColdFusion works primarily with relational databases, such as Oracle, DB2, and SQL Server.

The following image shows the basic layout of a database table:

A. row  B. column

A column defines one piece of data stored in all rows of the table. A row contains one item from each column in the table.

For example, a table might contain the ID, name, title, and other information for individuals employed by a company. Each row, called a data record, corresponds to one employee. The value of a column within a record is referred to as a record field.

The following image shows an example table, named employees, containing information about company employees:
Example employees table

The record for employee 4 contains the following field values:

- LastName field is “Smith”
- FirstName field is “John”
- Title field is “Engineer”

This example uses the EmpID field as the table’s primary key field. The primary key contains a unique identifier to maintain each record’s unique identity. Primary keys field can include an employee ID, part number, or customer number. Typically, you specify which column contains the primary key when you create a database table.

To access the table to read or modify table data, you use the SQL programming language. For example, the following SQL statement returns all rows from the table where the department ID is 3:

```sql
SELECT * FROM employees WHERE DEPTID=3
```

Note: In this topic, SQL keywords and syntax are always represented by uppercase letters. Table and column names use mixed uppercase and lowercase letters.

Using multiple database tables

In many database designs, information is distributed to multiple tables. The following image shows two tables, one for employee information and one for employee addresses:

<table>
<thead>
<tr>
<th>EmpID</th>
<th>LastName</th>
<th>FirstName</th>
<th>Title</th>
<th>DepID</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jones</td>
<td>Joe</td>
<td>Engineer</td>
<td>3</td>
<td>jones</td>
<td>60944</td>
</tr>
<tr>
<td>2</td>
<td>Davis</td>
<td>Kim</td>
<td>Manager</td>
<td>4</td>
<td>heems</td>
<td>60844</td>
</tr>
<tr>
<td>3</td>
<td>Baker</td>
<td>Mary</td>
<td>Engineer</td>
<td>2</td>
<td>mbaker</td>
<td>60955</td>
</tr>
<tr>
<td>4</td>
<td>Smith</td>
<td>John</td>
<td>Engineer</td>
<td>3</td>
<td>jsmith</td>
<td>60333</td>
</tr>
<tr>
<td>5</td>
<td>Novak</td>
<td>Jino</td>
<td>Manager</td>
<td>3</td>
<td>ksmith</td>
<td>60850</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EmpID</th>
<th>Street</th>
<th>City</th>
<th>State</th>
<th>Zip</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Addison St</td>
<td>Newton</td>
<td>MA</td>
<td>02160</td>
</tr>
<tr>
<td>2</td>
<td>10 Oak Dr</td>
<td>Newton</td>
<td>MA</td>
<td>02161</td>
</tr>
<tr>
<td>3</td>
<td>55 Main St</td>
<td>Newton</td>
<td>MA</td>
<td>02160</td>
</tr>
<tr>
<td>4</td>
<td>55 Maple Lk</td>
<td>Newton</td>
<td>MA</td>
<td>02160</td>
</tr>
<tr>
<td>5</td>
<td>20 Elm St</td>
<td>Newton</td>
<td>MA</td>
<td>02160</td>
</tr>
</tbody>
</table>

A. employees table  B. addresses table
In this example, each table contains a column named EmpID. This column associates a row of the employees table with a row in the addresses table.

For example, to obtain all information about an employee, you request a row from the employees table and the row from the addresses table with the same value for EmpID.

One advantage of using multiple tables is that you can add tables containing new information without modifying the structure of your existing tables. For example, to add payroll information, you add a new table to the database where the first column contains the employee's ID and the columns contain current salary, previous salary, bonus payment, and 401(k) percent.

Also, an access to a small table is more efficient than an access to a large table. Therefore, if you update the street address of an employee, you update only the addresses table, without having to access any other table in the database.
Database permissions
In many database environments, a database administrator defines the access privileges for users accessing the database, usually through username and password. When a person attempts to connect to a database, the database ensures that the username and password are valid and then imposes access requirements on the user.

Privileges can restrict user access so that a user can do the following:
- Read data.
- Read data and add rows.
- Read data, add rows, modify existing tables.

In ColdFusion, you use the ColdFusion Administrator to define database connections, called data sources. As part of defining these connections, you specify the username and password used by ColdFusion to connect to the database. The database can then control access based on this username and password.

For more information on creating a data source, see Configuring and Administering ColdFusion.

Commits, rollbacks, and transactions
Before you access data stored in a database, it is important to understand several database concepts, including:
- Commit
- Rollback
- Transactions

A database commit occurs when you make a permanent change to a database. For example, when you write a new row to a database, the write does not occur until the database commits the change.

Rollback is the process of undoing a change to a database. For example, if you write a new row to a table, you can rollback the write up to the point where you commit the write. After the commit, you can no longer rollback the write.

Most databases support transactions where a transaction consists of one or more SQL statements. Within a transaction, your SQL statements can read, modify, and write a database. You end a transaction by either committing all your changes within the transaction or rolling back all of them.

Transactions can be useful when you have multiple writes to a database and want to make sure all writes occurred without error before committing them. In this case, you wrap all writes within a single transaction and check for errors after each write. If any write causes an error, you rollback all of them. If all writes occur successfully, you commit the transaction.

A bank might use a transaction to encapsulate a transfer from one account to another. For example, if you transfer money from your savings account to your checking account, you do not want the bank to debit the balance of your savings account unless it also credits your checking account. If the update to the checking account fails, the bank can rollback the debit of the savings account as part of the transaction.

ColdFusion includes the cftransaction tag that lets you implement database transactions for controlling rollback and commit. For more information, see the CFML Reference.

Database design guidelines
From this basic description, the following database design rules emerge:
• Each record should contain a unique identifier as the primary key such as an employee ID, a part number, or a customer number. The primary key is typically the column used to maintain each record’s unique identity among the tables in a relational database. Databases allow you to use multiple columns for the primary key.

• When you define a column, you define a SQL data type for the column, such as allowing only numeric values to be entered in the salary column.

• Assessing user needs and incorporating those needs in the database design is essential to a successful implementation. A well-designed database accommodates the changing data needs within an organization.

The best way to familiarize yourself with the capabilities of your database product or database management system (DBMS) is to review the product documentation.

Using SQL

The following information introduces SQL, describes basic SQL syntax, and contains examples of SQL statements. so that you can begin to use ColdFusion. For complete SQL information, see the SQL reference that ships with your database.

A query is a request to a database. The query can ask for information from the database, write new data to the database, update existing information in the database, or delete records from the database.

Structured Query Language (SQL) is an ANSI/ISO standard programming language for writing database queries. All databases supported by ColdFusion support SQL, and all ColdFusion tags that access a database let you pass SQL statements to the tag.

**SQL example**

The most commonly used SQL statement in ColdFusion is the SELECT statement. The SELECT statement reads data from a database and returns it to ColdFusion. For example, the following SQL statement reads all the records from the employees table:

```
SELECT * FROM employees
```

You interpret this statement as "Select all rows from the table employees" where the wildcard symbol (*) corresponds to all columns.

*If you are using Dreamweaver MX 2004, Adobe Dreamweaver CS3, or HomeSite+, you can use the built-in query builder to build SQL statements graphically by selecting the tables and records to retrieve. For more information, see "Writing queries by using an editor" on page 389.*

In many cases, you do not want all rows from a table, but only a subset of rows. The next example returns all rows from the employees table, where the value of the DeptID column for the row is 3:

```
SELECT * FROM employees WHERE DeptID=3
```

You interpret this statement as "Select all rows from the table employees where the DeptID is 3".

SQL also lets you specify the table columns to return. For example, instead of returning all columns in the table, you can return a subset of columns:

```
SELECT LastName, FirstName FROM employees WHERE DeptID=3
```

You interpret this statement as "Select the columns FirstName and LastName from the table employees where the DeptID is 3".
In addition to reading data from a table, you can write data to a table using the SQL INSERT statement. The following statement adds a new row to the employees table:

```
INSERT INTO employees(EmpID, LastName, Firstname) VALUES(51, 'Doe', 'John')
```

**Basic SQL syntax elements**
The following tables briefly describe the main SQL command elements.

**Statements**
A SQL statement always begins with a SQL verb. The following keywords identify commonly used SQL verbs:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECT</td>
<td>Retrieves the specified records.</td>
</tr>
<tr>
<td>INSERT</td>
<td>Adds a new row.</td>
</tr>
<tr>
<td>UPDATE</td>
<td>Changes values in the specified rows.</td>
</tr>
<tr>
<td>DELETE</td>
<td>Removes the specified rows.</td>
</tr>
</tbody>
</table>

**Statement clauses**
Use the following keywords to refine SQL statements:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FROM</td>
<td>Names the data tables for the operation.</td>
</tr>
<tr>
<td>WHERE</td>
<td>Sets one or more conditions for the operation.</td>
</tr>
<tr>
<td>ORDER BY</td>
<td>Sorts the result set in the specified order.</td>
</tr>
<tr>
<td>GROUP BY</td>
<td>Groups the result set by the specified select list items.</td>
</tr>
</tbody>
</table>

**Operators**
The following basic operators specify conditions and perform logical and numeric functions:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AND</td>
<td>Both conditions must be met</td>
</tr>
<tr>
<td>OR</td>
<td>At least one condition must be met</td>
</tr>
<tr>
<td>NOT</td>
<td>Exclude the condition following</td>
</tr>
<tr>
<td>LIKE</td>
<td>Matches with a pattern</td>
</tr>
<tr>
<td>IN</td>
<td>Matches with a list of values</td>
</tr>
<tr>
<td>BETWEEN</td>
<td>Matches with a range of values</td>
</tr>
<tr>
<td>=</td>
<td>Equal to</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>Not equal to</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to</td>
</tr>
</tbody>
</table>
Case sensitivity with databases
ColdFusion is a case-insensitive programming environment. Case insensitivity means the following statements are equivalent:

```coldfusion
<cfset foo="bar">
<CFSET FOO="BAR">
<CfSet FOO="bar">

However, many databases, especially UNIX databases, are case-sensitive. Case sensitivity means that you must match exactly the case of all column and table names in SQL queries.

For example, the following queries are not equivalent in a case-sensitive database:

```
SELECT LastName FROM EMPLOYEES
SELECT LASTNAME FROM employees
```

In a case-sensitive database, employees and EMPLOYEES are two different tables.

For information on how your database handles case, see the product documentation.

SQL notes and considerations
When writing SQL in ColdFusion, keep the following guidelines in mind:

• There is a lot more to SQL than what is covered here. It is a good idea to purchase one or several SQL guides for reference.

• The data source, columns, and tables that you reference must exist in order to perform a successful query.

• Some DBMS vendors use nonstandard SQL syntax (known as a dialect) in their products. ColdFusion does not validate the SQL; it is passed on to the database for validation, so you are free to use any syntax that is supported by your database. Check your DBMS documentation for nonstandard SQL usage.

Reading data from a database
You use the SQL SELECT statement to read data from a database. The SQL statement has the following general syntax:

```
SELECT column_names
FROM table_names
[ WHERE search_condition ]
[ GROUP BY group_expression ] [HAVING condition]
[ ORDER BY order_condition [ ASC | DESC ] ]
```

The statements in square brackets are optional.

**Note:** There are additional options to SELECT depending on your database. For a complete syntax description for SELECT, see the product documentation.
Results of a SELECT statement

When the database processes a SELECT statement, it returns a record set containing the requested data. The format of a record set is a table with rows and columns. For example, if you write the following query:

SELECT * FROM employees WHERE DeptID=3

The query returns the following table:

<table>
<thead>
<tr>
<th>EmpID</th>
<th>LastName</th>
<th>FirstName</th>
<th>Title</th>
<th>DeptID</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Because the data returned to ColdFusion by a SELECT statement is in the form of a database table, ColdFusion lets you write a SQL query on the returned results. This functionality is called query of queries. For more information on query of queries, see "Accessing and Retrieving Data" on page 392.

The next example uses a SELECT statement to return only a specific set of columns from a table:

SELECT LastName, FirstName FROM employees WHERE DeptID=3

The query returns the following table:

<table>
<thead>
<tr>
<th>LastName</th>
<th>FirstName</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Filtering results

The SELECT statement lets you filter the results of a query to return only those records that meet specific criteria. For example, if you want to access all database records for employees in department 3, you use the following query:

SELECT * FROM employees WHERE DeptID=3

You can combine multiple conditions using the WHERE clause. For example, the following example uses two conditions:

SELECT * FROM employees WHERE DeptID=3 AND Title='Engineer'

Sorting results

By default, a database does not sort the records returned from a SQL query. In fact, you cannot guarantee that the records returned from the same query are returned in the same order each time you run the query.

However, if you require records in a specific order, you can write your SQL statement to sort the records returned from the database. To do so, you include an ORDER BY clause in the SQL statement.

For example, the following SQL statement returns the records of the table ordered by the LastName column:

SELECT * FROM employees ORDER BY LastName

You can combine multiple fields in the ORDER BY clause to perform additional sorting:
SELECT * FROM employees ORDER BY DepartmentID, LastName

This statement returns row ordered by department, then by last name within the department.

Returning a subset of columns
You might want only a subset of columns returned from a database table, as in the following example, which returns only the FirstName, LastName, and Phone columns. This example is useful if you are building a web page that shows the phone numbers for all employees.

SELECT FirstName, LastName, Phone FROM employees

However, this query does not return the table rows in alphabetical order. You can include an ORDER clause in the SQL, as follows:

SELECT the FirstName, LastName, Phone FROM employees ORDER BY LastName, FirstName

Using column aliases
You might have column names that you do not want to retain in the results of your SQL statement. For example, your database is set up with a column that uses a reserved word in ColdFusion, such as EQ. In this case, you can rename the column as part of the query, as follows:

SELECT EmpID, LastName, EQ as MyEQ FROM employees

The results returned by this query contains columns named EmpID, LastName, and MyEQ.

Accessing multiple tables
In a database, you can have multiple tables containing related information. You can extract information from multiple tables as part of a query. In this case, you specify multiple table names in the SELECT statement, as follows:

SELECT LastName, FirstName, Street, City, State, Zip FROM employees, addresses WHERE employees.EmpID = addresses.EmpID ORDER BY LastName, FirstName

This SELECT statement uses the EmpID field to connect the two tables. This query prefixes the EmpID column with the table name. This is necessary because each table has a column named EmpID. You must prefix a column name with its table name if the column name appears in multiple tables.

In this case, you extract LastName and FirstName information from the employees table and Street, City, State, and Zip information from the addresses table. You can use output such as this is to generate mailing addresses for an employee newsletter.

The results of a SELECT statement that references multiple tables is a single result table containing a join of the information from corresponding rows. A *join* means information from two or more rows is combined to form a single row of the result. In this case, the resultant record set has the following structure:

<table>
<thead>
<tr>
<th>LastName</th>
<th>FirstName</th>
<th>Street</th>
<th>City</th>
<th>State</th>
<th>Zip</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What is interesting in this result is that even though you used the EmpID field to combine information from the two tables, you did not include that field in the output.

**Modifying a database**

You can use SQL to modify a database in the following ways:

- Inserting data into a database
- Updating data in a database
- Deleting data from a database
- Updating multiple tables

**Inserting data into a database**

You use SQL INSERT statement to write information to a database. A write adds a new row to a database table. The basic syntax of an INSERT statement is as follows:

```
INSERT INTO table_name(column_names) VALUES(value_list)
```

where:

- `column_names` specifies a comma-separated list of columns.
- `value_list` specifies a comma-separated list of values. The order of values has to correspond to the order that you specified column names.

**Note:** There are additional options to INSERT depending on your database. For a complete syntax description for INSERT, see the product documentation.

For example, the following SQL statement adds a new row to the employees table:

```
INSERT INTO employees(EmpID, LastName, Firstname) VALUES(51, 'Smith', 'John')
```

This statement creates a new row in the employees table and sets the values of the EmpID, LastName, and FirstName fields of the row. The remaining fields in the row are set to Null. Null means the field does not contain a value.

When you, or your database administrator, creates a table, you can set properties on the table and the columns of the table. One of the properties you can set for a column is whether the field supports Null values. If a field supports Nulls, you can omit the field from the INSERT statement. The database automatically sets the field to Null when you insert a new row.

However, if the field does not support Nulls, you must specify a value for the field as part of the INSERT statement; otherwise, the database issues an error.

The LastName and FirstName values in the query are contained within single-quotation marks. This is necessary because the table columns are defined to contain character strings. Numeric data does not require the quotation marks.

**Updating data in a database**

Use the UPDATE statement in SQL to update the values of a table row. Update lets you update the fields of a specific row or all rows in the table. The UPDATE statement has the following syntax:

```
UPDATE table_name
SET column_name1=value1, ... , column_nameN=valueN
[ WHERE search_condition ]
```
**Note:** There are additional options to UPDATE depending on your database. For a complete syntax description for UPDATE, see the product documentation.

You should not attempt to update a record's primary key field. Your database typically enforces this restriction.

The UPDATE statement uses the optional WHERE clause, much like the SELECT statement, to determine which table rows to modify. The following UPDATE statement updates the e-mail address of John Smith:

```
UPDATE employees SET Email='jsmith@mycompany.com' WHERE EmpID = 51
```

Be careful using UPDATE. If you omit the WHERE clause to execute the following statement:

```
UPDATE employees SET Email = 'jsmith@mycompany.com'
```

you update the Email field for all rows in the table.

### Deleting data from a database

The DELETE statement removes rows from a table. The DELETE statement has the following syntax:

```
DELETE FROM table_name
```

**Note:** There are additional options to DELETE depending on your database. For a complete syntax description for DELETE, see the product documentation.

You can remove all rows from a table using a statement in the form:

```
DELETE FROM employees
```

Typically, you specify a WHERE clause to the DELETE statement to delete specific rows of the table. For example, the following statement deletes John Smith from the table:

```
DELETE FROM employees WHERE EmpID=51
```

### Updating multiple tables

The preceding examples describe how to modify a single database table. However, you might have a database that uses multiple tables to represent information.

One way to update multiple tables is to use one INSERT statement per table and to wrap all INSERT statements within a database transaction. A transaction contains one or more SQL statements that can be rolled back or committed as a unit. If any single statement in the transaction fails, you can roll back the entire transaction, cancelling any previous writes that occurred within the transaction. You can use the same technique for selects, updates, and deletes. The following example uses the `cftransaction` tag to wrap multiple SQL statements:

```
<cftransaction>

<cfquery name="qInsEmp" datasource="cfdocexamples">
    INSERT INTO Employees (FirstName,LastName,EMail,Phone,Department)
    VALUES ('Simon', 'Horwith', 'SHORWITH','(202)-797-6570','Research and Development')
</cfquery>

<cfquery name="qGetID" datasource="cfdocexamples">
    SELECT MAX(Emp_ID) AS New_Employee
    FROM Employees
</cfquery>

</cftransaction>
```
Writing queries by using an editor

Dreamweaver and HomeSite+ provide a graphical user interface (GUI) for writing and executing queries. A GUI is useful for developing and testing your queries before you insert them into a ColdFusion application. For more information about these GUIs, see the documentation in your specific tool.

Writing queries using Dreamweaver

You define a query by using the Dreamweaver Recordset dialog box, which lets you create a record set without manually entering SQL statements. Defining a record set with this method can be as easy as selecting a database connection and table from the pop-up menus.

Define a record set without writing SQL

1. In the Dreamweaver Document window, open the page that will use the record set.
2. To open the Data Bindings panel, select Window > Data Bindings.
3. In the Data Bindings panel, click the Plus (+) button and choose Recordset (Query) from the pop-up menu.

The Simple Recordset dialog box appears:

4. Complete the dialog box.
5. Click the Test button to execute the query and ensure that it retrieves the information you intended.
   - If you defined a filter that uses parameters input by users, the Test button displays the Test Value dialog box. Enter a value in the Test Value text box and click OK. If an instance of the record set is successfully created, a table displaying the data from your record set appears.
6. Click OK to add the record set to the list of available content sources in the Data bindings panel.

If you prefer to write your own SQL statements, or need to create more complex queries than the Simple Recordset dialog box allows, you can define record sets using the Advanced Recordset dialog box.

Creating an advanced record set by writing SQL:

1. In the Dreamweaver Document window, open the page that will use the record set.
2. Select Windows > Data Bindings to display the Data Bindings panel.
3. In the Data Bindings panel, click the Plus (+) button and select Recordset (Query) from the pop-up menu.
   - If the Simple Recordset dialog box appears, switch to the Advanced Recordset dialog box by clicking the Advanced button.

The Advanced Recordset dialog box appears:
4 Complete the dialog box.

5 Click the Test button to execute the query and ensure that it retrieves the information you intended.

   If you defined a filter that uses parameters input by users, the Test button displays the Test Value dialog box. Enter a value in the Test Value text field and click OK. If an instance of the record set is successfully created, a table displaying the data from your record set appears.

6 Click OK to add the record set to the list of available content sources in the Data Bindings panel.

**Writing queries by using HomeSite+**

HomeSite+ includes the combined features of HomeSite 5 and ColdFusion Studio 5, with additional support for new ColdFusion tags. HomeSite+ supports SQL Builder for writing queries.

SQL Builder is a powerful visual tool for building, testing, and saving SQL statements for use in application data queries. You can copy completed SQL code blocks directly into your ColdFusion applications.

**Open SQL Builder**

❖ Do one of the following:

   • Select Tools > SQL Builder from the HomeSite+ menu, select an RDS server, select a database from the drop-down list, and click New Query.
   • In the Database tab, select an RDS server, right-click a database name or a table, and select New Query.
   • Open the cfquery tag editor, select an RDS server, and click New Query.

**The SQL Builder interface**

The following image shows the SQL Builder interface:
The SQL Builder is divided into the following four sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toolbar</td>
<td>Contains buttons for SQL keywords and commands.</td>
</tr>
<tr>
<td>Table pane</td>
<td>Provides a view of the tables in your query and allows you to create joins between tables.</td>
</tr>
<tr>
<td>Properties pane</td>
<td>Allows you to set the properties of the query, such as the columns that are being selected or the columns that are being updated.</td>
</tr>
<tr>
<td>SQL pane</td>
<td>Shows you the SQL statement as it is built. The SQL pane does not support reverse editing, so any changes you make in this pane will not be made to the query in the Properties pane or the Table pane.</td>
</tr>
</tbody>
</table>

**Writing SQL statements**

SQL Builder opens a SELECT statement by default, because this is the most common type of query. SQL Builder supports the following four types of SQL statements:

- Select (default)
- Insert
- Update
- Delete
Chapter 23: Accessing and Retrieving Data

Several ColdFusion tags provide a way to retrieve data from a database and work with query data. Use the \texttt{cfquery} tag to query a data source, the \texttt{cfoutput} tag to output the query results to a web page, and the \texttt{cfqueryparam} tag to help reduce security risks in your applications.

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Outputting query data ............................................................................................................................ 395
Getting information about query results ............................................................................................... 397
Enhancing security with \texttt{cfqueryparam} ......................................................................................... 398

Working with dynamic data

A web application page is different from a static web page because it can publish data dynamically. This can involve querying databases, connecting to LDAP or mail servers, and leveraging COM, DCOM, CORBA, or Java objects to retrieve, update, insert, and delete data at run time—as your users interact with pages in their browsers.

For ColdFusion developers, the term data source can refer to a number of different types of structured content accessible locally or across a network. You can query websites, LDAP servers, POP mail servers, and documents in a variety of formats. Most commonly though, a database drives your applications, and for this discussion a data source means the entry point from ColdFusion to a database.

In this topic, you build a query to retrieve data from the \texttt{cfdocexamples} data source.

To query a database, you must use:

- ColdFusion data sources
- The \texttt{cfquery} tag
- SQL commands

Retrieving data

You can query databases to retrieve data at run time. The retrieved data, called the record set, is stored on that page as a query object. A query object is a special entity that contains the record set values, plus RecordCount, CurrentRow, ColumnList, SQL, Cached, and SqlParameter query variables. You specify the query object's name in the name attribute of the \texttt{cfquery} tag. The query object is often called simply the query.

The following is a simple \texttt{cfquery} tag:

\begin{verbatim}
<cfquery name = "GetSals" datasource = "cfdocexamples">
    SELECT * FROM Employee
</cfquery>
\end{verbatim}
ORDER BY LastName
</cfquery>

Note: The terms “record set” and “query object” are often used synonymously when discussing record sets for queries. For more information, see “Using Query of Queries” on page 413.

When retrieving data from a database, perform the following tasks:

- To tell ColdFusion how to connect to a database, use the cfquery tag on a page.

- To specify the data that you want to retrieve from the database, write SQL commands inside the cfquery block.

- Reference the query object and use its data values in any tag that presents data, such as cfoutput, cfgrid, cftable, cfgraph, or cftree.

The cfquery tag

The cfquery tag is one of the most frequently used CFML tags. You use it to retrieve and reference the data returned from a query. When ColdFusion encounters a cfquery tag on a page, it does the following:

- Connects to the specified data source.

- Performs SQL commands that are enclosed within the block.

- Returns result set values to the page in a query object.

The cfquery tag syntax

The following code shows the syntax for the cfquery tag:

```<cfquery name="EmpList" datasource="cfdocexamples">
  SQL code...
</cfquery>```

In this example, the query code tells ColdFusion to do the following:

- Connect to the cfdocexamples data source (the cfdocexamples.mdb database).

- Execute SQL code that you specify.

- Store the retrieved data in the query object EmpList.

When creating queries to retrieve data, keep the following guidelines in mind:

- You must use opening <cfquery> and ending </cfquery> tags, because the cfquery tag is a block tag.

- Enter the query name and datasource attributes within the opening cfquery tag.

- To tell the database what to process during the query, place SQL statements inside the cfquery block.

- When referencing text literals in SQL, use single-quotation marks ('). For example, SELECT * FROM mytable WHERE FirstName='Jacob' selects every record from mytable in which the first name is Jacob.

- Surround attribute values with double quotation marks (“attrib_value”).

- Make sure that a data source exists in the ColdFusion Administrator before you reference it in a cfquery tag.

- Columns and tables that you refer to in your SQL statement must exist, otherwise the query fails.

- Reference the query data by naming the query in one of the presentation tags, such as cfoutput, cfgrid, cftable, cfgraph, or cftree.
• When ColdFusion returns database columns, it removes table and owner prefixes. For example, if you query Employee.Emp_ID in the query, the Employee, is removed and returns as Emp_ID. You can use an alias to handle duplicate column names; for more information, see “Using Query of Queries” on page 413.

• You cannot use SQL reserved words, such as MIN, MAX, COUNT, in a SQL statement. Because reserved words are database-dependent, see your database's documentation for a list of reserved words.

• If you use COMPUTE AVG() in your SQL, ColdFusion 8 returns avg() as the column name. (Previous versions (ColdFusion 5 and ColdFusion MX 7) returned ave() as the column name.)

Building queries
As discussed earlier, you build queries by using the cfquery tag and SQL.

Note: This and many subsequent procedures use the cfdocexamples data source that connects to the cfdocexamples.mdb database. This data source is installed by default. For information on adding or configuring a data source, see Configuring and Administering ColdFusion.

Query the table
1 Create a ColdFusion page with the following content:

```
<html>
<head>
<title>Employee List</title>
</head>
<body>
<h1>Employee List</h1>
<cfquery name="EmpList" datasource="cfdocexamples">
  SELECT FirstName, LastName, Salary, Contract
  FROM Employee
</cfquery>
</body>
</html>
```

Note: Adobe recommends that you create structured, reusable code by putting queries in ColdFusion components; however, for simplicity, the examples in this topic include the query in the body of the ColdFusion page. For more information about using ColdFusion components, see “Building and Using ColdFusion Components” on page 158.

2 Save the page as emplist.cfm in the myapps directory under your web_root directory. For example, the default path on a Windows computer would be:

   C:\CFusion\wwwroot\myapps\

3 Enter the following URL in your web browser:

   http://localhost/myapps/emplist.cfm

   Only the header appears.

4 View the source in the browser:
ColdFusion creates the EmpList data set, but only HTML and text return to the browser. When you view the page's source, you see only HTML tags and the heading "Employee List." To display the data set on the page, you must code tags and variables to output the data.

Reviewing the code

The query you just created retrieves data from the cfdocexamples database. The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfquery name=&quot;EmpList&quot; datasource=&quot;cfdocexamples&quot;&gt;</code></td>
<td>Queries the database specified in the cfdocexamples data source.</td>
</tr>
<tr>
<td><code>SELECT FirstName, LastName, Salary, Contract</code></td>
<td>Gets information from the FirstName, LastName, Salary, and Contract fields in the Employee table.</td>
</tr>
<tr>
<td><code>&lt;/cfquery&gt;</code></td>
<td>Ends the cfquery block.</td>
</tr>
</tbody>
</table>

Outputting query data

After you define a query, you can use the cfoutput tag with the query attribute to output data from the record set. When you use the query attribute, keep the following in mind:

- ColdFusion loops through all the code contained within the cfoutput block, once for each row in the record set returned from the database.
- You must reference specific column names within the cfoutput block to output the data to the page.
- You can place text, CFML tags, and HTML tags inside or surrounding the cfoutput block to format the data on the page.
- Although you do not have to specify the query name when you refer to a query column, you should use the query name as a prefix for best practices reasons. For example, if you specify the Emplist query in your cfoutput tag, you can refer to the FirstName column in the Emplist query as Firstname. However, using the query name as a prefix—Emplist.FirstName—is preferred, and is in the following procedure.

The cfoutput tag accepts a variety of optional attributes but, ordinarily, you use the query attribute to define the name of an existing query.

1. Edit emplist.cfm so that it appears as follows:

```html
<html>
<head>
<title>Employee List</title>
</head>
<body>
Employee List
</body>
</html>
```
Save the file and view it in your web browser:

A list of employees appears in the browser, with each line displaying one row of data.

**Note:** You might have to refresh your browser to see your changes.

You created a ColdFusion application page that retrieves and displays data from a database. At present, the output is raw and needs formatting. For more information, see “Introduction to Retrieving and Formatting Data” on page 511.

### Reviewing the code

The results of the query appear on the page. The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfoutput query=&quot;EmpList&quot;&gt;</code></td>
<td>Displays information retrieved in the EmpList query.</td>
</tr>
<tr>
<td><code>#EmpList.FirstName#, #EmpList.LastName#, #EmpList.Salary#, #EmpList.Contract#&lt;br&gt;</code></td>
<td>Displays the value of the FirstName, LastName, Salary, and Contract fields of each record, separated by commas and spaces.</td>
</tr>
<tr>
<td><code>&lt;br&gt;</code></td>
<td>Inserts a line break (go to the next line) after each record.</td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td>Ends the cfoutput block.</td>
</tr>
</tbody>
</table>

### Query output notes and considerations

When outputting query results, keep the following guidelines in mind:

- A `cfquery` must retrieve data before the `cfoutput` tag can display its results. Although you can include both on the same page, Adobe recommends that you put queries in ColdFusion components and output the results on a separate page. For more information, see “Building and Using ColdFusion Components” on page 158.

- To output data from all the records of a query, specify the query name by using the `query` attribute in the `cfoutput` tag.

- Columns must exist and be retrieved to the application to output their values.

- Inside a `cfoutput` block that uses a `cfquery` attribute, you can prefix the query variables with the name of the query; for example, `EmpList.FirstName`.

- As with other attributes, surround the `query` attribute value with double-quoted marks (`"`).

- As with any variables that you reference for output, surround column names with number signs (#) to tell ColdFusion to output the column’s current values.

- Add a `<br>` tag to the end of the variable references so that ColdFusion starts a new line for each row that the query returns.
Getting information about query results

Each time you query a database with the `cfquery` tag, you get the data (the record set) and the query variables; together these comprise the query object. The following table describes the query variables, which are sometimes called query properties:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RecordCount</td>
<td>The total number of records returned by the query.</td>
</tr>
<tr>
<td>ColumnList</td>
<td>A comma-delimited list of the query columns, in alphabetical order.</td>
</tr>
<tr>
<td>SQL</td>
<td>The SQL statement executed.</td>
</tr>
<tr>
<td>Cached</td>
<td>Whether the query was cached.</td>
</tr>
<tr>
<td>SQLParameters</td>
<td>Ordered array of <code>cfqueryparam</code> values.</td>
</tr>
<tr>
<td>ExecutionTime</td>
<td>Cumulative time required to process the query, in milliseconds.</td>
</tr>
</tbody>
</table>

In your CFML code, you use these variables as if they were columns in a database table. Use the `result` attribute to specify the name of the structure that ColdFusion populates with these variables. You then use that structure name to refer to the query variables as the following example shows:

**Output information about the query on your page**

1. Edit `emplist.cfm` so that it appears as follows:

   ```cfml
   <cfset Emp_ID = 1>
   <cfquery name="EmpList" datasource="cfdocexamples" result="tmpResult">
      SELECT FirstName, LastName, Salary, Contract
      FROM Employee
      WHERE Emp_ID = <cfqueryPARAM value="#Emp_ID#" CFSQLType = "CF_SQL_INTEGER">
   </cfquery>
   <cfoutput query="EmpList">
      #EmpList.FirstName#, #EmpList.LastName#, #EmpList.Salary#, #EmpList.Contract#
   </cfoutput>
   <cfoutput>
      The query returned #tmpResult.RecordCount# records.<br>
      The query columns are:#tmpResult.ColumnList#.br>
      The SQL is #tmpResult.SQL#.br>
      Whether the query was cached: #tmpResult.Cached#.br>
      Query execution time: #tmpResult.ExecutionTime#.br>
   </cfoutput>
   <cfdump var="#tmpResult.SQLParameters#">

2. Save the file and view it in your web browser:

   The number of employees now appears below the list of employees. You might have to refresh your browser and scroll to see the RecordCount output.

**Reviewing the code**

You now display the number of records retrieved in the query. The following table describes the code and its function:
Query variable notes and considerations
When using query variables, keep the following guidelines in mind:

- Reference the query variable within a `cfoutput` block so that ColdFusion outputs the query variable value to the page.
- Surround the query variable reference with number signs (`#`) so that ColdFusion knows to replace the variable name with its current value.
- Do not use the `cfoutput` tag `query` attribute when you output the `RecordCount` or `ColumnList` property. If you do, you get one copy of the output for each row. Instead, prefix the variable with the name of the query.

Enhancing security with `cfqueryparam`
Some DBMSs let you send multiple SQL statements in a single query. However, hackers might try to modify URL or form variables in a dynamic query by appending malicious SQL statements to existing parameters. Be aware that there are potential security risks when you pass parameters in a query string. This can happen in many development environments, including ColdFusion, ASP, and CGI. Using the `cfqueryparam` tag can reduce this risk.

About query string parameters
When you let a query string pass a parameter, ensure that only the expected information is passed. The following ColdFusion query contains a `WHERE` clause, which selects only database entries that match the last name specified in the `LastName` field of a form:

```coldfusion
<cfquery name="GetEmployees" datasource="cfdocexamples">
  SELECT FirstName, LastName, Salary
  FROM Employee
  WHERE LastName='#Form.LastName#
</cfquery>
```

Someone could call this page with the following malicious URL:

http://myserver/page.cfm?Emp_ID=7%20DELETE%20FROM%20Employee

The result is that ColdFusion tries to execute the following query:

```coldfusion
<cfquery name="GetEmployees" datasource="cfdocexamples">
  SELECT * FROM Employee
  WHERE Emp_ID = 7 DELETE FROM Employee
</cfquery>
```
In addition to an expected integer for the Emp_ID column, this query also passes malicious string code in the form of a SQL statement. If this query successfully executes, it deletes all rows from the Employee table—something you definitely do not want to enable by this method. To prevent such actions, you must evaluate the contents of query string parameters.

### Using cfqueryparam

You can use the `cfqueryparam` tag to evaluate query string parameters and pass a ColdFusion variable within a SQL statement. This tag evaluates variable values before they reach the database. You specify the data type of the corresponding database column in the `cfsqltype` attribute of the `cfqueryparam` tag. In the following example, because the Emp_ID column in the cfdocexamples data source is an integer, you specify a `cfsqltype` of `cf_sql_integer`:

```cfml
<cfquery name="EmpList" datasource="cfdocexamples">
  SELECT * FROM Employee
  WHERE Emp_ID = <cfqueryparam value="#Emp_ID#" cfsqltype="cf_sql_integer">
</cfquery>
```

The `cfqueryparam` tag checks that the value of Emp_ID is an integer data type. If anything else in the query string is not an integer, such as a SQL statement to delete a table, the `cfquery` tag does not execute. Instead, the `cfqueryparam` tag returns the following error message:

Invalid data '7 DELETE FROM Employee' for CFSQLTYPE 'CF_SQL_INTEGER'.

### Using cfqueryparam with strings

When passing a variable that contains a string to a query, specify a `cfsqltype` value of `cf_sql_char`, and specify the `maxLength` attribute, as in the following example:

```cfml
<cfquery name="getFirst" dataSource = "cfdocexamples">
  SELECT * FROM employees
  WHERE LastName = <cfqueryparam value="#LastName#" cfsqltype="cf_sql_char" maxLength="17">
</cfquery>
```

In this case, `cfqueryparam` performs the following checks:

- It ensures that LastName contains a string.
- It ensures that the string is 17 characters or less.
- It escapes the string with single-quotation marks so that it appears as a single value to the database. Even if a hacker passes a bad URL, it appears as follows:

```
WHERE LastName = 'Smith DELETE FROM MyCustomerTable'.
```

### Using cfSqlType

The following table lists the available SQL types against which you can evaluate the `value` attribute of the `cfqueryparam` tag:

<table>
<thead>
<tr>
<th>SQL Type</th>
<th>ColdFusion Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIGINT</td>
<td>BIT</td>
</tr>
<tr>
<td>DECIMAL</td>
<td>DOUBLE</td>
</tr>
<tr>
<td>INTEGER</td>
<td>LONGVARCHAR</td>
</tr>
<tr>
<td>NUMERIC</td>
<td>REAL</td>
</tr>
<tr>
<td>TIME</td>
<td>TIMESTAMP</td>
</tr>
<tr>
<td>BIT</td>
<td>CHAR</td>
</tr>
<tr>
<td>CHAR</td>
<td>FLOAT</td>
</tr>
<tr>
<td>CHAR</td>
<td>MONEY</td>
</tr>
<tr>
<td>CHAR</td>
<td>MONEY4</td>
</tr>
<tr>
<td>CHAR</td>
<td>REAL</td>
</tr>
<tr>
<td>CHAR</td>
<td>TINYINT</td>
</tr>
<tr>
<td>CHAR</td>
<td>VARCHAR</td>
</tr>
<tr>
<td>CHAR</td>
<td>IDSTAMP</td>
</tr>
<tr>
<td>CHAR</td>
<td>REFCURSOR</td>
</tr>
<tr>
<td>CHAR</td>
<td>SMALLINT</td>
</tr>
</tbody>
</table>
Note: Specifying the `cfsqltype` attribute causes the DBMS to use bind variables, which can greatly enhance performance.
Chapter 24: Updating Your Database

ColdFusion lets you insert, update, and delete information in a database.

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About updating your database

ColdFusion was originally developed as a way to readily interact with databases. You can quickly insert, update, and delete the contents of your database by using ColdFusion forms, which are typically a pair of pages. One page displays the form with which your end user will enter values; the other page performs the action (insert, update or delete).

Depending on the extent and type of data manipulation, you can use CFML with or without SQL commands. If you use SQL commands, ColdFusion requires a minimal amount of SQL knowledge.

Inserting data

You usually use two application pages to insert data into a database:

• An insert form
• An insert action page

You can create an insert form with standard HTML form tags or with cfform tags (see “Creating custom forms with the cfform tag” on page 530). When the user submits the form, form variables are passed to a ColdFusion action page that performs an insert operation (and whatever else is called for) on the specified data source. The insert action page can contain either a cfinsert tag or a cfquery tag with a SQL INSERT statement. The insert action page should also contain a confirmation message for the end user.

Creating an HTML insert form

The following procedure creates a form using standard HTML tags. The form looks like the following in your web browser:
1  Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>Insert Data Form</title>
</head>

<body>
<h2>Insert Data Form</h2>
<table>
<!--- begin html form; put action page in the "action" attribute of the form tag. --->
<form action="insert_action.cfm" method="post">
<tr>
<td>Employee ID:</td>
<td><input type="text" name="Emp_ID" size="4" maxlength="4"></td>
</tr>
<tr>
<td>First Name:</td>
<td><input type="Text" name="FirstName" size="35" maxlength="50"></td>
</tr>
<tr>
<td>Last Name:</td>
<td><input type="Text" name="LastName" size="35" maxlength="50"></td>
</tr>
<tr>
<td>Department Number:</td>
<td><input type="Text" name="Dept_ID" size="4" maxlength="4"></td>
</tr>
<tr>
<td>Start Date:</td>
<td><input type="Text" name="StartDate" size="16" maxlength="16"></td>
</tr>
<tr>
<td>Salary:</td>
<td><input type="Text" name="Salary" size="10" maxlength="10"></td>
</tr>
</form>
</table>
</body>
</html>
```
2 Save the file as insert_form.cfm in the myapps directory under your web_root and view it in your web browser.

Note: The form will not work until you write an action page for it. For more information, see "Creating an action page to insert data" on page 403.

Data entry form notes and considerations
If you use the cfinsert tag in the action page to insert the data into the database, you should follow these rules for creating the form page:

• You only need to create HTML form fields for the database columns into which you will insert data.
• By default, cfinsert inserts all of the form's fields into the database columns with the same names. For example, it puts the Form.Emp_ID value in the database Emp_ID column. The tag ignores form fields that lack corresponding database column names.

Note: You can also use the formfields attribute of the cfinsert tag to specify which fields to insert; for example, formfields="prod_ID,Emp_ID,status".

Creating an action page to insert data
You can use the cfinsert tag or the cfquery tag to create an action page that inserts data into a database.

Creating an insert action page with cfinsert
The cfinsert tag is the easiest way to handle simple inserts from either a cfform or an HTML form. This tag inserts data from all the form fields with names that match database field names.

1 Create a ColdFusion page with the following content:

```coldfusion
<html>
<head>
<title>Input form</title>
</head>

<body>

<!--- If the Contractor check box is clear, set the value of the Form.Contract to "No" --->
<cfif not isdefined("Form.Contract")>
<cfset Form.Contract = "N">
</cfif>

<!--- Insert the new record --->
<cfinsert datasource="cfdocexamples" tablename="EMPLOYEE">
<h1>Employee Added</h1>
(cfoutput> You have added #Form.FirstName# #Form.Lastname# to the employee database.
</cfoutput>
</cfinsert>

</body>
</html>
```
2  Save the page as insert_action.cfm.

3  View insert_form.cfm in your web browser and enter values.

   Note: You might want to compare views of the Employee table in the cfdocexamples data source before and after inserting values in the form.

4  Click Submit.

   ColdFusion inserts your values into the Employee table and displays a confirmation message.

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| <cfif not isdefined("Form.Contract")> 
   <cfset Form.Contract = "N"> 
</cfif> | Sets the value of Form.Contract to No if it is not defined. If the Contractor check box is unchecked, no value is passed to the action page; however, the database field must have some value. |
| <cfinsert datasource="cfdocexamples" 
tablename="EMPLOYEE"> | Creates a row in the Employee table of the cfdocexamples database. Inserts data from the form into the database fields with the same names as the form fields. |
| <cfoutput>You have added #Form.FirstName# #Form.LastName# to the employee database.</cfoutput> | Informs the user that values were inserted into the database. |

Note: If you use form variables in cfinsert or cfupdate tags, ColdFusion automatically validates any form data it sends to numeric, date, or time database columns. You can use the hidden field validation functions for these fields to display a custom error message. For more information, see “Introduction to Retrieving and Formatting Data” on page 511.

Creating an insert action page with cfquery

For more complex inserts from a form submittal, you can use a SQL INSERT statement in a cfquery tag instead of using a cfinsert tag. The SQL INSERT statement is more flexible because you can insert information selectively or use functions within the statement.

The following procedure assumes that you have created the insert_action.cfm page, as described in “Creating an insert action page with cfinsert” on page 403.

1  In insert_action.cfm, replace the cfinsert tag with the following highlighted cfquery code:

   <html>
   <head>
      <title>Input form</title>
   </head>

   <body>
   <!--- If the Contractor check box is clear), set the value of the Form.Contract to "No" ---->
   <cfif not isdefined("Form.Contract")>
     <cfset Form.Contract = "No"> 
   </cfif>
   </body>
<!-- Insert the new record --->
<cfquery name="AddEmployee" datasource="cfdocexamples">
  INSERT INTO Employee
  VALUES (#Form.Emp_ID#, '#Form.FirstName#',
          '#Form.LastName#', #Form.Dept_ID#,
          '#Form.StartDate#', #Form.Salary#, '#Form.Contract#')
</cfquery>

<h1>Employee Added</h1>
<cfoutput>You have added #Form.FirstName# #Form.LastName# to the employee database.</cfoutput>
</body>
</html>

2 Save the page.
3 View insert_form.cfm in your web browser and enter values.
4 Click Submit.

ColdFusion inserts your values into the Employee table and displays a confirmation message.

Reviewing the code
The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| <cfquery name="AddEmployee" datasource="cfdocexamples">
  INSERT INTO Employee
  VALUES (#Form.Emp_ID#, '#Form.FirstName#',
          '#Form.LastName#', #Form.Dept_ID#, 
          '#Form.StartDate#', #Form.Salary#, '#Form.Contract#')
</cfquery> | Inserts a new row into the Employee table of the cfdocexamples database. Specifies each form field to be added. Because you are inserting data into all database fields in the same left-to-right order as in the database, you do not have to specify the database field names in the query. Because #Form.Emp_ID#, #Form.Dept_ID#, and #Form.Salary# are numeric, they do not need to be enclosed in quotation marks. |

Inserting into specific fields
The preceding example inserts data into all the fields of a table (the Employee table has seven fields). There might be times when you do not want users to add data into all fields. To insert data into specific fields, the SQL statement in the cfquery must specify the field names following both INSERT INTO and VALUES. For example, the following cfquery omits salary and start date information from the update. Database values for these fields are 0 and NULL, respectively, according to the database's design.

<cfquery name="AddEmployee" datasource="cfdocexamples">
  INSERT INTO Employee
  (Emp_ID, FirstName, LastName,
   Dept_ID, Contract)
  VALUES
  (#Form.Emp_ID#, '#Form.FirstName#', '#Form.LastName#', 
   #Form.Dept_ID#, '#Form.Contract#')
</cfquery>

Updating data
You usually use the following two application pages to update data in a database:
Creating an update form

The following are the key differences between an update form and an insert form:

- An update form contains a reference to the primary key of the record that is being updated.

  *A primary key is a fields in a database table that uniquely identifies each record. For example, in a table of employee names and addresses, only the Emp_ID is unique to each record.*

- An update form is usually populated with existing record data.

The easiest way to designate the primary key in an update form is to include a hidden input field with the value of the primary key for the record you want to update. The hidden field indicates to ColdFusion which record to update.

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>Update Form</title>
</head>

<body>
<br>
</body>
</html>
```

```
<cfquery name="GetRecordtoUpdate" datasource="cfdocexamples">
  SELECT * FROM Employee
  WHERE Emp_ID = #URL.Emp_ID#
</cfquery>
```

```
<cfoutput query="GetRecordtoUpdate">
  <table>
    <form action="update_action.cfm" method="Post">
      <input type="Hidden" name="Emp_ID" value="#Emp_ID#">
      <tr><td>First Name:</td><td><input type="text" name="FirstName" value="#FirstName#"></td></tr>
      <tr><td>Last Name:</td><td><input type="text" name="LastName" value="#LastName#"></td></tr>
      <tr><td>Department Number:</td><td><input type="text" name="Dept_ID" value="#Dept_ID#"></td></tr>
      <tr><td>Start Date:</td><td><input type="text" name="StartDate" value="#StartDate#"></td></tr>
      <tr><td>Salary:</td><td><input type="text" name="Salary" value="#Salary#"></td></tr>
    </form>
  </table>
</cfoutput>
```
2 Save the file as update_form.cfm.

3 View update_form.cfm in your web browser by specifying the page URL and an Employee ID; for example, enter the following: http://localhost/myapps/update_form.cfm?Emp_ID=3

Note: Although you can view an employee’s information, you must code an action page before you can update the database. For more information, see “Creating an action page to update data” on page 408.

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfquery name=&quot;GetRecordtoUpdate&quot;</td>
<td>Queries the cfdocexamples data source and returns records in which the employee ID matches what was entered in the URL that called this page.</td>
</tr>
<tr>
<td>datasource=&quot;cfdocexamples&quot;&gt;</td>
<td></td>
</tr>
<tr>
<td>SELECT * FROM Employee</td>
<td></td>
</tr>
<tr>
<td>WHERE Emp_ID = #URL.Emp_ID#</td>
<td></td>
</tr>
<tr>
<td>&lt;/cfquery&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;cfoutput query=&quot;GetRecordtoUpdate&quot;&gt;</td>
<td>Makes available as variables the results of the GetRecordtoUpdate query in the form created in subsequent lines.</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>&lt;/cfoutput&gt;</td>
<td></td>
</tr>
<tr>
<td>&lt;form action=&quot;update_action.cfm&quot; method=&quot;Post&quot;&gt;</td>
<td>Creates a form whose variables are processed on the update_action.cfm action page.</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>&lt;/form&gt;</td>
<td></td>
</tr>
</tbody>
</table>
Creating an action page to update data

You can create an action page to update data with either the `cfupdate` tag or `cfquery` with the UPDATE statement.

Creating an update action page with cfupdate

The `cfupdate` tag is the easiest way to handle simple updates from a front-end form. The `cfupdate` tag has an almost identical syntax to the `cfinsert` tag.

To use the `cfupdate` tag, you must include the primary key fields in your form submission. The `cfupdate` tag automatically detects the primary key fields in the table that you are updating and looks for them in the submitted form fields. ColdFusion uses the primary key fields to select the record to update (therefore, you cannot update the primary key value itself). It then uses the remaining form fields that you submit to update the corresponding fields in the record. Your form only needs to have fields for the database fields that you want to change.

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
  <title>Update Employee</title>
</head>
<body>
  <cfif not isdefined("Form.Contract")>
    <cfset form.contract = "N">  
  <cfelse>
    <cfset form.contract = "Y">  
  </cfif>

  <cfupdate datasource="cfdocexamples" tablename="EMPLOYEE">
    <h1>Employee Updated</h1>
    <input type="Hidden" name="Emp_ID" value="#Emp_ID#"> 
    Uses a hidden input field to pass the Emp_ID (primary key) value to the action page.
    First Name: <input type="text" name="FirstName" value="#FirstName#">  
    Last Name: <input type="text" name="LastName" value="#LastName#">  
    Department Number: 
    <input type="text" name="Dept_ID" value="#Dept_ID#">  
    Start Date: <input type="text" name="StartDate" value="#StartDate#">  
    Salary: <input type="text" name="Salary" value="#Salary#">  
    Populates the fields of the update form. This example does not use ColdFusion formatting functions. As a result, start dates look like 1985-03-12 00:00:00 and salaries do not have dollar signs or commas. The user can replace the information in any field using any valid input format for the data.
    Contractor: 
    <cfif #Contract# IS "Yes"> 
      <input type="checkbox" name="Contract" value="Y">  
    <cfelse>
      <input type="checkbox" name="Contract">  
    </cfif>
    The Contract field requires special treatment because a check box appears and sets its value. The `cfif` structure puts a check mark in the check box if the Contract field value is Yes, and leaves the box empty otherwise.
  </cfoutput>
  <input type="Submit" value="Update Information">
</form>
</cfoutput>
```

The Contract field requires special treatment because a check box appears and sets its value. The `cfif` structure puts a check mark in the check box if the Contract field value is Yes, and leaves the box empty otherwise.
<cfoutput>
You have updated the information for #Form.FirstName# #Form.LastName# in the employee
database.
</cfoutput>

</body>
</html>

2 Save the page as update_action.cfm.

3 View update_form.cfm in your web browser by specifying the page URL and an Employee ID; for example, enter
the following: http://localhost/myapps/update_form.cfm?Emp_ID=3

The current information for that record appears:

4 Enter new values in any of the fields, and click Update Information.

ColdFusion updates the record in the Employee table with your new values and displays a confirmation message.

**Reviewing the code**
The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfif not isdefined(&quot;Form.Contract&quot;)&gt;</code>&lt;cfset Form.contract = &quot;N&quot;&gt;<code>&lt;cfelse&gt;</code>&lt;cfset form.contract = &quot;Y&quot;&gt;<code>&lt;cfif&gt;</code></td>
<td>Sets the value of <code>Form.Contract</code> to <code>No</code> if it is not defined, or to <code>Yes</code> if it is defined. If the Contractor check box is unchecked, no value is passed to the action page; however, the database field must have some value.</td>
</tr>
<tr>
<td><code>&lt;cfupdate datasource=&quot;cfdocexamples&quot; tablename=&quot;EMPLOYEE&quot;&gt;</code></td>
<td>Updates the record in the database that matches the primary key on the form (Emp_ID). Updates all fields in the record with names that match the names of form controls.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code>You have updated the information for #Form.FirstName# #Form.LastName# in the employee database.<code>&lt;/cfoutput&gt;</code></td>
<td>Informs the user that the change was made successfully.</td>
</tr>
</tbody>
</table>
Creating an update action page with cfquery

For more complicated updates, you can use a SQL UPDATE statement in a cfquery tag instead of a cfupdate tag. The SQL UPDATE statement is more flexible for complicated updates.

The following procedure assumes that you have created the update_action.cfm page as described in "Creating an update action page with cfupdate" on page 408.

1. In update_action.cfm, replace the cfupdate tag with the following highlighted cfquery code:

   ```html
   <html>
   <head>
   <title>Update Employee</title>
   </head>
   <body>
   <cfif not isdefined("Form.Contract")>
   <cfset form.contract = "No">
   <cfelse>
   <cfset form.contract = "Yes">
   </cfif>

   <!--- cfquery requires date formatting when retrieving from Access. Use the left function when setting StartDate to trim the ".0" from the date when it first appears from the Access database --->
   <cfquery name="UpdateEmployee" datasource="cfdocexamples">
       UPDATE Employee
       SET FirstName = '#Form.FirstName#',
           LastName = '#Form.LastName#',
           Dept_ID = #Form.Dept_ID#,
           StartDate = '#left(Form.StartDate,19)#',
           Salary = #Form.Salary#
       WHERE Emp_ID = #Form.Emp_ID#
   </cfquery>

   <h1>Employee Updated</h1>
   <cfoutput>
   You have updated the information for
   #Form.FirstName# #Form.LastName#
   in the employee database.
   </cfoutput>
   </body>
   </html>

2. Save the page.

3. View update_form.cfm in your web browser by specifying the page URL and an Employee ID; for example, enter the following: http://localhost/myapps/update_form.cfm?Emp_ID=3

4. Enter new values in any of the fields, and click Update Information.

   ColdFusion updates the record in the Employee table with your new values and displays a confirmation message.

When the cfquery tag retrieves date information from a Microsoft Access database, it displays the date and time with tenths of seconds, as follows:
Deleting data

You use a cfquery tag with a SQL DELETE statement to delete data from a database. ColdFusion has no cfdelete tag.

Deleting a single record

To delete a single record, use the table's primary key in the WHERE condition of a SQL DELETE statement. In the following procedure, Emp_ID is the primary key, so the SQL Delete statement is as follows:

```
DELETE FROM Employee WHERE Emp_ID = #Form.Emp_ID#
```

You often want to see the data before you delete it. The following procedure displays the data to be deleted by reusing the form page used to insert and update data. Any data that you enter in the form before submitting it is not used, so you can use a table to display the record to be deleted instead.

1. In update_form.cfm, change the title to "Delete Form" and the text on the submit button to "Delete Record".
2. Change the form tag so that it appears as follows:
   ```
   <form action="delete_action.cfm" method="Post">
   ```
3. Save the modified file as delete_form.cfm.
4. Create a ColdFusion page with the following content:
   ```
   <html>
   <head>
   <title>Delete Employee Record</title>
   </head>
   <body>
   
   <cfquery name="DeleteEmployee" 
   datasource="cfdocexamples">
   DELETE FROM Employee 
   WHERE Emp_ID = #Form.Emp_ID#
   </cfquery>
   
   <h1>The employee record has been deleted.</h1>
   <cfoutput>
   You have deleted #Form.FirstName# #Form.LastName# from the employee database.
   </cfoutput>
   
   </body>
   </html>
   ```
5. Save the page as delete_action.cfm.
6. View delete_form.cfm in your web browser by specifying the page URL and an Employee ID; for example, enter the following: http://localhost/myapps/delete_form.cfm?Emp_ID=3. Click Delete Record

   ColdFusion deletes the record in the Employee table and displays a confirmation message.

Reviewing the code

The following table describes the code and its function:
Deleting multiple records

You can use a SQL condition to delete several records. The following example deletes the records for everyone in the Sales department (which has Dept_ID number 4) from the Employee table:

DELETE FROM Employee WHERE Dept_ID = 4

To delete all the records from the Employee table, use the following code:

DELETE FROM Employee

**Important:** Deleting records from a database is not reversible. Use DELETE statements carefully.
Chapter 25: Using Query of Queries

A query that retrieves data from a record set is called a Query of Queries. After you generate a record set, you can interact with its results as if they were database tables by using Query of Queries.

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About record sets

Query of Queries is based on manipulating the record set, which you can create using the cfquery tag and other ways.

When you execute a database query, ColdFusion retrieves the data in a record set. In addition to presenting record set data to the user, you can manipulate this record set to improve your application's performance.

Because a record set contains rows (records) and columns (fields), you can think of it as a virtual database table, or as a spreadsheet. For example, the cfpop tag retrieves a record set in which each row is a message and each column is a message component, such as To, From, and Subject.

Creating a record set

You can perform a Query of Queries on any ColdFusion tag or function that generates a record set, including the following:

- cfcollection
- cfdirectory
- cfftp
- cfhttp
- cfindex
- cfldap
- cfmail
- cfpop
- cfprocresult
- cfquery (against a database or against another Query of Queries)
- cfsearch
- cfstoredproc
- cfwddx
- The QueryNew function
Creating a record set with the QueryNew() function

In addition to creating a record set by using a cfquery or other CFML tags, you can create it with the QueryNew() function.

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>The queryNew function</title>
   </head>
   <body>
   <h2>QueryNew Example</h2>
   <!--- Create a query, specify data types for each column. --->
   <cfset qInstruments = queryNew("name, instrument, years_playing",
   "CF_SQL_VARCHAR, CF_SQL_VARCHAR, CF_SQL_INTEGER")>
   <!--- Add rows. --->
   <cfset newrow = queryaddrow(qInstruments, 3)>
   <!--- Set values in cells. --->
   <cfset temp = querysetcell(qInstruments, "name", "Thor", 1)>
   <cfset temp = querysetcell(qInstruments, "instrument", "hammer", 1)>
   <cfset temp = querysetcell(qInstruments, "years_playing", "1000", 1)>
   <cfset temp = querysetcell(qInstruments, "name", "Bjorn", 2)>
   <cfset temp = querysetcell(qInstruments, "instrument", "sitar", 2)>
   <cfset temp = querysetcell(qInstruments, "years_playing", "24", 2)>
   <cfset temp = querysetcell(qInstruments, "name", "Raoul", 3)>
   <cfset temp = querysetcell(qInstruments, "instrument", "flute", 3)>
   <cfset temp = querysetcell(qInstruments, "years_playing", "12", 3)>
   <!--- Output the query. --->
   <cfoutput query="qInstruments">
   <pre>
   #name##instrument##years_playing#
   </pre>
   </cfoutput>
   </h3>Individual record retrieval: </h3>
   <cfoutput>
   <p>
   #qInstruments.name[2]# has played #qInstruments.instrument[2]# for
   #qInstruments.years_playing[2]# years.
   </p>
   </cfoutput>
   </body>
   </html>

   2. Save the page as queryNew.cfm in the myapps directory under the web_root directory.

   3. Display queryNew.cfm in your browser

About Query of Queries

After you have created a record set with a tag or function, you can retrieve data from the record set in one or more dependent queries. A query that retrieves data from a record set is called a Query of Queries. A typical use of a Query of Queries is to retrieve an entire table into memory with one query, and then access the table data (the record set) with subsequent sorting or filtering queries. In essence, you query the record set as if it were a database table.
Note: Because you can generate a record set in ways other than using the cfquery tag, the term In Memory Query is sometimes used instead of Query of Queries.

**Benefits of Query of Queries**
Performing a Query of Queries has many benefits, including the following:

1. If you need to access the same tables multiple times, you greatly reduce access time, because the data is already in memory (in the record set).
   
   A Query of Queries is ideal for tables of 5,000 to 50,000 rows, and is limited only by the memory of the ColdFusion host computer.

2. You can perform joins and union operations on results from different data sources.
   
   For example, you can perform a union operation on queries from different databases to eliminate duplicates for a mailing list.

3. You can efficiently manipulate cached query results in different ways. You can query a database once, and then use the results to generate several different summary tables.
   
   For example, if you need to summarize the total salary by department, by skill, and by job, you can make one query to the database and use its results in three separate queries to generate the summaries.

4. You can obtain drill-down, master-detail information for which you do not access the database for the details.
   
   For example, you can select information about departments and employees in a query, and cache the results. You can then display the employees' names. When users select an employee, the application displays the employee's details by selecting information from the cached query, without accessing the database.

5. You can use a Query of Queries in report definitions to generate subreport data. For more information, see "Using subreports" on page 838.

**Performing a Query of Queries**
There are four steps to perform a Query of Queries.

1. Generate a record set through a master query.
   
   You can write a master query using a tag or function that creates a record set. For more information, see "Creating a record set" on page 413.

2. Write a detail query—a cfquery tag that specifies dbtype="query".

3. In the detail query, write a SQL statement that retrieves the relevant records. Specify the names of one or more existing queries as the table names in your SQL code. Do not specify a datasource attribute.

4. If the database content does not change rapidly, use the cachedwithin attribute of the master query to cache the query results between page requests. This way, ColdFusion accesses the database on the first page request, and does not query the database again until the specified time expires. You must use the CreateTimeSpan function to specify the cachedwithin attribute value (in days, hours, minutes, seconds format).

The detail query generates a new query result set, identified by the value of the name attribute of the detail query. The following example illustrates the use of a master query and a single detail query that extracts information from the master.

**Use the results of a query in a query**

1. Create a ColdFusion page with the following content:
<h1>Employee List</h1>

<!--- LastNameSearch (normally generated interactively) --->
<cfset LastNameSearch="Doe">

<!--- Master Query --->
<cfquery datasource="cfdocexamples" name="master"
    cachedwithin=#CreateTimeSpan(0,1,0,0)#>
    SELECT * from Employee
</cfquery>

<!--- Detail Query (dbtype=query, no data source) --->
<cfquery dbtype="query" name="detail">
    SELECT Emp_ID, FirstName, LastName
    FROM master
    WHERE LastName=<cfqueryparam value="#LastNameSearch#" cfsqltype="cf_sql_char" maxLength="20"></cfquery>

<!--- output the detail query results --->
<p>Output using a query of query:</p>
<cfoutput query=detail>
    #Emp_ID#: #FirstName# #LastName#<br>
</cfoutput>

<p>Columns in the master query:</p>
<cfoutput>
    #master.columnlist#<br>
</cfoutput>

<p>Columns in the detail query:</p>
<cfoutput>
    #detail.columnlist#<br>
</cfoutput>

2  Save the page as query_of_query.cfm in the myapps directory under the web_root.

3  Display query_of_query.cfm in your browser

**Reviewing the code**

The master query retrieves the entire Employee table from the cfdocexamples data source. The detail query selects only the three columns to display for employees with the specified last name. The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfset LastNameSearch=&quot;Doe&quot;</td>
<td>Sets the last name to use in the detail query. In a complete application, this information comes from user interaction.</td>
</tr>
</tbody>
</table>
| <cfquery datasource="cfdocexamples" name="master"
    cachedwithin=#CreateTimeSpan(0,1,0,0)#>
    SELECT * from Employee
</cfquery> | Queries the cfdocexamples data source and selects all data in the Employees table. Caches the query data between requests to this page, and does not query the database if the cached data is less than an hour old. |
| <cfquery dbtype="query" name="detail">
    SELECT Emp_ID, FirstName, LastName
    FROM master
    WHERE LastName=<cfqueryparam value="#LastNameSearch#" cfsqltype="cf_sql_char" maxLength="20"></cfquery> | Uses the master query as the source of the data in a new query, named detail. This new query selects only entries that match the last name specified by the LastNameSearch variable. The query also selects only three columns of data: employee ID, first name, and last name. The query uses the cfqueryparam tag to prevent passing erroneous or harmful code. |
Displaying record set data incrementally

If your database is large, you can limit the number of rows displayed at one time. The following example shows how to use the `currentRow` query variable of a Query of Queries to do this. For more information on query variables, see “Getting information about query results” on page 397.

1 Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>QoQ with incremental row return</title>
</head>

<body>
<h3>QoQ with incremental row return</h3>

<!--- define startrow and maxrows to facilitate 'next N' style browsing --->
<cfparam name = "MaxRows" default = "5">
<cfparam name = "StartRow" default = "1">

<!--- master query: retrieve all info from Employee table --->
<cfquery name = "GetSals" datasource = "cfdocexamples">
  SELECT * FROM Employee  
  ORDER BY LastName
</cfquery>

<!--- detail query: select 3 fields from the master query --->
<cfquery name = "GetSals2" dbtype = "query">
  SELECT FirstName, LastName, Salary  
  FROM GetSals  
  ORDER BY LastName
</cfquery>

<!--- build table to display output --->
<table cellpadding = 1 cellspacing = 1>
  <tr>
    <td bgcolor = f0f0f0>
      <b><i>&nbsp;</i></b>
    </td>
    <td bgcolor = f0f0f0>
      <b><i>FirstName</i></b>
    </td>
    <td bgcolor = f0f0f0>
      <b><i>LastName</i></b>
    </td>
    <td bgcolor = f0f0f0>
      <b><i>Salary</i></b>
    </td>
  </tr>
  <cfoutput query=detail>
    #Emp_ID#: #FirstName# #LastName#  
  </cfoutput>
  <cfoutput>
    #master.columnlist#  
  </cfoutput>
  <cfoutput>
    #detail.columnlist#  
  </cfoutput>
</table>
</body>
</html>
```
Save the page as qoq_next_row.cfm in the myapps directory under the web_root.

3 Display qoq_next_row.cfm in your browser

**Using the cfdump tag with query results**

As you debug your CFML code, you can use the `cfdump` tag to quickly display the contents of your query. This tag has the following format:

```cfml
<cfdump var="#query_name#"/>
```

For more information on the `cfdump` tag, see the [CFML Reference](#).

**Using Query of Queries with non-SQL record sets**

A Query of Queries can operate on any CFML tag or function that returns a record set; you are not limited to operating on `cfquery` results. You can perform queries on non-SQL record sets, such as a `cfdirectory` tag, a `cfsearch` tag, a `cfldap` tag, and so on.
The following example shows how a Query of Queries interacts with the record set of a Verity search. This example assumes that you have a valid Verity collection, called bbb, which contains documents with a target word, film, or its variants (films, filmed, filming). Change the name of the collection and the search criteria to as appropriate for your Verity collection. For more information on Verity, see "Building a Search Interface" on page 459.

**Use Query of Queries with a Verity record set**

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>QoQ and Verity</title>
</head>

<body>
<h3>Master query dump:</h3>
<cfdump var="#quick#">

<!--- Detail query: retrieve from the master query only those documents with a score greater than a criterion (here, 0.7743). --->
<cfquery name="qoq" dbtype="query">
    SELECT * from quick
    WHERE quick.score > 0.7743
</cfquery>

<h3>Detail query dump:</h3>
<cfdump var="#qoq#">
</body>
</html>
```

2. Save the page as qoq_verity.cfm in the myapps directory under the web_root.

3. Display qoq_verity.cfm in your browser

The next example shows how a Query of Queries combines record sets from a cfdirectory tag, which is limited to retrieval of one file type per use.

**Use Query of Queries to combine record sets**

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>Images Folder</title>
</head>

<body>
<h2>Image Retrieval with QoQ</h2>

<!--- Set the images directory. --->
<cfset dir = "(C:\pix\")>

<!--- Retrieve all GIFs. --->
```
<cfdirectory name="GetGIF"
  action="list"
  directory="#dir#"
  filter="*.gif">

<!--- Retrieve all JPGs --->
<cfdirectory name="GetJPG"
  action="list"
  directory="#dir#"
  filter="*.jpg">

<!--- Join the queries with a UNION in a QoQ (cfdirectory
  automatically returns the directory name as "Name"). --->
<cfquery dbtype="query" name="GetBoth">
  SELECT * FROM GetGIF
  UNION
  SELECT * FROM GetJPG
  ORDER BY Name
</cfquery>

<!--- Display output in a linked, ordered list. --->
<cfoutput>
  <p>The <strong>#dir#</strong> directory contains #GetBoth.RecordCount#
    images:<br>
  </p><ol><cfloop query="GetBoth">
    <li><a href="../images/#Name#">#GetBoth.Name#</a><br>
  </cfloop>
</ol>
</cfoutput>
</body>
</html>

2  Save the page as qoq_cfdirectory.cfm in the myapps directory under the web_root.
3  Display qoq_cfdirectory.cfm in your browser

---

**Query of Queries user guide**

If you know SQL or have interacted with databases, you might be familiar with some of the Query of Queries functionality.

**Using dot notation**

ColdFusion supports using dot notation in table names.

**Example**

If a structure named A contains a field named B, which contains a table named Products, you can refer to the table with dot notation, as follows:

```
SELECT tape_ID, length
FROM A.B.Products;
```
Using joins
A join operation uses a single SELECT statement to return a result set from multiple, related tables, typically those with a primary key - foreign key relationship. There are two SQL clauses that perform joins:

- **WHERE clause**: ColdFusion supports joins through a WHERE clause.
- **INNER JOIN and OUTER JOIN**: ColdFusion does not support joins through INNER JOIN or OUTER JOIN clauses.

*Note*: Query of Queries supports joins between two tables only.

Using unions
The UNION operator lets you combine the results of two or more SELECT expressions into a single record set. The original tables must have the same number of columns, and corresponding columns must be UNION-compatible data types. Columns are UNION-compatible data types if they meet one of the following conditions:

- The same data type; for example, both Tinyint
- Both Numeric; for example, Tinyint, Smallint, Integer, Bigint, Double, Float, Real, Decimal, or Numeric
- Both Characters; for example, Char, Varchar, or LongVarchar
- Both Dates; for example, Time, TimeStamp, or Date

*Note*: Query Of Queries does not support ODBC-formatted dates and times.

Syntax
```
select_expression = select_expression UNION [ALL] select_expression
```

Example
This example uses the following tables:

<table>
<thead>
<tr>
<th>Table1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type(int)</td>
<td>Name(varchar)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tennis</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Baseball</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Football</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ID(int)</td>
<td>Sport(varchar)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Football</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Volleyball</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PingPong</td>
<td></td>
</tr>
</tbody>
</table>

To combine Table1 and Table2, use a UNION statement, as follows:
```
SELECT * FROM Table1
UNION
SELECT * FROM Table2
```

The UNION statement produces the following result (UNION) table:
Using aliases for column names
The column names of a UNION table are the column names in the result set of the first SELECT statement in the
UNION operation; ColdFusion ignores the column names in the other SELECT statement. To change the column
names of the result table, you can use an alias, as follows:

```
SELECT Type as SportType, Name as SportName FROM Table1
UNION
SELECT * FROM Table2
```

Duplicate rows and multiple tables
By default, the UNION operator removes duplicate rows from the result table. If you use the keyword ALL, then
duplicates are included.

You can combine an unlimited number of tables using the UNION operator, for example:

```
SELECT * FROM Table1
UNION
SELECT * FROM Table2
UNION
SELECT * FROM Table3
...  
```

Parentheses and evaluation order
By default, the Query of Queries SQL engine evaluates a statement containing UNION operators from left to right.
You can use parentheses to change the order of evaluation. For example, the following two statements are different:

```
/* First statement. */
SELECT * FROM TableA
UNION ALL
(SELECT * FROM TableB
UNION
SELECT * FROM TableC)

/* Second statement. */
(SELECT * FROM TableA
UNION ALL
SELECT * FROM TableB)
UNION
SELECT * FROM TableC
```

In the first statement, there are no duplicates in the union between TableB and TableC. Then, in the union between
that set and TableA, the ALL keyword includes the duplicates. In the second statement, duplicates are included in the
union between TableA and TableB but are eliminated in the subsequent union with TableC. The ALL keyword has
no effect on the final result of this expression.
Using other keywords with UNION
When you perform a UNION, the individual SELECT statements cannot have their own ORDER BY or COMPUTE clauses. You can only have one ORDER BY or COMPUTE clause after the last SELECT statement; this clause is applied to the final, combined result set. You can only specify GROUP BY and HAVING expressions in the individual SELECT statements.

Using conditional operators
ColdFusion lets you use the following conditional operators in your SQL statements:

- Test
- Null
- Comparison
- Between
- IN
- LIKE

Test conditional
This conditional tests whether a Boolean expression is True, False, or Unknown.

Syntax
cond_test ::= expression [IS [NOT] {TRUE | FALSE | UNKNOWN} ]

Example
SELECT _isValid FROM Chemicals
WHERE _isValid IS true;

Null conditional
This conditional tests whether an expression is null.

Syntax
null_cond ::= expression IS [NOT] NULL

Example
SELECT bloodVal FROM Standards
WHERE bloodVal IS NOT null;

Comparison conditional
This conditional lets you compare an expression against another expression of the same data type (Numeric, String, Date, or Boolean). You can use it to selectively retrieve only the relevant rows of a record set.

Syntax
comparison_cond ::= expression [> | >= | <> | != | < | <=] expression

Example
The following example uses a comparison conditional to retrieve only those dogs whose IQ is at least 150:

SELECT dog_name, dog_IQ
FROM Dogs
WHERE dog_IQ >= 150;
**Between conditional**
This conditional lets you compare an expression against another expression. You can use it to selectively retrieve only the relevant rows of a record set. Like the comparison conditional, the BETWEEN conditional makes a comparison; however, the between conditional makes a comparison against a range of values. Therefore, its syntax requires two values, which are inclusive, a minimum and a maximum. You must separate these values with the AND keyword.

**Syntax**
```
between_cond ::= expression [NOT] BETWEEN expression AND expression
```

**Example**
The following example uses a BETWEEN conditional to retrieve only those dogs whose IQ is between 150 and 165, inclusive:
```
SELECT dog_name, dog_IQ
FROM Dogs
WHERE dog_IQ BETWEEN 150 AND 165;
```

**IN conditional**
This conditional lets you specify a comma-delimited list of conditions to match. It is similar in function to the OR conditional. In addition to being more legible when working with long lists, the IN conditional can contain another SELECT statement.

**Syntax**
```
in_cond ::= expression [NOT] IN (expression_list)
```

**Example**
The following example uses the IN conditional to retrieve only those dogs who were born at either Ken's Kennels or Barb's Breeders:
```
SELECT dog_name, dog_IQ, Kennel_ID
FROM Dogs
WHERE kennel_ID IN ('Kens','Barbs');
```

**LIKE conditional**
This conditional lets you perform wildcard searches, in which you compare your data to search patterns. This strategy differs from other conditionals, such as BETWEEN or IN, because the LIKE conditional compares your data to a value that is partially unknown.

**Syntax**
```
like_cond ::= left_string_exp [NOT] LIKE right_string_exp [ESCAPE escape_char]
```

The left_string_exp can be either a constant string, or a column reference to a string column. The right_string_exp can be either a column reference to a string column, or a search pattern. A search pattern is a search condition that consists of literal text and at least one wildcard character. A wildcard character is a special character that represents an unknown part of a search pattern, and is interpreted as follows:

- The underscore (_) represents any single character.
- The percent sign (%) represents zero or more characters.
- Square brackets ([ ]) represents any character in the range.
- Square brackets with a caret (^) represent any character not in the range.
- All other characters represent themselves.

**Note:** Earlier versions of ColdFusion do not support bracketed ranges.
Examples
The following example uses the LIKE conditional to retrieve only those dogs of the breed Terrier, whether the dog is a Boston Terrier, Jack Russell Terrier, Scottish Terrier, and so on:

```
SELECT dog_name, dog_IQ, breed
FROM Dogs
WHERE breed LIKE '%Terrier';
```

The following examples are select statements that use bracketed ranges:

```
SELECT lname FROM Suspects WHERE lname LIKE 'A[^c]%';
SELECT lname FROM Suspects WHERE lname LIKE '[a-m]%';
SELECT lname FROM Suspects WHERE lname LIKE '%[]';
SELECT lname FROM Suspects WHERE lname LIKE 'A[[]]';
SELECT lname FROM Suspects WHERE lname LIKE 'A[^c-f]%';
```

**Case sensitivity**
Unlike the rest of ColdFusion, Query of Queries is case-sensitive. However, Query of Queries supports two string functions, `UPPER()` and `LOWER()`, which you can use to achieve case-insensitive matching.

Examples
The following example matches only 'Sylvester':

```
SELECT dog_name
FROM Dogs
WHERE dog_name LIKE 'Sylvester';
```

The following example is not case-sensitive; it uses the `LOWER()` function to treat 'Sylvester', 'sylvester', 'SYLVESTER', and so on as all lowercase, and matches them with the all lowercase string, 'sylvester':

```
SELECT dog_name
FROM Dogs
WHERE LOWER(dog_name) LIKE 'sylvester';
```

If you use a variable on the right side of the LIKE conditional and want to ensure that the comparison is not case-sensitive, use the `LCase` or `UCase` function to force the variable text to be all of one case, as in the following example:

```
WHERE LOWER(dog_name) LIKE '#LCase(FORM.SearchString)#';
```

**Escaping wildcards**
You can specify your own escape character by using the conditional ESCAPE clause.

Example
The following example uses the ESCAPE clause to enable a search for a literal percent sign (%), which ColdFusion normally interprets as a wildcard character:

```
SELECT emp_discount
FROM Benefits
WHERE emp_discount LIKE '10\%'
ESCAPE '\';
```

**Managing data types for columns**
A Query of Queries requires that every column have metadata that defines the column's data type. All queries that ColdFusion creates have metadata. However, a query created with `QueryNew` function that omits the second parameter does not contain metadata. You use this optional second parameter to define the data type of each column in the query.
Specify column data types in the QueryNew function

Type a QueryNew function, specifying the column names in the first parameter and the data types in the second parameter, as the following example shows:

```cff
<cfset qInstruments = queryNew("name, instrument, years_playing", "CF_SQL_VARCHAR, CF_SQL_VARCHAR, CF_SQL_INTEGER")>
```

Note: To see the metadata for a Query of Queries, use the GetMetaData function.

Specify the column data types in the QueryAddColumn function

1 Create a query by specifying the QueryNew function with no parameters.

```cff
<!--- Make a query. --->
<cfset myQuery = QueryNew("")>
```

2 Add and populate a column with the QueryAddColumn function, specifying the data type in the third parameter:

```cff
<!--- Create an array. --->
<cfset FastFoodArray = ArrayNew(1)>
<cfset FastFoodArray[1] = "French Fries">
<cfset FastFoodArray[2] = "Hot Dogs">
<cfset FastFoodArray[3] = "Fried Clams">
<cfset FastFoodArray[4] = "Thick Shakes">
<!--- Use the array to add a column to the query. --->
<cfset nColumnNumber = QueryAddColumn(myQuery, "FastFood", "CF_SQL_VARCHAR", FastFoodArray)>
```

If you do not specify the data type, ColdFusion examines the first fifty rows of each column to determine the data type when performing conditional expressions.

In some cases, ColdFusion can guess a data type that is inappropriate for your application. In particular, if you use columns in a WHERE clause or other conditional expression, the data types must be compatible. If they are not compatible, you must use the CAST function to recast one of the columns to a compatible data type. For more information on casting, see "Using the CAST function" on page 426. For more information on data type compatibility, see "Understanding Query of Queries processing" on page 433.

Note: Specifying the data type in the QueryNew function helps you avoid compatibility issues.

Using the CAST function

In some cases, a column's data type may not be compatible with the processing you want to do. For example, query columns returned by the cfhttp tag are all of type CF_SQL_VARCHAR, even though the contents may be numeric. In this case, you can use the Query of Queries CAST function to convert a column value into an expression of the correct data type.

The syntax for the CAST function is as follows:

```cff
CAST ( expression AS castType )
```

Where castType is one of the following:

- BINARY
- BIGINIT
- BIT
- DATE
- DECIMAL
• DOUBLE
• INTEGER
• TIME
• TIMESTAMP
• VARCHAR

For example:

```cfc
<cfhttp
  url="http://quote.yahoo.com/download/quotes.csv?Symbols=cisco,jnpr&format=csv&ext=.csv"
  method="GET"
  name="qStockItems"
  columns="Symbol,Change,LastTradedPrice"
  textqualifier="",""
  delimiter="","
  firstrowasheaders="no">
  <cfdump var="#qStockItems#">
    <cfdump var="#qStockItems.getColumnNames()#">
  </cfdump>
  <cfoutput>
    <cfloop index="i" from="1" to="#arrayLen(qStockItems.getColumnNames())#">
      #qStockItems.getMetaData().getColumnTypeName(javaCast("int",i))#<br/>
    </cfloop>
  </cfoutput>
  <cftry>
    <cfquery name="hello" dbtype="query">
      SELECT SUM(CAST(qStockItems.LastTradedPrice as INTEGER))
      AS SUMNOW from qStockItems
    </cfquery>
    <cfcatch>Error in Query of Queries</cfcatch>
  </cftry>
  <cfoutput>
    <cfdump var="#hello#">
  </cfoutput>
</cfhttp>
```

### Using aggregate functions

Aggregate functions operate on a set of data and return a single value. Use these functions for retrieving summary information from a table, as opposed to retrieving an entire table and then operating on the record set of the entire table.

Consider using aggregate functions to perform the following operations:

- To display the average of a column
- To count the number of rows for a column
- To find the earliest date in a column

Since not every relational database management system (RDBMS) supports all aggregate functions, refer to your database's documentation. The following table lists the aggregate functions that ColdFusion supports:
**Syntax**

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG()</td>
<td>Returns the average (mean) for a column.</td>
</tr>
<tr>
<td>COUNT()</td>
<td>Returns the number of rows in a column.</td>
</tr>
<tr>
<td>MAX()</td>
<td>Returns the largest value of a column.</td>
</tr>
<tr>
<td>MIN()</td>
<td>Returns the lowest value of a column.</td>
</tr>
<tr>
<td>SUM()</td>
<td>Returns the sum of values of a column.</td>
</tr>
</tbody>
</table>

Syntax

aggregate_func ::= <COUNT>(* | column_name) | AVG | SUM | MIN | MAX) ([ALL | DISTINCT] numeric_exp)

Example

The following example uses the AVG() function to retrieve the average IQ of all terriers:

```sql
SELECT dog_name, AVG(dog_IQ) AS avg_IQ
FROM Dogs
WHERE breed LIKE '%Terrier';
```

Arbitrary expressions in aggregate functions

ColdFusion supports aggregate functions of any arbitrary expression, as follows:

```sql
SELECT lorange, count(lorange+hirange)
FROM roysched
GROUP BY lorange;
```

Aggregate functions in arbitrary expressions

ColdFusion supports mathematical expressions that include aggregate functions, as follows:

```sql
SELECT MIN(lorange) + MAX(hirange)
FROM roysched
GROUP BY lorange;
```

Using group by and having expressions

ColdFusion supports the use of any arbitrary arithmetic expression, as long as it is referenced by an alias.

Examples

The following code is correct:

```sql
SELECT (lorange + hirange)/2 AS midrange,
COUNT(*)
FROM roysched
GROUP BY midrange;
```

The following code is correct:

```sql
SELECT (lorange+hirange)/2 AS x,
COUNT(*)
FROM roysched GROUP BY x
HAVING x > 10000;
```

The following code is not supported in Query of Queries:

```sql
SELECT (lorange + hirange)/2 AS midrange,
COUNT(*)
FROM roysched
```
GROUP BY (lorange + hirange)/2;

**Using ORDER BY clauses**

ColdFusion supports the ORDER BY clause to sort. Make sure that it is the last clause in your SELECT statement. You can sort by multiple columns, by relative column position, by nonselected columns. You can specify a descending sort direction with the DESC keyword (by default, most RDBMS sorts are ascending, which makes the ASC keyword unnecessary).

**Syntax**

order_by_column ::= ( <IDENTIFIER> | <INTEGER_LITERAL> ) [ASC | DESC]

**Example**

The following example shows a simple sort using an ORDER BY clause:

```
SELECT acetylcholine_levels, dopamine_levels
FROM results
ORDER BY dopamine_levels
```

The following example shows a more complex sort; results are first sorted by ascending levels of dopamine, then by descending levels of acetylcholine. The ASC keyword is unnecessary, and is used only for legibility.

```
SELECT acetylcholine_levels, dopamine_levels
FROM results
ORDER BY 2 ASC, 1 DESC
```

**Using aliases**

ColdFusion supports the use of database column aliases. An alias is an alternate name for a database field or value. ColdFusion lets you reuse an alias in the same SQL statement.

One way to create an alias is to concatenate (append) two or more columns to generate a value. For example, you can concatenate a first name and a last name to create the value fullname. Because the new value does not exist in a database, you refer to it by its alias. The AS keyword assigns the alias in the SELECT statement.

**Examples**

ColdFusion supports alias substitutions in the ORDER BY, GROUP BY, and HAVING clauses.

*Note: ColdFusion does not support aliases for table names.*

```
SELECT FirstName + ' ' + LastName AS fullname
from Employee;
```

The following examples rely on these two master queries:

```
<cfquery name="employee" datasource="2pubs">
   SELECT * FROM employee
</cfquery>

<cfquery name="roysched" datasource="2pubs">
   SELECT * FROM roysched
</cfquery>
```

**ORDER BY example**

```
<cfquery name="order_by" dbtype="query">
   SELECT (job_id || job_lvl)/2 AS job_value
   FROM employee
   ORDER BY job_value
</cfquery>
```
GROUP BY example
<cfquery name="group_by" dbtype="query">
    SELECT lorange || hirange AS x, count(hirange)
    FROM roysched
    GROUP BY x
</cfquery>

HAVING example
<cfquery name="having" dbtype="query">
    SELECT (lorange || hirange)/2 AS x,
    COUNT(*)
    FROM roysched GROUP BY x
    HAVING x > 10000
</cfquery>

Handling null values
ColdFusion uses Boolean logic to handle conditional expressions. Proper handling of NULL values requires the use of ternary logic. The IS [NOT] NULL clause works correctly in ColdFusion. However the following expressions do not work properly when the column breed is NULL:

WHERE (breed > 'A')
WHERE NOT (breed > 'A')

The correct behavior should not include NULL breed columns in the result set of either expression. To avoid this limitation, you can add an explicit rule to the conditionals and rewrite them in the following forms:

WHERE breed IS NOT NULL AND (breed > 'A')
WHERE breed IS NOT NULL AND not (breed > 'A')

Concatenating strings
Query of Queries support two string concatenation operators: + and ||, as the following examples show:

LASTNAME + ', ' + FIRSTNAME
LASTNAME || ', ' || FIRSTNAME

Escaping reserved keywords
ColdFusion has a list of reserved keywords, which are typically part of the SQL language and are not normally used for names of columns or tables. To escape a reserved keyword for a column name or table name, enclose it in brackets.

Important: Earlier versions of ColdFusion let you use some reserved keywords without escaping them.

Examples
ColdFusion supports the following SELECT statement examples:

SELECT [from] FROM parts;
SELECT [group].firstname FROM [group];
SELECT [group].[from] FROM [group];

ColdFusion does not support nested escapes, such as in the following example:

SELECT [[from]] FROM T;

The following table lists ColdFusion reserved keywords:
<table>
<thead>
<tr>
<th>ABSOLUTE</th>
<th>ACTION</th>
<th>ADD</th>
<th>ALL</th>
<th>ALLOCATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALTER</td>
<td>AND</td>
<td>ANY</td>
<td>ARE</td>
<td>AS</td>
</tr>
<tr>
<td>ASC</td>
<td>ASSERTION</td>
<td>AT</td>
<td>AUTHORIZATION</td>
<td>AVG</td>
</tr>
<tr>
<td>BEGIN</td>
<td>BETWEEN</td>
<td>BIT</td>
<td>BIT_LENGTH</td>
<td>BOTH</td>
</tr>
<tr>
<td>BY</td>
<td>CASCADE</td>
<td>CASCADED</td>
<td>CASE</td>
<td>CAST</td>
</tr>
<tr>
<td>CATALOG</td>
<td>CHAR</td>
<td>CHARACTER</td>
<td>CHARACTER_LENGTH</td>
<td>CHAR_LENGTH</td>
</tr>
<tr>
<td>CHECK</td>
<td>CLOSE</td>
<td>COALESCE</td>
<td>COLLATE</td>
<td>COLLATION</td>
</tr>
<tr>
<td>COLUMN</td>
<td>COMMIT</td>
<td>CONNECT</td>
<td>CONNECTION</td>
<td>CONSTRAINT</td>
</tr>
<tr>
<td>CONSTRAINTS</td>
<td>CONTINUE</td>
<td>CONVERT</td>
<td>CORRESPONDING</td>
<td>COUNT</td>
</tr>
<tr>
<td>CREATE</td>
<td>CROSS</td>
<td>CURRENT</td>
<td>CURRENT_DATE</td>
<td>CURRENT_TIME</td>
</tr>
<tr>
<td>CURRENT_TIMESTAMP</td>
<td>CURRENT_USER</td>
<td>CURSOR</td>
<td>DATE</td>
<td>DAY</td>
</tr>
<tr>
<td>DEALLOCATE</td>
<td>DEC</td>
<td>DECIMAL</td>
<td>DECLARE</td>
<td>DEFAULT</td>
</tr>
<tr>
<td>DEFERRABLE</td>
<td>DEFERRED</td>
<td>DELETE</td>
<td>DESC</td>
<td>DESCRIBE</td>
</tr>
<tr>
<td>DESCRIPTOR</td>
<td>DIAGNOSTICS</td>
<td>DISCONNECT</td>
<td>DISTINCT</td>
<td>DOMAIN</td>
</tr>
<tr>
<td>DOUBLE</td>
<td>DROP</td>
<td>ELSE</td>
<td>END</td>
<td>END-EXEC</td>
</tr>
<tr>
<td>ESCAPE</td>
<td>EXCEPT</td>
<td>EXCEPTION</td>
<td>EXEC</td>
<td>EXECUTE</td>
</tr>
<tr>
<td>EXISTS</td>
<td>EXTERNAL</td>
<td>EXTRACT</td>
<td>FALSE</td>
<td>FETCH</td>
</tr>
<tr>
<td>FIRST</td>
<td>FLOAT</td>
<td>FOR</td>
<td>FOREIGN</td>
<td>FOUND</td>
</tr>
<tr>
<td>FROM</td>
<td>FULL</td>
<td>GET</td>
<td>GLOBAL</td>
<td>GO</td>
</tr>
<tr>
<td>GOTO</td>
<td>GRANT</td>
<td>GROUP</td>
<td>HAVING</td>
<td>HOUR</td>
</tr>
<tr>
<td>IDENTITY</td>
<td>IMMEDIATE</td>
<td>IN</td>
<td>INDICATOR</td>
<td>INITIALLY</td>
</tr>
<tr>
<td>INNER</td>
<td>INPUT</td>
<td>INSENSITIVE</td>
<td>INSERT</td>
<td>INT</td>
</tr>
<tr>
<td>INTEGER</td>
<td>INTERSECT</td>
<td>INTERVAL</td>
<td>INTO</td>
<td>IS</td>
</tr>
<tr>
<td>ISOLATION</td>
<td>JOIN</td>
<td>KEY</td>
<td>LANGUAGE</td>
<td>LAST</td>
</tr>
<tr>
<td>LEADING</td>
<td>LEFT</td>
<td>LEVEL</td>
<td>LIKE</td>
<td>LOCAL</td>
</tr>
<tr>
<td>LOWER</td>
<td>MATCH</td>
<td>MAX</td>
<td>MIN</td>
<td>MINUTE</td>
</tr>
<tr>
<td>MODULE</td>
<td>MONTH</td>
<td>NAMES</td>
<td>NATIONAL</td>
<td>NATURAL</td>
</tr>
<tr>
<td>NCHAR</td>
<td>NEXT</td>
<td>NO</td>
<td>NOT</td>
<td>NULL</td>
</tr>
<tr>
<td>NULLIF</td>
<td>NUMERIC</td>
<td>OCTET_LENGTH</td>
<td>OF</td>
<td>ON</td>
</tr>
<tr>
<td>ONLY</td>
<td>OPEN</td>
<td>OPTION</td>
<td>OR</td>
<td>ORDER</td>
</tr>
<tr>
<td>OUTER</td>
<td>OUTPUT</td>
<td>OVERLAPS</td>
<td>PAD</td>
<td>PARTIAL</td>
</tr>
<tr>
<td>POSITION</td>
<td>PRECISION</td>
<td>PREPARE</td>
<td>PRESERVE</td>
<td>PRIMARY</td>
</tr>
<tr>
<td>PRIOR</td>
<td>PRIVILEGES</td>
<td>PROCEDURE</td>
<td>PUBLIC</td>
<td>READ</td>
</tr>
<tr>
<td>REAL</td>
<td>REFERENCES</td>
<td>RELATIVE</td>
<td>RESTRICT</td>
<td>REVOKE</td>
</tr>
</tbody>
</table>
Using Queries of Queries with dates

If you create a query object with the `QueryNew` function and populate a column with date constants, ColdFusion stores the dates as a string inside the query object until a Query of Queries is applied to the query object. When ColdFusion applies a Query of Queries to the query object, it converts the string representations into date objects.

Query of Queries supports date constants in SQL and ODBC format, as follows:

- **SQL format**: Dates, times, or timestamps in one of the following format:
  - Date string: `yyyy-mm-dd`, for example, 1955-06-13.
  - Time string: `hh:mm:ss[.nnn]`, for example, 14:34:30.75.
  - Timestamp string: `yyyy-mm-dd hh:mm:ss[.nnn]`, for example, 1924-01-14 12:00:00.000.

- **ODBC format**: Dates, times, or timestamps in one of the following format:
  - Date string: `{d 'value'}`, for example, `{d '2004-07-06'}`.
  - Time string: `{t 'value'}`, for example, `{t '13:45:30'}`.
  - Timestamp string: `{ts 'value'}`, for example, `{ts '2004-07-06 13:45:30'}`.

If you want to convert the date to its original format, use the `DateFormat` function and apply the "mm/dd/yy" mask.

Understanding Query of Queries performance

Query of Queries performs very well on single-table query objects that were accessed directly from a database. This is because ColdFusion stores meta information for a query object accessed from a database.

When working with a query resulting in a SQL join, Query of Queries performs as follows:

1. Query of Queries is very efficient for simple joins in which there is only one equality between two column references or constants, for example:
   ```
   SELECT T1.a, b, c, d FROM T1, T2 WHERE T1.a = T2.a
   ```

2. Query of Queries is less efficient for joins in which the predicate contains multiple expressions, for example:
   ```
   SELECT T1.a, b, c, d FROM T1, T2
   ```
WHERE T1.a = T2.a AND T1.b + T1.c = T2.b + T2.c

Understanding Query of Queries processing
Query of Queries can process the following:

- Column comparisons
- Queries passed by reference
- Complex objects

Comparing columns with different data types
Starting with ColdFusion MX 7, ColdFusion includes enhancements that allow you to compare columns with different data types.

If one of the operands has a known column type (only constants have an unknown column type), Query of Queries tries to coerce the constant with an unknown type to the type of the operand with metadata. The pairs of allowed coercions are as follows:

- Binary, string
- Dates, string
- Numeric, bigdecimal
- Boolean, numeric

That is, ColdFusion can coerce between binary and string, but not between date and string.

If both operands have known data types, the types must be the same. The only exception is that ColdFusion can coerce among integer, float, and double.

If both operands are constants, ColdFusion tries to coerce the values, first to the most restrictive type, then to the least restrictive type.

- First to binary then to string.
- First to date then to string.
- First to boolean then to numeric.

Passing queries by reference
A Query of Queries is copied by reference from its related query; this means that ColdFusion does not create a new query when you create a Query of Queries. It also means that changes to a Query of Queries, such as ordering, modifying, and deleting data, are also applied to the base query object.

If you do not want the original query to change, use the Duplicate function to create a copy and create the Query of Queries using the copied query.

Managing complex objects
You cannot use Query Of Queries on a record set that contains complex objects, such as arrays and structures.

Note: You can store a record set in a complex objects.
Chapter 26: Managing LDAP Directories

CFML applications use the `cfldap` tag to access and manage LDAP (Lightweight Directory Access Protocol) directories. This chapter provides information on how to use this tag to view, query, and update LDAP directories.

This topic teaches you how to query and update an LDAP database. It does not assume that you are familiar with LDAP, and provides an introduction to LDAP directories and the LDAP protocol. However, it does assume that you have information on your LDAP database's structure and attributes, and it does not explain how to create an LDAP directory or manage a directory server. To learn more about LDAP and LDAP servers, see your LDAP server documentation and published books on LDAP.

The examples in this topic use the Airius sample LDAP database that is supplied with the Netscape and iPlanet Directory Servers.

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Using LDAP with ColdFusion ........................................... 438
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Updating an LDAP directory ............................................. 444
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About LDAP

The LDAP protocol enables organizations to arrange and access directory information in a hierarchy. In this context, `directory` refers to a collection of information, such as a telephone directory, not a collection of files in a folder on a disk drive.

LDAP originated in the mid-1990s as a response to the need to access ISO X.500 directories from personal computers that had limited processing power. Since then, products such as iPlanet Server have been developed that are native LDAP directory servers. Several companies now provide LDAP access to their directory servers, including Novell NDS, Microsoft Active Directory Services (ADS), Lotus Domino, and Oracle.

An LDAP directory is typically a hierarchically structured database. Each layer in the hierarchy typically corresponds to a level of organizational structure.

The following example shows a simple directory structure:
This example is fully symmetrical: all the entries at each layer are of the same type.

You can also structure an LDAP directory so that the layers under one entry contain different information from the layers under another entry.

The following image shows such an asymmetric directory:

In this directory structure, the second level of the tree divides the directory into two organizational units: people and groups. The third level contains entries with information that is specific to the organizational unit. Each person’s entry includes a name, e-mail address, and telephone number. Each group’s entry includes the names of group members.
This complexity and flexibility is a key to LDAP's usefulness. With it, you can represent any organizational structure. LDAP offers performance advantages over conventional databases for accessing hierarchical, directory-like information that is read frequently and changed infrequently.

Although LDAP is often used for e-mail, address, telephone, or other organizational directories, it is not limited to these types of applications. For example, you can store ColdFusion Advanced Security information in an LDAP database.

### The LDAP information structure

There are several LDAP concepts that are the basis of the LDAP information structure:

- **Entry**
- **Attribute**
- **Distinguished name (DN)**
- **Schema, including the object class and attribute type**

#### Entry

The basic information object of LDAP is the *entry*. An entry is composed of one or more *attributes*. Entries are subject to content rules defined by the directory *schema* (see "Schema" on page 437).

Each node, not just the terminal nodes, of an LDAP directory is an entry. In the preceding images, each item is an entry. For example, in the first diagram, both USA and Ferrari are entries. The USA entry's attributes could include a Language attribute, and the Ferrari entry could include an entry for the chief executive officer.

#### Attribute

An LDAP directory entry consists of one or more attributes. Attributes have *types* and *values*. The type determines the information that the values can contain. The type also specifies how the value is processed. For example, the type determines whether an attribute can have multiple values. The mail attribute type, which contains an e-mail address, is multivalued so you can store multiple e-mail addresses for one person.

Some commonly used attribute types have short keyword type names. Often these correspond to longer type names, and the two names can be used interchangeably. The following table lists common attribute type keywords used in LDAP directories:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Long name</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>CountryName</td>
<td></td>
</tr>
<tr>
<td>st</td>
<td>stateOrProvinceName</td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>LocalityName</td>
<td>Typically, city, but can be any geographical unit</td>
</tr>
<tr>
<td>street</td>
<td>StreetAddress</td>
<td></td>
</tr>
<tr>
<td>o</td>
<td>OrganizationName</td>
<td></td>
</tr>
<tr>
<td>ou</td>
<td>OrganizationalUnitName</td>
<td></td>
</tr>
<tr>
<td>cn</td>
<td>CommonName</td>
<td>Typically, first and last name</td>
</tr>
</tbody>
</table>
Distinguished name (DN)

An entry's distinguished name uniquely identifies it in the directory. A DN is made up of relative distinguished names (RDNs). An RDN identifies the entry among the children of its parent entry. For example, in the first image in About LDAP, the RDN for the Ferrari entry is "o=Ferrari".

An entry's DN consists of an entry's RDN followed by the DN of its parent. In other words, it consists of the RDNs for the entry and each of the entry's parent entries, up to the root of the directory tree. The RDNs are separated by commas and optional spaces. For example, in the first image, the DN for the Ferrari entry is "o=Ferrari, c=Italy".

As with file system pathnames and URLs, entering the correct LDAP name format is essential to successful search operations.

Note: The RDN is an attribute of a directory entry. The full DN is not. However, you can output the full DN by specifying "dn" in a query's attributes list. For more information, see cfldap in CFML Reference. ColdFusion always returns DNs with spaces after the commas.

A multivalued RDN is made up of more than one attribute-value pair. In multivalued RDNs, the attribute-value pairs are separated by plus signs (+). In the sample directories, individuals could have complex RDNs consisting of their common name and their e-mail address, for example, "cn=Robert Boyd + mail=rjboyd@adobe.com".

Schema

The concepts of schemas and object classes are central to a thorough understanding of LDAP. Although detailed descriptions of them are beyond the scope of this topic, the following sections provide enough information to use the cfldap tag effectively.

A directory schema is a set of rules that determines what can be stored in a directory. It defines, at a minimum, the following two basic directory characteristics:

- The object classes to which entries can belong
- The directory attribute types

Object class

Object classes enable LDAP to group related information. Frequently, an object class corresponds to a real object or concept, such as a country, person, room, or domain (in fact, these are all standard object type names). Each entry in an LDAP directory must belong to one or more object classes.

The following characteristics define an object class:

- The class name
- A unique object ID that identifies the class
- The attribute types that entries of the class must contain
- The attribute types that entries of the class can optionally contain
• (Optional) A superior class from which the class is derived

If an entry belongs to a class that derives from another class, the entry’s objectclass attribute lists the lowest-level class and all the superior classes from which the lowest-level class derives.

When you add, modify, or delete a directory entry, you must treat the entry’s object class as a possibly multivalued attribute. For example, when you add a new entry, you specify the object class in the `cfldap` tag `attributes` attribute. To retrieve an entry’s object class names, specify “objectclass” in the list of query attributes. To retrieve entries that provide a specific type of information, you can use the object class name in the `cfldap` tag `filter` attribute.

**Attribute type**
A schema’s attribute type specification defines the following properties:

• The attribute type name
• A unique object ID that identifies the attribute type
• (Optional) An indication of whether the type is single-valued or multivalued (the default is multivalued)
• The attribute syntax and matching rules (such as case sensitivity)

The attribute type definition can also determine limits on the range or size of values that the type represents, or provide an application-specific usage indicator. For standard attributes, a registered numeric ID specifies the syntax and matching rule information. For more information on attribute syntaxes, see ETF RFC 2252 at http://www.ietf.org/rfc/rfc2252.txt.

**Operational attributes**, such as creatorsName or modifyTimeStamp, are managed by the directory service and cannot be changed by user applications.

### Using LDAP with ColdFusion

The `cfldap` tag extends the ColdFusion query capabilities to LDAP network directory services. The `cfldap` tag lets you use LDAP in many ways, such as the following:

• Create Internet White Pages so users can locate people and resources and get information about them.
• Provide a front end to manage and update directory entries.
• Build applications that incorporate data from directory queries in their processes.
• Integrate applications with existing organizational or corporate directory services.

The `cfldap` tag `action` attribute supports the following operations on LDAP directories:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>query</td>
<td>Returns attribute values from a directory.</td>
</tr>
<tr>
<td>add</td>
<td>Adds an entry to a directory.</td>
</tr>
<tr>
<td>delete</td>
<td>Deletes an entry from a directory.</td>
</tr>
<tr>
<td>modify</td>
<td>Adds, deletes, or changes the value of an attribute in a directory entry.</td>
</tr>
<tr>
<td>modifyDN</td>
<td>Renames a directory entry (changes its distinguished name).</td>
</tr>
</tbody>
</table>
The following table lists the attributes that are required and optional for each action. For more information on each attribute, see the cfldap tag in the CFML Reference.

<table>
<thead>
<tr>
<th>Action</th>
<th>Required attributes</th>
<th>Optional attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>query</td>
<td>server, name, start, attributes</td>
<td>port, username, password, timeout, secure, rebind, referral, scope, filter, sort, sortControl, startRow, maxRows, separator, delimiter</td>
</tr>
<tr>
<td>add</td>
<td>server, dn, attributes</td>
<td>port, username, password, timeout, secure, rebind, referral, separator, delimiter</td>
</tr>
<tr>
<td>delete</td>
<td>server, dn</td>
<td>port, username, password, timeout, secure, rebind, referral</td>
</tr>
<tr>
<td>modify</td>
<td>server, dn, attributes</td>
<td>port, username, password, timeout, secure, rebind, referral, modifyType, separator, delimiter</td>
</tr>
<tr>
<td>modifyDN</td>
<td>server, dn, attributes</td>
<td>port, username, password, timeout, secure, rebind, referral</td>
</tr>
</tbody>
</table>

### Querying an LDAP directory

The cfldap tag lets you search an LDAP directory. The tag returns a ColdFusion query object with the results, which you can use as you would any query result. When you query an LDAP directory, you specify the directory entry where the search starts and the attributes whose values to return. You can specify the search scope and attribute content filtering rules and use other attributes to further control the search.

#### Scope

The search scope sets the limits of a search. The default scope is the level below the distinguished name specified in the start attribute. This scope does not include the entry identified by the start attribute. For example, if the start attribute is "ou=support, o=adobe" the level below support is searched. You can restrict a query to the level of the start entry, or extend it to the entire subtree below the start entry.

#### Search filter

The search filter syntax has the form attribute operator value. The default filter, objectclass=*, returns all entries in the scope.

The following table lists the filter operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Example</th>
<th>Matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>(mail=*)</td>
<td>All entries that contain a mail attribute.</td>
</tr>
<tr>
<td>=~</td>
<td>(sn~=Hansen)</td>
<td>Entries with a surname that approximates Hansen. The matching rules for approximate matches vary among directory vendors, but anything that &quot;sounds like&quot; the search string should be matched. In this example, the directory server might return entries with the surnames Hansen and Hanson.</td>
</tr>
<tr>
<td>&gt;=</td>
<td>(st=&gt;ma)</td>
<td>The name &quot;ma&quot; and names appearing after &quot;ma&quot; in an alphabetical state attribute list.</td>
</tr>
<tr>
<td>&lt;=</td>
<td>(st&lt;=ma)</td>
<td>The name &quot;ma&quot; and names appearing before &quot;ma&quot; in an alphabetical state attribute list.</td>
</tr>
<tr>
<td>*</td>
<td>(o=macro*)</td>
<td>Organization names that start with &quot;macro&quot;.</td>
</tr>
<tr>
<td></td>
<td>(o=media)</td>
<td>Organization names that end with &quot;media&quot;.</td>
</tr>
</tbody>
</table>
The Boolean operators & and | can operate on more than two attributes and precede all of the attributes on which they operate. You surround a filter with parentheses and use parentheses to group conditions.

If the pattern that you are matching contains an asterisk, left parenthesis, right parenthesis, backslash, or NUL character, you must use the following three-character escape sequence in place of the character:

<table>
<thead>
<tr>
<th>Character</th>
<th>Escape sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>\2A</td>
</tr>
<tr>
<td>(</td>
<td>\28</td>
</tr>
<tr>
<td>)</td>
<td>\29</td>
</tr>
<tr>
<td>\</td>
<td>\5C</td>
</tr>
<tr>
<td>NUL</td>
<td>\00</td>
</tr>
</tbody>
</table>

For example, to match the common name St*r Industries, use the filter:

(cn=St\2Ar Industries).

LDAP v3 supports an extensible match filter that permits server-specific matching rules. For more information on using extensible match filters, see your LDAP server documentation.

### Searching and sorting notes

- To search for multiple values of a multivalued attribute type, use the & operator to combine expressions for each attribute value. For example, to search for an entry in which cn=Robert Jones and cn=Bobby Jones, specify the following filter:

  ```
  filter="(&(cn=Robert Jones)(cn=Bobby Jones))"
  ```

- You can use object classes as search filter attributes; for example, you can use the following search filter:

  ```
  filter="(objectclass=inetorgperson)"
  ```

- To specify how query results are sorted, use the `sort` field to identify the attribute(s) to sort. By default, ColdFusion returns sorted results in case-sensitive ascending order. To specify descending order, case-insensitive sorting, or both, use the `sortControl` attribute.

- ColdFusion requests the LDAP server to do the sorting. This can have the following effects:
  - The sort order might differ between ColdFusion MX and previous versions.
• If you specify sorting and the LDAP server does not support sorting, ColdFusion generates an error. To sort results from servers that do not support sorting, use a query of queries on the results.

• If you use filter operators to construct sophisticated search criteria, performance might degrade if the LDAP server is slow to process the synchronous search routines that cfldap supports. You can use the cfldap tag `timeout` and `maxRows` attributes to control the apparent performance of pages that perform queries, by limiting the number of entries and by exiting the query if the server does not respond in a specified time.

**Getting all the attributes of an entry**

Typically, you do not use a query that gets all the attributes in an entry. Such a query would return attributes that are used only by the directory server. However, you can get all the attributes by specifying attributes="*" in your query.

If you do this, ColdFusion returns the results in a structure in which each element contains a single attribute name-value pair. The tag does not return a query object. ColdFusion does this because LDAP directory entries, unlike the rows in a relational table, vary depending on their object class.

For example, the following code retrieves the contents of the Airius directory:

```cfc LDAP
<cfldap name="GetList"
server=#myServer#
action="query"
attributes="*"
scope="subtree"
start="o=airius.com"
sort="sn,cn">
```

This tag returns entries for all the people in the organization and entries for all the groups. The group entries have a different object class, and therefore different attributes from the person entries. If ColdFusion returned both types of entries in one query object, some rows would have only the group-specific attribute values and the other rows would have only person-specific attribute values. Instead, ColdFusion returns a structure in which each attribute is an entry.

**Example: querying an LDAP directory**

The following example uses the cfldap tag to get information about the people in the Airius corporation's Santa Clara office. Users can enter all or part of a person's name and get a list of matching names with their departments, e-mail addresses, and telephone numbers.

This example uses the sample Airius corporate directory that is distributed with the Netscape Directory Server. If you do not have access to this directory, modify the code to work with your LDAP directory.

1 Create a file that looks like the following:

```html
<!--- This example shows the use of CFLDAP --->
<html>
<head> <title>cfldap Query Example</title> </head>

<h3>cfldap Query Example</h3>

<body>
<p>This tool queries the Airius.com database to locate all people in the company's Santa Clara office whose common names contain the text entered in the form.</p>

<p>Enter a full name, first name, last name, or name fragment.</p>

<form action="cfldap.cfm" method="POST">
  <input type="text" name="name">
</form>
```
Change the server attribute from ldap.airius.com to the name of your installation of the Airius database.

3 Save the page as cfldap.cfm and run it in your browser.

**Reviewing the code**

The following table describes the code:
This search shows the use of a logical AND statement in a filter. It returns one attribute, the surname, that is used only for sorting the results.

In this query, the ou attribute value consists of two values in a comma-delimited list. One is the department name. The other is People. This is because the Airius database uses the ou attribute type twice:

- In the distinguished names, at the second level of the directory tree, where it differentiates between organizational units such as people, groups, and directory servers
As the department identifier in each person’s entry

Because the attribute values are returned in order from the person entry to the directory tree root, the ListFirst function extracts the person’s department name.

### Updating an LDAP directory

The cfldap tag lets you perform the following actions on LDAP directory entries:

- Add
- Delete
- Add attributes
- Delete attributes
- Replace attributes
- Change the DN (rename the entry)

These actions let you manage LDAP directory contents remotely.

You build a ColdFusion page that lets you manage an LDAP directory. The form displays directory entries in a table and includes a button that lets you populate the form fields based on the unique user ID.

The example ColdFusion page does not add or delete entry attributes or change the DN. For information on these operations, see “Adding and deleting attributes of a directory entry” on page 451 and “Changing a directory entry’s DN” on page 452.

To keep the code short, this example has limitations that are not appropriate in a production application. In particular, it has the following limitations:

- If you enter an invalid user ID and click either the Update or the Delete button, ColdFusion generates a “No such object” error, because there is no directory entry to update or delete. Your application should verify that the ID exists in the directory before it tries to change or delete its entry.
- If you enter a valid user ID in an empty form and click Update, the application deletes all the attributes for the User. The application should ensure that all required attribute fields contain valid entries before updating the directory.

### Adding a directory entry

When you add an entry to an LDAP directory, you specify the DN, all the required attributes, including the entry’s object class, and any optional attributes. The following example builds a form that adds an entry to an LDAP directory.

1. Create a file that looks like the following:

```cftml
<!--- Set the LDAP server ID, user name, and password as variables here so they can be changed in only one place. --->
<cfset myServer="ldap.myco.com">
<cfset myUserName="cn=Directory Manager">
<cfset myPassword="password">

<!--- Initialize the values used in form fields to empty strings. --->
<cfparam name="fullNameValue" default="">
<cfparam name="surnameValue" default="">
```
<cfparam name="emailValue" default="">
<cfparam name="phoneValue" default="">
<cfparam name="uidValue" default="">

<!----When the form is submitted, add the LDAP entry. ----->
<cfif isdefined("Form.action") AND Trim(Form.uid) IS NOT ">
  <cfif Form.action is "add">
    <cfif Trim(Form.fullName) is "" OR Trim(Form.surname) is ""
      OR Trim(Form.email) is "" OR Trim(Form.phone) is "">
      <h2>You must enter a value in every field.</h2>
    <cfset fullNameValue=Trim(Form.fullName)>
    <cfset surnameValue=Trim(Form.surname)>
    <cfset emailValue=Trim(Form.email)>
    <cfset phoneValue=Trim(Form.phone)>
    <cfset uidValue=Trim(Form.uid)>
    <cfelse>
      <cfset attributelist="objectclass=top, person, organizationalperson, inetOrgPerson; cn=#Trim(Form.fullName)#; sn=#Trim(Form.surname)#; mail=#Trim(Form.email)#; telephonenumber=#Trim(Form.phone)#; ou=Human Resources; uid=#Trim(Form.uid)#">
      <cfldap action="add"
        attributes="#attributelist#"
        dn="uid=#Trim(Form.uid)#, ou=People, o=Airius.com"
        server=#myServer#
        username=#myUserName#
        password=#myPassword#>
      <cfoutput><h3>Entry for User ID #Form.uid# has been added</h3>
      </cfoutput>
    </cfif>
  </cfif>
</cfif>

<html>
<head>
<title>Update LDAP Form</title>
</head>
<body>
<h2>Manage LDAP Entries</h2>
<form action="update_ldap.cfm" method="post">
<table>
  <tr><td>Full Name:</td>  <td><cfinput type="Text"
    name="fullName"
    value="#fullNameValue#
    size="20"
    maxlength="30"
    tabindex="1"/></td></tr>
  <tr><td>Surname:</td>  <td><cfinput type="Text"
    name="surname"
    value="#surnameValue#
    size="20"
    maxlength="20"
    tabindex="2"/></td></tr>
</table>
</form>
</body>
</html>
<td>E-mail Address:</td>
<td><cfinput type="Text"
            name="email"
            value="#emailValue#"
            size="20"
            maxlength="20"
            tabindex="3"></td>
</tr>
<tr>
<td>Telephone Number:</td>
<td><cfinput type="Text"
            name="phone"
            value="#phoneValue#"
            size="20"
            maxlength="20"
            tabindex="4"></td>
</tr>
<tr>
<td>User ID:</td>
<td><cfinput type="Text"
            name="uid"
            value="#uidValue#"
            size="20"
            maxlength="20"
            tabindex="5"></td>
</tr>
<tr>
<td colspan="2">
<input type="Submit"
            name="action"
            value="Add"
            tabindex="8"></td>
</tr>
</table>
<br>
*All fields are required for Add<br>
</cfform>

<!---Output the user list. --->
<h2>User List for the Human Resources Department</h2>
<cfldap name="GetList"
        server="#myServer#"
        action="query"
        attributes="cn,sn,mail,telephonenumber,uid"
        start="o=Airius.com"
        scope="subtree"
        filter="ou=Human Resources"
        sort="sn,cn"
        sortControl="asc, nocase">
<table border="1">
<tr>
<th>Full Name</th>
<th>Surname</th>
<th>Mail</th>
<th>Phone</th>
<th>UID</th>
</tr>
<cfoutput query="GetList">
<tr>
<td>#GetList.cn#</td>
</tr>
</cfoutput>
</table>
At the top of the file, change the myServer, myUserName, and myPassword variable assignments to values that are valid for your LDAP server.

Save the page as update_ldap.cfm and run it in your browser.

**Reviewing the code**

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfset myServer=&quot;ldap.myco.com&quot;&gt;</code>&lt;br&gt;<code>&lt;cfset myUserName=&quot;cn=Directory Manager&quot;&gt;</code>&lt;br&gt;<code>&lt;cfset myPassword=&quot;password&quot;&gt;</code></td>
<td>Initializes the LDAP connection information variables. Uses variables for all connection information so that any changes have to be made in only one place.</td>
</tr>
<tr>
<td><code>&lt;cfparam name=&quot;fullNameValue&quot; default=&quot;&quot;&gt;</code>&lt;br&gt;<code>&lt;cfparam name=&quot;surnameValue&quot; default=&quot;&quot;&gt;</code>&lt;br&gt;<code>&lt;cfparam name=&quot;emailValue&quot; default=&quot;&quot;&gt;</code>&lt;br&gt;<code>&lt;cfparam name=&quot;phoneValue&quot; default=&quot;&quot;&gt;</code>&lt;br&gt;<code>&lt;cfparam name=&quot;uidValue&quot; default=&quot;&quot;&gt;</code></td>
<td>Sets the default values of empty strings for the form field value variables. The data entry form uses <code>cfinput</code> fields with <code>value</code> attributes so that the form can be prefilled and so that, if the user submits an incomplete form, ColdFusion can retain any entered values in the form when it re-displays the page.</td>
</tr>
<tr>
<td><code>&lt;cfif isdefined(&quot;Form.action&quot;) AND</code>&lt;br&gt;<code>Trim(Form.uid) IS NOT &quot;&gt;</code></td>
<td>Ensures that the user entered a User ID in the form.</td>
</tr>
<tr>
<td><code>&lt;cfif Form.action is &quot;add&quot;&gt;</code>&lt;br&gt;<code>&lt;cfif Trim(Form.fullName) is &quot;&quot; OR Trim(Form.surname) is &quot;&quot; OR Trim(Form.email) is &quot;&quot; OR Trim(Form.phone) is &quot;&quot;&gt;</code>&lt;br&gt;<code>&lt;h2&gt;You must enter a value in every field.&lt;/h2&gt;</code>&lt;br&gt;<code>&lt;cfset fullNameValue=Form.fullName&gt;</code>&lt;br&gt;<code>&lt;cfset surnameValue=Form.surname&gt;</code>&lt;br&gt;<code>&lt;cfset emailValue=Form.email&gt;</code>&lt;br&gt;<code>&lt;cfset phoneValue=Form.phone&gt;</code>&lt;br&gt;<code>&lt;cfset uidValue=Form.uid&gt;</code></td>
<td>If any field in the submitted form is blank, display a message and set the other form fields to display data that the user submitted.</td>
</tr>
<tr>
<td><code>&lt;cfelse&gt;</code>&lt;br&gt;<code>&lt;cfset attributelist=&quot;objectclass=top,person, organizationalperson, inetOrgPerson; cn=#Trim(Form.fullName)#; sn=#Trim(Form.surname)#; mail=#Trim(Form.email)#; telephonenumber=#Trim(Form.phone)#; ou=Human Resources; uid=#Trim(Form.uid)#&quot;&gt;</code></td>
<td>If the user entered data in all fields, sets the attributelist variable to specify the entry’s attributes, including the object class and the organizational unit (in this case, Human Resources). The <code>Trim</code> function removes leading or trailing spaces from the user data.</td>
</tr>
</tbody>
</table>
Code | Description
--- | ---
```
<cfldap action="add"
    attributes="#attributeList#"
    dn="uid=#Trim(Form.uid)#,
        ou=People, o=Airius.com"
    server=#myServer#
    username=#myUserName#
    password=#myPassword#>
<cfoutput><h3>Entry for User ID #Form.uid# has been added</h3>
<cfif>
<cfif>
</cfif>
</cfoutput>
</cfldap>
```
| Adds the new entry to the directory.

```
<cfldap name="GetList"
    server=#myServer#
    action="query"
    attributes="cn,sn,mail,
                telephonenumber, uid"
    start="o=Airius.com"
    scope="subtree"
    filter="ou=Human Resources"
    sort="sn, cn"
    sortControl="asc, nocase">
<cfoutput query="GetList">
<tr><td>Full Name</td>
<td>Surname</td>
<td>Mail</td>
<td>Phone</td>
<td>UID</td></tr>
</cfoutput>
</cfldap>
```
| Queries the directory and gets the common name, surname, e-mail address, telephone number, and user ID from the matching entries.
| Searches the subtree from the entry with the DN of o=Airius.com, and selects all entries in which the organizational unit is Human Resources.
| Sorts the results by surname and then common name (to sort by last name, then first). Sorts in default ascending order that is not case-sensitive.
| Displays the query results in a table.

```
<cfform action="update_ldap.cfm" method="post">
<table>
<tr><td>Full Name:</td>
<td><cfinput type="Text"
            name="fullName"
            value=#fullNameValue#
            size="20"
            maxlength="30"
            tabindex="1"></td>
</tr>
<tr><td colspan="2">
<input type="Submit"
      name="action"
      value="Add"
      tabindex="6"></td>
</tr>
</table>
<br>
*All fields are required for Add<br>
</cfform>
```
| Outputs the data entry form, formatted as a table. Each cfinput field always has a value, set by the value attribute when the page is called. The value attribute lets ColdFusion update the form contents when the form is redisplayed after the user clicks Add. The code that handles cases in which the user fails to enter all the required data uses this feature.
Deleting a directory entry
To delete a directory entry, you must specify the entry DN.

The following example builds on the code that adds an entry. It adds Retrieve and Delete buttons. The Retrieve button lets you view a user's information in the form before you delete it.

1. Open update_ldap.cfm, which you created in "Adding a directory entry" on page 444.
2. Between the first and second `<cfif>` tags, add the following code:

```cfc
<cfelseif Form.action is "Retrieve">
  <cfldap name="GetEntry" server=#myServer# action="query" attributes="cn,sn,mail,telephonenumber,uid" scope="subtree" filter="uid=#Trim(Form.UID)#" start="o=Airius.com">
    <cfset fullNameValue = GetEntry.cn[1]>
    <cfset surnameValue = GetEntry.sn[1]>
    <cfset emailValue = GetEntry.mail[1]>
    <cfset phoneValue = GetEntry.telephonenumber[1]>
    <cfset uidValue = GetEntry.uid[1]>
  </cfldap>
</cfelseif>

<cfelseif Form.action is "Delete">
  <cfldap action="delete" dn="uid=#Trim(Form.UID)#, ou=People, o=Airius.com" server=#myServer# username=#myUserName# password=#myPassword#>
    <cfoutput><h3>Entry for User ID #Form.UID# has been deleted</h3></cfoutput>
</cfelseif>

3. At the end of the code for the Add button (the `input` tag with `Value=Add` at the bottom of the form), delete the `</td>` end tag.
4. After the end of the Add button `input` tag, add the following code:

```cfc
<input type="Submit" name="action" value="Retrieve" tabindex="7" />
<input type="Submit" name="action" value="Delete" tabindex="8" />
</td>
```

5. Save the file and run it in your browser.

Reviewing the code
The following table describes the code:
Updating a directory entry

The cfldap tag lets you change the values of entry attributes. To do so, you specify the entry DN in the `dn` attribute, and list the attributes to change and their new values in the `attributes` attribute.

The following example builds on the code that adds and deletes an entry. It can update one or more of an entry's attributes. Because the UID is part of the DN, you cannot change it.

1. Open update_ldap.cfm, which you created in “Adding a directory entry” on page 444.

2. Between the `cfelseif` `Form.action` is "Retrieve" block and the `</cfif>` tag, add the following code:

```cfc
cfelseif Form.action is "Retrieve"
<cfldap name="GetEntry"
server=#myServer#
action="query"
attributes="cn,sn,mail,
telephonenumber,uid"
scope="subtree"
filter="uid=#Trim(Form.UID)#"
start="o=Airius.com">
<cfset fullNameValue=
GetEntry.cn[1]>
<cfset surnameValue=GetEntry.sn[1]>
<cfset emailValue=GetEntry.mail[1]>
<cfset phoneValue=
GetEntry.telephonenumber[1]>
<cfset uidValue=GetEntry.uid[1]>
<cfoutput><h3>Entry for User ID #Form.UID# has been updated</h3></cfoutput>
</cfif>

3. Between the `cfelseif` `Form.action` is "Retrieve" and the `</cfelseif>` tag, add the following code:

```cfc
cfelseif Form.action is "Update"
<cfset attributeList="cn=#Trim(form.FullName)#; sn=#Trim(form.surname)#;
mail=#Trim(form.email)#;
telephonenumber=#Trim(form.phone)#">
<cfldap action="modify"
modifytype="replace"
attributes="#attributeList#"
dn="uid=#Trim(Form.UID)#, ou=People, o=Airius.com"
server=#myServer#
username=#myUserName#
password="password">
<cfoutput><h3>Entry for User ID #Form.UID# has been updated</h3></cfoutput>
</cfif>

4. Between the `cfelseif` `Form.action` is "Retrieve" and the `</cfif>` tag, add the following code:

```cfc
cfelseif Form.action is "Delete"
<cfldap action="delete"
dn="uid=#Trim(Form.UID)#,
ou=People, o=Airius.com"
server=#myServer#
username=#myUserName#
password="password">
<cfoutput><h3>Entry for User ID #Form.UID# has been deleted</h3></cfoutput>
</cfif>

5. Add the following submit buttons for the Retrieve and Delete actions:

```cfc
<input type="Submit" name="action" value="Retrieve" tabindex="7">
<input type="Submit" name="action" value="Delete" tabindex="8">
</td>
```

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<cfelseif Form.action is "Retrieve">
  `<cfldap name="GetEntry">
  `server=#myServer#
  `action="query"
  `attributes="cn,sn,mail,
  `telephonenumber,uid"
  `scope="subtree"
  `filter="uid=#Trim(Form.UID)#"
  `start="o=Airius.com">
  `<cfset fullNameValue=
  GetEntry.cn[1]>
  `<cfset surnameValue=GetEntry.sn[1]>
  `<cfset emailValue=GetEntry.mail[1]>
  `<cfset phoneValue=
  GetEntry.telephonenumber[1]>
  `<cfset uidValue=GetEntry.uid[1]>
  `<cfoutput><h3>Entry for User ID #Form.UID# has been updated</h3></cfoutput>` | If the user clicks Retrieve, queries the directory and gets the information for the specified User ID. Sets the form field's Value attribute to the corresponding query column. This example uses the array index [1] to identify the first row of the GetEntry query object. Because the query always returns only one row, the index can be omitted. |
| `</cfif>`                                                          |             |
| `<cfelseif Form.action is "Delete">
  `<cfldap action="delete">
  `dn="uid=#Trim(Form.UID)#,
  `ou=People, o=Airius.com"
  `server=#myServer#
  `username=#myUserName#
  `password="password">
  `<cfoutput><h3>Entry for User ID #Form.UID# has been deleted</h3></cfoutput>` | The user clicks delete, deletes the entry with the specified User ID and informs the user that the entry was deleted. |
| `</cfif>`                                                          |             |
| `&nbsp
  <input type="Submit" name="action" value="Retrieve" tabindex="7">
  &nbsp
  <input type="Submit" name="action" value="Delete" tabindex="8"></td>` | Displays submit buttons for the Retrieve and Delete actions. |
At the end of the code for the Delete button (the input tag with Value=Delete at the bottom of the form), delete the </td> mark.

After the end of the Delete button input tag, add the following code:

```cfc
<input type="Submit"
name="action"
value="Update"
tabindex="9"></td>
```

Save the file and run it in your browser.

Reviewing the code

The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<cfelseif Form.action is "Update">
  <cfset attributelist="cn=#Trim(form.FullName)#; sn=#Trim(Form.surname)#; mail=#Trim(Form.email)#; telephonenumber=#Trim(Form.phone)#">
  <cfldap action="modify"
    modifytype="replace"
    attributes="#attributelist#"
    dn="uid=#Trim(Form.UID)#, ou=People, o=Airius.com"
    server=#myServer#
    username=#myUserName#
    password=#myPassword#>
  <cfoutput><h3>Entry for User ID #Form.UID# has been updated</h3></cfoutput>
</cfelseif>` | If the user clicks Update, sets the attribute list to the form field values and replaces the attributes for the entry with the specified UID. Displays a message to indicate that the entry was updated. This code replaces all of the attributes in a form, without checking whether they are blank. A more complete example would check for blank fields and either require entered data or not include the corresponding attribute in the attributes string. |
| `<input type="Submit"
name="action"
value="Update"
tabindex="9"></td>` | Defines the Submit button for the update action. |

Adding and deleting attributes of a directory entry

The following table lists the cfldap tag attributes that you must specify to add and delete LDAP attributes in an entry:

<table>
<thead>
<tr>
<th>Action</th>
<th>cfldap syntax</th>
</tr>
</thead>
</table>
| Add attribute to entry | `dn = "entry dn"
action = "modify"
modifytype = "add"
attributes = "attribName=attribValue[;...]"]` |
| Delete attribute from entry | `dn = "entry dn"
action = "modify"
modifytype = "delete"
attributes = "attribName[;...]"]` |

You can add or delete multiple attributes in one statement. To do this, use semicolons to separate the attributes in the attribute string.

The following example specifies the description and seealso LDAP attributes:

```
attributes="description=Senior Technical Writer;seealso=writers"
```
You can change the character that you use to separate values of multivalued attributes in an attribute string. You can also change the character that separates attributes when a string contains multiple attributes. For more information, see “Specifying an attribute that includes a comma or semicolon” on page 452.

You can add or delete attributes only if the directory schema defines them as optional for the entry’s object class.

**Changing a directory entry’s DN**

To change the DN of an entry, you must provide the following information in the `cfldap` tag:

```
<cfldap action="modifyDN"
   dn="original DN"
   attributes="dn=new DN"
   server="#myServer#"
   username="#myUserName#"
   password="#myPassword#">
```

For example:

```
<cfldap action="modifyDN"
   dn="#old_UID#, ou=People, o=Airius.com"
   attributes="uid=#newUID#"
   server="#myServer#"
   username="#myUserName#"
   password="#myPassword#">
```

The new DN and the entry attributes must conform to the directory schema; therefore, you cannot move entries arbitrarily in a directory tree. You can only modify a leaf only. For example, you cannot modify the group name if the group has children.

*Note: LDAP v2 does not let you change entry DNs.*

**Advanced topics**

Some more advanced techniques enable you to use LDAP directories more effectively.

**Specifying an attribute that includes a comma or semicolon**

LDAP attribute values can contain commas. The `cfldap` tag normally uses commas to separate attribute values in a value list. Similarly, an attribute can contain a semicolon, which `cfldap` normally uses to delimit (separate) attributes in an attribute list. To override the default separator and delimiter characters, you use the `cfldap` tag `separator` and `delimiter` attributes.

For example, assume you want to add the following attributes to an LDAP entry:

```
cn=Proctor, Goodman, and Jones
description=Friends of the company; Rationalists
```

Use the `cfldap` tag in the following way:

```
<cfldap action="modify"
   modifyType="add"
   attributes="cn=Proctor, Goodman, and Jones: description=Friends of the company; Rationalists"
   separator="&"
   delimiter=":
   server="#myServer#"
   username="#myUserName#"
   password="#myPassword#">
```
Using cfldap output
You can create a searchable Verity collection from LDAP data. For an example of building a Verity collection using an LDAP directory, see “Indexing query results obtained from an LDAP directory” on page 485.

The ability to generate queries from other queries is very useful when cfldap queries return complex data. For more information on querying queries, see “Using Query of Queries” on page 413.

Viewing a directory schema
LDAP v3 exposes a directory's schema information in a special entry in the root DN. You use the directory root subschemaSubentry attribute to access this information.

The following ColdFusion query shows how to get and display the directory schema. It displays information from the schema's object class and attribute type definitions. For object classes, it displays the class name, superior class, required attribute types, and optional attribute types. For attribute types, it displays the type name, type description, and whether the type is single- or multivalued.

The example does not display all the information in the schema. For example, it does not display the matching rules. It also does not display the object class IDs, attribute type IDs, attribute type syntax IDs, or the object class descriptions. (The object class description values are all "Standard Object Class.")

Note: To be able to view the schema for an LDAP server, the server must support LDAP v3

This example does not work on iPlanet Directory Server 5.0. It does work on a 4.x server.

View the schema for an LDAP directory
1  Create a file that looks like the following:

```html
<html>
<head>
  <title>LDAP Schema</title>
</head>

<body>
<!--- Start at Root DSE to get the subschemaSubentry attribute. --->
<cfldap
  name="EntryList"
  server="ldap.mycorp.com"
  action="query"
  attributes="subschemaSubentry"
  scope="base"
  start="">

<!--- Use the DN from the subschemaSubEntry attribute to get the schema. --->
<cfldap
  name="EntryList2"
  server="ldap.mycorp.com"
  action="query"
  attributes="objectclasses, attributetypes"
  scope="base"
  filter="objectclass=*"
  start=#entryList.subschemaSubentry#>

<!--- Only one record is returned, so query loop is not required. --->
<h2>Object Classes</h2>
<table border="1">
  <tr>
    <th>Name</th>
```


<th>Superior class</th>
<th>Must have</th>
<th>May have</th>
</tr>
<cfloop index = "thisElement" list = #Entrylist2.objectclasses#>
<cfscript>
thisElement = Trim(thisElement);
nameloc = Find("NAME", thisElement);
descloc = Find("DESC", thisElement);
suploc = Find("SUP", thisElement);
mustloc = Find("MUST", thisElement);
mayloc = Find("MAY", thisElement);
endloc = Len(thisElement);
</cfscript>
<tr>
<td><cfoutput>#Mid(thisElement, nameloc+6, descloc-nameloc-8)#</cfoutput></td>
<cfif #suploc# NEQ 0>
<td><cfoutput>#Mid(thisElement, suploc+5, mustloc-suploc-7)#</cfoutput></td>
<cfelse>
<td>NONE</td>
</cfif>
<cfif #mayloc# NEQ 0>
<td><cfoutput>#Replace(Mid(thisElement, mustloc+6, mayloc-mustloc-9), " ", ", "all")#</cfoutput></td>
<td><cfoutput>#Replace(Mid(thisElement, mayloc+5, endloc-mayloc-8), " ", ", "all")#</cfoutput></td>
<cfelse>
<td><cfoutput>#Replace(Mid(thisElement, mustloc+6, endloc-mustloc-9), " ", ", "all")#</cfoutput></td>
<td>NONE</td>
</cfif>
</tr>
</cfloop>
</table>
<br><br>
<h2>Attribute Types</h2>
<table border="1" >
<tr>
<th>Name</th>
<th>Description</th>
<th>multivalued?</th>
</tr>
<cfloop index = "thisElement" list = #ReplaceNoCase(EntryList2.attributeTypes, ", alias", "<br> Alias", "all")# delimiters = ",">
<cfscript>
thisElement = Trim(thisElement);
nameloc = Find("NAME", thisElement);
descloc = Find("DESC", thisElement);
syntaxloc = Find("SYNTAX", thisElement);
singleloc = Find("SINGLE", thisElement);
endloc = Len(thisElement);
</cfscript>
<tr>
<td><cfoutput>#Mid(thisElement, nameloc+6, descloc-nameloc-8)#</cfoutput></td>
<td><cfoutput>#Mid(thisElement, descloc+6, syntaxloc-descloc-8)#</cfoutput></td>
2. Change the server from `ldap.mycorp.com` to your LDAP server. You might also need to specify a user ID and password in the `cfldap` tag.

3. Save the template as `ldapschema.cfm` in `myapps` under your web root directory and view it in your browser.

### Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<cfldap<br/` name="EntryList"
server="ldap.mycorp.com"
action="query"
attributes="subschemaSubentry"
scope="base"
start="#entryList.subschemaSubentry#;` |
| Gets the value of the subschemaSubentry attribute from the root of the directory server. The value is the DN of the schema. |
| `<cfldap<br/` name="EntryList2"
server="ldap.mycorp.com"
action="query"
attributes="objectclasses,attributetypes"
scope="base"
filter="objectclass=*"
start="#entryList.subschemaSubentry#;` |
| Uses the schema DN to get the objectclasses and attributetypes attributes from the schema. |
## Object Classes

<table>
<thead>
<tr>
<th>Name</th>
<th>Superior class</th>
<th>Must have</th>
<th>May have</th>
</tr>
</thead>
</table>

Displays the object class name, superior class, required attributes, and optional attributes for each object class in a table.

The schema contains the definitions of all object classes in a comma delimited list, so the code uses a list type `cfloop` tag.

The `thisElement` variable contains the object class definition. Trim off any leading or trailing spaces, then use the class definition field keywords in `Find` functions to get the starting locations of the required fields, including the Object class ID. (The ID is not displayed.)

Gets the length of the `thisElement` string for use in later calculations.

Displays the field values. Uses the `Mid` function to extract individual field values from the `thisElement` string.

The top object class does not have a superior class entry. Handles this special case by testing the `suploc` location variable. If the value is not 0, handles normally, otherwise, output “NONE”.

There might not be any optional attributes. Handles this case similarly to the superior class. The calculation of the location of required attributes uses the location of the optional attributes if the field exists; otherwise, uses the end of the object class definition string.
Referrals

An LDAP database can be distributed over multiple servers. If the requested information is not on the current server, the LDAP v3 standard provides a mechanism for the server to return a referral to the client that informs the client of an alternate server. (This feature is also included in some LDAP v2-compliant servers.)

ColdFusion can handle referrals automatically. If you specify a nonzero referral attribute in the cflap tag, ColdFusion sends the request to the server specified in the referral.

The referral attribute value specifies the number of referrals allowed for the request. For example, if the referral attribute is 1, and server A sends a referral to server B, which then sends a referral to server C, ColdFusion returns an error. If the referral attribute is 2, and server C has the information, the LDAP request succeeds. The value to use depends on the topology of the distributed LDAP directory, the importance of response speed, and the value of response completeness.

When ColdFusion follows a referral, the rebind attribute specifies whether ColdFusion uses the cflap tag login information in the request to the new server. The default, No, sends an anonymous login to the server.

Managing LDAP security

When you consider how to implement LDAP security, you must consider server security and application security.
Server security
The cfldap tag supports secure socket layer (SSL) v2 security. This security provides certificate-based validation of the LDAP server. It also encrypts data transferred between the ColdFusion server and the LDAP server, including the user password, and ensures the integrity of data passed between the servers. To specify SSL v2 security, set the cfldap tag secure="cfssl_basic" attribute.

About LDAP Server Security
ColdFusion uses Java Native Directory Interface (JNDI), the LDAP provider, and an SSL package to create the client side of an SSL communication. The LDAP server provides the server side. The LDAP server that the cfldap tag connects to using SSL holds an SSL server certificate, a certificate that is securely “signed” by a trusted authority and identifies (authenticates) the sender. During the initial SSL connection, the LDAP server presents its server certificate to the client. If the client trusts this certificate, the SSL connection is established and secure LDAP communication can begin.

ColdFusion determines whether to trust the server by comparing the server’s certificate with the information in the jre/lib/security/cacerts keystore of the JRE used by ColdFusion. The ColdFusion default cacerts file contains information about many certificate granting authorities. If you must update the file with additional information, you can use the keytool utility in the ColdFusion jre/bin directory to import certificates that are in X.509 format. For example, enter the following:

ektool -import -keystore cacerts -alias ldap -file ldap.crt -keypass bl19mq

The keytool utility initial keypass password is “change it”. For more information on using the keytool utility, see the Sun JDK documentation.

Once ColdFusion establishes secure communication with the server, it must provide the server with login credentials. You specify the login credentials in the cfldap tag username and password attributes. When the server determines that the login credentials are valid, ColdFusion can access the directory.

Using LDAP security
To use security, first ensure that the LDAP server supports SSL v2 security.

Specify the cfldap tag secure attribute as follows:

secure = "cfssl_basic"

For example:

<cfldap action="modify"
   modifyType="add"
   attributes="cn=Lizzie"
   dn="uid=lborden, ou=People, o=Airius.com"
   server=#myServer#
   username=#myUserName#
   password=#myPassword#
   secure="cfssl_basic"
   port=636>

The port attribute specifies the server port used for secure LDAP communications, which is 636 by default. If you do not specify a port, ColdFusion attempts to connect to the default, nonsecure, LDAP port 389.

Application security
To ensure application security, you must prevent outsiders from gaining access to the passwords that you use in cfldap tags. The best way to do this is to use variables for your username and password attributes. You can set these variables on one encrypted application page. For more information on securing applications, see “Securing Applications” on page 311.
Chapter 27: Building a Search Interface

You can provide a full-text search capability for documents and data sources on a ColdFusion site by enabling the Verity search engine. Verity full-text search lets people visiting your site use simple one- and two-word searches to quickly find the information they need. You can use the more robust Verity Query Language and the Verity advanced search operators to transparently implement business-specific meaning behind searches. This allows even one word searches to return accurate results.

You can build a Verity search interface with which users can perform powerful searches on your site. You also can index your documents and data sources so that users can search them.

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Creating a search tool for ColdFusion applications .................. 465
Creating a search page ................................................... 471
Enhancing search results ............................................... 473
Working with data returned from a query ............................... 480

About Verity

To efficiently search through paragraphs of text or files of varying types, you need full-text search capabilities. Adobe ColdFusion includes the Verity search engine, which provides full-text indexing and searching.

The Verity engine performs searches against collections, not against the actual documents. A collection is a special database created by Verity that contains metadata that describes the documents that you have indexed. The indexing process examines documents of various types in a collection and creates a metadata description—the index—which is specialized for rapid search and retrieval operations.

The ColdFusion implementation of Verity supports collections of the following basic data types:

- Text files such as HTML pages and CFML pages
- Binary documents (see “Supported file types” on page 460)
- Record sets returned from a query and CF query object, including: cfquery, cfldap, and cfpop queries

You can build collections from individual documents or from an entire directory tree. Collections can be stored anywhere, so you have a great deal of flexibility in accessing indexed data.

In your ColdFusion application, you can search multiple collections, each of which can focus on a specific group of documents or queries, according to subject, document type, location, or any other logical grouping. Because you can perform searches against multiple collections, you have substantial flexibility in designing your search interface.

Using Verity with ColdFusion

Here are some ways to use Verity with ColdFusion:

- Index your website and provide a generalized search mechanism, such as a form interface, for executing searches.
- Index specific directories that contain documents for subject-based searching.
Index specific categories of documents. By organizing your documents into categories, you can let users search specific types of documents. For example, if your website contains FAQs, documentation, and tutorials, you can create a search that lets users search within each of these categories.

- Index cfquery record sets, giving users the ability to search against the data. Because collections contain data optimized for retrieval, this method is much faster than performing multiple database queries to return the same data.
- Index cfldap and cfpop query results.
- Manage and search collections generated outside of ColdFusion using native Verity tools. Collections must be registered with the Verity K2 administration service. To do this you must either use the Verity tools, or map the collection using the cfcollection tag.
- Index e-mail generated by ColdFusion application pages and create a searching mechanism for the indexed messages.
- Build collections of inventory data and make those collections available for searching from your ColdFusion application pages.
- Support international users in a range of languages using the cfindex, cfcollection, and cfsearch tags.

**Advantages of using Verity**

Verity can index the output from queries so that you or a user can search against the record sets. Searching query results has a clear advantage over using SQL to search a database directly in speed of execution because metadata from the record sets are stored in a Verity index that is optimized for searching.

Performing a Verity search has the following advantages over other search methods:

- You can reduce the programming overhead of query constructs by allowing users to construct their own queries and execute them directly. You need to be concerned only with presenting the output to the client web browser.
- Verity can index database text fields, such as notes and product descriptions, that cannot be effectively indexed by native database tools.
- When indexing collections that contain documents in formats such as Adobe Acrobat (PDF) and Microsoft Word, Verity scans for the document title (if one was entered), in addition to the document text, and displays the title in the search results list.
- When Verity indexes web pages, it can return the URL for each document. This is a valuable document management feature.

For more information, see “Indexing data returned by a query” on page 480.

**Supported file types**

The ColdFusion Verity implementation supports a wide array of file and document types. As a result, you can index web pages, ColdFusion applications, and many binary document types and produce search results that include summaries of these documents.

Verity supports the following formats:
<table>
<thead>
<tr>
<th>Document format</th>
<th>Format</th>
<th>Version(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text and markup</td>
<td>ANSI (TXT)</td>
<td>All versions</td>
</tr>
<tr>
<td></td>
<td>ASCII (TXT)</td>
<td>All versions</td>
</tr>
<tr>
<td></td>
<td>HTML (HTM)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>IBM DCA/RFT (Revisable Form Text) (DC)</td>
<td>SC23-0758-1</td>
</tr>
<tr>
<td></td>
<td>Rich Text Format/WordPad (RTF)</td>
<td>1 through 1.6</td>
</tr>
<tr>
<td></td>
<td>Unicode Text (TXT)</td>
<td>3, 4</td>
</tr>
<tr>
<td>Word processing</td>
<td>Adobe Maker Interchange Format (MIF)</td>
<td>5, 5.5, 6, 7</td>
</tr>
<tr>
<td></td>
<td>Applix Words (AW)</td>
<td>3.11, 4.2, 4.3, 4.4, 4, 41, 4.2</td>
</tr>
<tr>
<td></td>
<td>DisplayWrite (IP)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Folio Flat File (FFF)</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>Fujitsu Oasys (OA2)</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>JustSystems Ichitaro (JTD)</td>
<td>8, 9, 10, 12</td>
</tr>
<tr>
<td></td>
<td>Lotus AMI Pro (SAM)</td>
<td>2, 3</td>
</tr>
<tr>
<td></td>
<td>Lotus Word Pro (LWP) (Windows only)</td>
<td>96, 97, Millennium Edition R9</td>
</tr>
<tr>
<td></td>
<td>Microsoft Word for PC (DOC)</td>
<td>4, 5, 5.5, 6</td>
</tr>
<tr>
<td></td>
<td>Microsoft Word for Windows (DOC)</td>
<td>1 through 2002</td>
</tr>
<tr>
<td></td>
<td>Microsoft Word for Macintosh (DOC)</td>
<td>4, 5, 6, 98</td>
</tr>
<tr>
<td></td>
<td>Microsoft Works (WPS)</td>
<td>1 through 2000</td>
</tr>
<tr>
<td></td>
<td>Microsoft Windows Write (WRI)</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td></td>
<td>WordPerfect for Windows V5 (WO)</td>
<td>5, 5.1</td>
</tr>
<tr>
<td></td>
<td>WordPerfect for Windows V6 and higher (WPD)</td>
<td>6, 7, 8, 10, 2000</td>
</tr>
<tr>
<td></td>
<td>WordPerfect for Macintosh</td>
<td>1.02, 2, 2.1, 2.2, 3, 3.1</td>
</tr>
<tr>
<td></td>
<td>WordPerfect for Linux</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>XyWrite (XY4)</td>
<td>4.12</td>
</tr>
<tr>
<td>Document format</td>
<td>Format</td>
<td>Version(s)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Spreadsheet formats</strong></td>
<td>Applix Spreadsheets (AS)</td>
<td>4.2, 4.3, 4.4</td>
</tr>
<tr>
<td></td>
<td>Comma Separated Values (CSV)</td>
<td>No specific version</td>
</tr>
<tr>
<td></td>
<td>Corel Quattro Pro (QPW, WB3)</td>
<td>5, 6, 7, 8</td>
</tr>
<tr>
<td></td>
<td>Lotus 1-2-3 for SmartSuite (123)</td>
<td>96, 97, Millennium Edition R9</td>
</tr>
<tr>
<td></td>
<td>Lotus 1-2-3 (WK4)</td>
<td>2, 3, 4, 5</td>
</tr>
<tr>
<td></td>
<td>Lotus 1-2-3 Charts (123)</td>
<td>2, 3, 4, 5</td>
</tr>
<tr>
<td></td>
<td>Microsoft Excel for Windows (XLS)</td>
<td>2.2, 3, 4, 5, 96, 97, 2000, 2002</td>
</tr>
<tr>
<td></td>
<td>Microsoft Excel for Macintosh (XLS)</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>Microsoft Excel Charts (XLS)</td>
<td>2, 3, 4, 5, 6, 7</td>
</tr>
<tr>
<td></td>
<td>Microsoft Works Spreadsheet (S30, S40)</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td><strong>Presentation formats</strong></td>
<td>Applix Presents (AG)</td>
<td>4.0, 4.2, 4.3, 4.4</td>
</tr>
<tr>
<td></td>
<td>Corel Presentations (SHW)</td>
<td>7, 9, 10, 11, 2000</td>
</tr>
<tr>
<td></td>
<td>Lotus Freelance Graphics for Windows (PRE)</td>
<td>2, 96, 97, 98, Millennium Edition R9</td>
</tr>
<tr>
<td></td>
<td>Lotus Freelance Graphics 2 (PRE)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Microsoft PowerPoint for Windows (PPT)</td>
<td>95, 97, 2000, 2002</td>
</tr>
<tr>
<td></td>
<td>Microsoft PowerPoint for PC (PPT)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Microsoft PowerPoint for Macintosh (PPT)</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>Microsoft Project (MPP)</td>
<td>98, 2000, 2002</td>
</tr>
<tr>
<td><strong>Display formats</strong></td>
<td>Adobe Portable Document Format (PDF)</td>
<td>1.1 (Acrobat 2.0) to 1.4 (Acrobat 5.0)</td>
</tr>
<tr>
<td><strong>Graphics formats</strong></td>
<td>AutoCAD Drawing format (DWG) (standalone)</td>
<td>R13, R14, and R2000</td>
</tr>
<tr>
<td></td>
<td>(does not extract metadata)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AutoCAD Drawing format (DXF) (standalone)</td>
<td>R13, R14, and R2000</td>
</tr>
<tr>
<td></td>
<td>(does not extract metadata)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Graphics Metafile (CGM) (embedded)</td>
<td>No specific version</td>
</tr>
<tr>
<td></td>
<td>Enhanced Metafile (EMF) (embedded and standalone)</td>
<td>No specific version</td>
</tr>
<tr>
<td></td>
<td>Lotus Pic (PIC) (standalone)</td>
<td>No specific version</td>
</tr>
<tr>
<td></td>
<td>Microsoft Visio (standalone)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Tagged Image File (TIFF) (standalone)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Windows Metafile (WMF) (embedded and standalone)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Multimedia formats</strong></td>
<td>MPEG-1 audio layer 3 (MP3)</td>
<td>ID3 versions 1 and 2</td>
</tr>
</tbody>
</table>
Specifying a language

If you install the optional ColdFusion International Search pack, you can specify a language other than English when creating a collection.

ColdFusion supports Verity Locales in European, Asian, and Middle Eastern languages. For more information about installing Verity Locales, see Installing and Using ColdFusion.

For English language support, Verity provides two options: English (Basic) and English (Advanced). The default language for Verity collections is English (Basic). Indexing a collection using English (Basic) is faster than using English (Advanced), however, English (Advanced) provides better search results.

You must specify a language when you create the collection. The language you specify should match the language the documents were authored in. By specifying the language your documents are written in, Verity is able to correctly interpret accented characters, and, in many languages, use variations of word stems and roots. However, Verity does not support the following in Eastern European and Middle Eastern languages, including these languages in the Universal language pack:

- Stemming
- Normalization
- Decomposition of compound words into subwords
- Part of speech
- Special number handling

If you have documents in several languages, create separate collections for each of them.

To specify a language when you are indexing data, select the language from the pop-up menu when you create a collection with the ColdFusion Administrator. In CFML, the `cfcollection`, `cfindex`, and `cfsearch` tags have an optional language attribute that you use to specify the language of the collection.

Use the following table to find the correct value for the language attribute for your collection; for example, the following code creates a collection for simplified Chinese:

```cfml
<cfcollection action = "create" collection = "lei_01"
    path = "c:\CFusion\verity\collections"
    language = "simplified_chinese">
```

The following table lists the languages names and attributes that ColdFusion supports:

<table>
<thead>
<tr>
<th>Document format</th>
<th>Format</th>
<th>Version(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container formats</td>
<td>DynaZip</td>
<td>No specific version</td>
</tr>
<tr>
<td></td>
<td>PKZIP (zip)</td>
<td>PKWARE versions through 2.04g</td>
</tr>
<tr>
<td></td>
<td>WinZIP</td>
<td>No specific version</td>
</tr>
<tr>
<td>E-mail formats</td>
<td>Microsoft Outlook (msg)</td>
<td>97, 2000, 2002</td>
</tr>
<tr>
<td></td>
<td>Microsoft Outlook Express (eml)</td>
<td>No specific version</td>
</tr>
</tbody>
</table>
You can register collections in the ColdFusion Administrator or by creating a collection with the `cfcollection` tag. If you register a given collection with ColdFusion and you specify a `language` attribute, you do not have to specify the `language` attribute when using `cfindex` and `cfsearch` tags for that collection. If you do not register a given collection with ColdFusion, ColdFusion uses English (Basic), the default language, unless you specify the language in the `language` attribute for the `cfindex` and `cfsearch` tags for that collection.

**Note:** When you search a collection in a language other than English, you must translate operators such as AND and OR into the language of the collection.

<table>
<thead>
<tr>
<th>Language</th>
<th>Language attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arabic</td>
<td>arabic</td>
</tr>
<tr>
<td>Chinese (simplified)</td>
<td>simplified_chinese</td>
</tr>
<tr>
<td>Chinese (traditional)</td>
<td>traditional_chinese</td>
</tr>
<tr>
<td>Czech</td>
<td>czech</td>
</tr>
<tr>
<td>Danish</td>
<td>danish</td>
</tr>
<tr>
<td>Dutch</td>
<td>dutch</td>
</tr>
<tr>
<td>English (Basic)</td>
<td>english</td>
</tr>
<tr>
<td>English (Advanced)</td>
<td>englishx</td>
</tr>
<tr>
<td>Finnish</td>
<td>finnish</td>
</tr>
<tr>
<td>French</td>
<td>french</td>
</tr>
<tr>
<td>German</td>
<td>german</td>
</tr>
<tr>
<td>Greek</td>
<td>greek</td>
</tr>
<tr>
<td>Hebrew</td>
<td>hebrew</td>
</tr>
<tr>
<td>Hungarian</td>
<td>hungarian</td>
</tr>
<tr>
<td>Italian</td>
<td>italian</td>
</tr>
<tr>
<td>Japanese</td>
<td>japanese</td>
</tr>
<tr>
<td>Korean</td>
<td>korean</td>
</tr>
<tr>
<td>Norwegian</td>
<td>norwegian</td>
</tr>
<tr>
<td>Norwegian (Bokmal)</td>
<td>bokmal</td>
</tr>
<tr>
<td>Norwegian (Nynorsk)</td>
<td>nynorsk</td>
</tr>
<tr>
<td>Polish</td>
<td>polish</td>
</tr>
<tr>
<td>Portuguese</td>
<td>portuguese</td>
</tr>
<tr>
<td>Russian</td>
<td>russian</td>
</tr>
<tr>
<td>Spanish</td>
<td>spanish</td>
</tr>
<tr>
<td>Swedish</td>
<td>swedish</td>
</tr>
<tr>
<td>Turkish</td>
<td>turkish</td>
</tr>
<tr>
<td>Multiple languages</td>
<td>uni</td>
</tr>
</tbody>
</table>
Creating a search tool for ColdFusion applications

There are three main tasks in creating a search tool for your ColdFusion application:

1. Create a collection.
2. Index the collection.
3. Design a search interface.

You can perform each task programmatically—that is, by writing CFML code. Alternatively, you can use the ColdFusion Administrator to create and index a collection.

**Creating a collection with the ColdFusion Administrator**

Use the following procedure to quickly create a collection with the ColdFusion Administrator:

1. In the ColdFusion Administrator, select Data & Services > Verity Collections.
2. Enter a name for the collection; for example, DemoDocs.
3. Enter a path for the directory location of the new collection, for example, `C:\CFusion\verity\collections\`

   By default in the server configuration, ColdFusion stores collections in `cf_root\verity\collections\` in Windows and in `cf_root/verity/collections` on UNIX. In the multiserver configuration, the default location for collections is `cf_webapp_root/verity/collections`. In the J2EE configuration, the default location for collections is `verity_root/verity/collections`, where `verity_root` is the directory in which you installed Verity.

   **Note:** This is the location for the collection, not for the files that you will search.

4. (Optional) Select a language other than English for the collection from the Language drop-down list.

   For more information on selecting a language, see "Specifying a language" on page 463.

5. (Optional) Select Enable Category Support to create a Verity Parametric collection.

   For more information on using categories, see “Narrowing searches by using categories” on page 476.

6. Click Create Collection.

   The name and full path of the new collection appears in the list of Verity Collections.

You have successfully created an empty collection. A collection becomes populated with data when you index it.

**About indexing a collection**

In order for information to be searched, it must be indexed. Indexing extracts both meaning and structure from unstructured information by indexing each document that you specify into a separate Verity collection that contains a complete list of all the words used in a given document along with metadata about that document. Indexed collections include information such as word proximity, metadata about physical file system addresses, and URLs of documents.

When you index databases and other record sets that you generated using a query, Verity creates a collection that normalizes both the structured and unstructured data. Search requests then check these collections rather than scanning the actual documents and database fields. This provides a faster search of information, regardless of the file type and whether the source is structured or unstructured.

Just as with creating a collection, you can index a collection programmatically or by using the ColdFusion Administrator. Use the following guidelines to determine which method to use:
You can use `cfcollection action="optimize"` if you notice that searches on a collection take longer than they did previously.

### Updating an index

Documents are modified frequently in many user environments. After you index your documents, any changes that you make are not reflected in subsequent Verity searches until you re-index the collection. Depending on your environment, you can create a scheduled task to automatically keep your indexes current. For more information on scheduled tasks, see *Configuring and Administering ColdFusion*.

### Creating a ColdFusion search tool programmatically

You can create a Verity search tool for your ColdFusion application in CFML. Although writing CFML code can take more development time than using these tools, there are situations in which writing code is the preferred development method.

#### Creating a collection with the `cfcollection` tag

The following are cases in which you might prefer using the `cfcollection` tag rather than the ColdFusion Administrator to create a collection:

- You want your ColdFusion application to be able to create, delete, and maintain a collection.
- You do not want to expose the ColdFusion Administrator to users.
- You want to create indexes on servers that you cannot access directly; for example, if you use a hosting company.

When using the `cfcollection` tag, you can specify the same attributes as in the ColdFusion Administrator:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>action</td>
<td>(Optional) The action to perform on the collection (create, delete, or optimize). The default value for the <code>action</code> attribute is <code>list</code>. For more information, see <code>cfcollection</code> in CFML Reference.</td>
</tr>
<tr>
<td>collection</td>
<td>The name of the new collection, or the name of a collection upon which you will perform an action.</td>
</tr>
<tr>
<td>path</td>
<td>The location for the Verity collection.</td>
</tr>
<tr>
<td>language</td>
<td>The language.</td>
</tr>
<tr>
<td>categories</td>
<td>(Optional) Specifies that <code>cfcollection</code> create a Verity Parametric Index (PI) for this collection. By default, the categories attribute is set to <code>False</code>. To create a collection that uses categories, specify <code>Yes</code>.</td>
</tr>
</tbody>
</table>

You can create a collection by directly assigning a value to the `collection` attribute of the `cfcollection` tag, as shown in the following code:

```xml
cfcollection action = "create"
collection = "a_new_collection"
path = "c:\CFusion\verity\collections\"
```
If you want your users to be able to dynamically supply the name and location for a new collection, use the following procedures to create form and action pages.

**Create a simple collection form page**

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
    <title>Collection Creation Input Form</title>
</head>

<body>
<h2>Specify a collection</h2>
<form action="collection_create_action.cfm" method="POST">

    <p>Collection name:<input type="text" name="CollectionName" size="25"></p>

    <p>What do you want to do with the collection?</p>
    <input type="radio" name="CollectionAction" value="Create" checked>Create<br>
    <input type="radio" name="CollectionAction" value="Optimize">Optimize<br>
    <input type="submit" name="submit" value="Submit">

</form>

</body>
</html>
```

2. Save the file as collection_create_form.cfm in the myapps directory under the web root directory.

*Note: The form will not work until you write an action page for it, which is the next procedure.*

**Create a collection action page**

1. Create a ColdFusion page with the following content:

```cfcollection
<html>
<head>
    <title>cfcollection</title>
</head>

<body>
<h2>Collection creation</h2>
<cfoutput>
<cfswitch expression=#Form.collectionaction#>
<cfcase value="Create">
    <cfcollection action="Create"
    collection="#Form.CollectionName#"
    path="c:\CFusion\verity\collections\"
    <p>The collection #Form.CollectionName# is created.</p>
</cfcase>

<cfcase value="Optimize">
    <cfcollection action="Optimize"
```

```
collection="#Form.CollectionName#">
   <p>The collection #Form.CollectionName# is optimized.</p>
</cfcase>

<cfcase value="Delete">
   <cfcollection action="Delete"
      collection="#Form.CollectionName#">
   <p>The collection is deleted.</p>
</cfcase>
</cfswitch>
</cfoutput>
</body>
</html>

2. Save the file as collection_create_action.cfm in the myapps directory under the web root directory.

3. In the web browser, enter the following URL to display the form page:
   http://hostname:portnumber/myapps/collection_create_form.cfm

4. Enter a collection name; for example, CodeColl.

5. Verify that Create is selected and submit the form.

6. (Optional) In the ColdFusion Administrator, reload the Verity Collections page.

You successfully created a collection, named CodeColl, that currently has no data.

Indexing a collection by using the cfindex tag
You can index a collection in CFML by using the cfindex tag, which eliminates the need to use the ColdFusion Administrator. The cfindex tag populates the collection with metadata that is then used to retrieve search results. You can use the cfindex tag to index either physical files (documents stored within your website's root folder), or the results of a database query.

Note: Prior to indexing a collection, you must create a Verity collection by using the ColdFusion Administrator, or the cfcollection tag. For more information, see "Creating a collection with the ColdFusion Administrator" on page 465, or "Creating a collection with the cfcollection tag" on page 466.

When using the cfindex tag, the following attributes correspond to the values that you would enter by using the ColdFusion Administrator to index a collection:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>collection</td>
<td>The name of the collection.</td>
</tr>
<tr>
<td>action</td>
<td>Specifies what the cfindex tag should do to the collection. The default action is to update the collection, which generates a new index. Other actions are to delete, purge, or refresh the collection.</td>
</tr>
</tbody>
</table>
| type | Specifies the type of files or other data to which the cfindex tag applies the specified action. The value you assign to the type attribute determines the value to use with the key attribute (see the following list). When you enter a value for the type attribute, cfindex expects a corresponding value in the key attribute. For example, if you specify type=file, cfindex expects a directory path and filename for the key attribute. The type attribute has the following possible values:  
  * file: Specifies a directory path and filename for the file that you are indexing.  
  * path: Specifies a directory path that contains the files that you are indexing.  
  * custom: Specifies custom data, such as a record set returned from a query.  |

Note: Prior to indexing a collection, you must create a Verity collection by using the ColdFusion Administrator, or the cfcollection tag. For more information, see "Creating a collection with the ColdFusion Administrator" on page 465, or "Creating a collection with the cfcollection tag" on page 466.
You can use form and action pages similar to the following examples to select and index a collection.

**Select which collection to index**

1. Create a ColdFusion page with the following content:

```html
<html><head>
    <title>Select the Collection to Index</title>
</head><body>
<h2>Specify the index you want to build</h2>
<form method="Post" action="collection_index_action.cfm">
  <p>Enter the collection you want to index:  
  <input type="text" name="IndexColl" size="25" maxLength="35"></p>
  <p>Enter the location of the files in the collection:  
  <input type="text" name="IndexDir" size="50" maxLength="100"></p>
  <p>Enter a Return URL to prepend to all indexed files:  
  <input type="text" name="urlPrefix" size="80" maxLength="100"></p>
  <input type="submit" name="submit" value="Index">
</form>
</body>
</html>
```

2. Save the file as collection_index_form.cfm in the myapps directory under the web_root.

*Note: The form does not work until you write an action page for it, which you do when you index a collection.*
Use cfindex to index a collection

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>Creating Index</title>
   </head>
   <body>
   <h2>Indexing Complete</h2>
   <cfindex collection="#Form.IndexColl#" action="refresh" extensions=".htm, .html, .xls, .txt, .mif, .doc" key="#Form.IndexDir#" type="path" urlpath="#Form.urlPrefix#" recurse="Yes" language="English">
   <cfoutput>
   The collection #Form.IndexColl# has been indexed.
   </cfoutput>
   </body>
   </html>
   ```

2. Save the file as collection_index_action.cfm.

3. In the web browser, enter the following URL to display the form page:

   ```
   http://hostname:portnumber/myapps/collection_index_form.cfm
   ```

4. Enter a collection name; for example, CodeColl.

5. Enter a file location; for example, C:\CFusion\wwwroot\vw_files.

6. Enter a URL prefix; for example, http://localhost:8500/vw_files (assuming that you are using the built-in web server).

7. Click Index.
   A confirmation message appears on successful completion.

   **Note:** For information about using the `cfindex` tag with a database to index a collection, see “Working with data returned from a query” on page 480.

Indexing a collection with the ColdFusion Administrator

As an alternative to programmatically indexing a collection, use the following procedure to index a collection with the ColdFusion Administrator.

1. In the list of Verity Collections, select a collection name; for example, CodeColl.

2. Click Index to open the index page.

3. For File Extensions, enter the types of files to index. Use a comma to separate multiple file types; for example, .htm, .html, .xls, .txt, .mif, .doc.

4. Enter (or Browse to) the directory path that contains the files to be indexed; for example, C:\inetpub\wwwroot\vw_files.

5. (Optional) To extend the indexing operation to all directories below the selected path, select the Recursively index subdirectories check box.

6. (Optional) Enter a Return URL to prepend to all indexed files.
This step lets you create a link to any of the files in the index; for example, http://127.0.0.1/vw_files/.

7 (Optional) Select a language other than English.
For more information, see “Specifying a language” on page 463.

8 Click Submit Changes.
On completion, the Verity Collections page appears.

Note: The time required to generate the index depends on the number and size of the selected files in the path.

This interface lets you easily build a very specific index based on the file extension and path information you enter. In most cases, you do not need to change your server file structures to accommodate the generation of indices.

Creating a search page

You use the cfsearch tag to search an indexed collection. Searching a Verity collection is similar to a standard ColdFusion query: both use a dedicated ColdFusion tag that requires a name attribute for their searches and both return a query object that contains rows matching the search criteria. The following table compares the two tags:

<table>
<thead>
<tr>
<th>cfquery</th>
<th>cfsearch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Searches a data source</td>
<td>Searches a collection</td>
</tr>
<tr>
<td>Requires a name attribute</td>
<td>Requires a name attribute</td>
</tr>
<tr>
<td>Uses SQL statements to specify search criteria</td>
<td>Uses a criteria attribute to specify search criteria</td>
</tr>
<tr>
<td>Returns variables keyed to database table field names</td>
<td>Returns a unique set of variables</td>
</tr>
<tr>
<td>Uses cfoutput to display query results</td>
<td>Uses cfoutput to display search results</td>
</tr>
</tbody>
</table>

Note: You receive an error if you attempt to search a collection that has not been indexed.

The following are important attributes for the cfsearch tag:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>The name of the search query.</td>
</tr>
<tr>
<td>collection</td>
<td>The name of the collection(s) being searched. Separate multiple collections with a comma; for example, collection = “sprocket_docs,CodeColl”.</td>
</tr>
<tr>
<td>criteria</td>
<td>The search target (can be dynamic).</td>
</tr>
<tr>
<td>maxrows</td>
<td>The maximum number of records returned by the search. Always specify this attribute to ensure optimal performance (start with 300 or less, if possible).</td>
</tr>
</tbody>
</table>

Each cfsearch returns variables that provide the following information about the search:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RecordCount</td>
<td>The total number of records returned by the search.</td>
</tr>
<tr>
<td>CurrentRow</td>
<td>The current row of the record set.</td>
</tr>
<tr>
<td>RecordsSearched</td>
<td>The total number of records in the index that were searched. If no records were returned in the search, this property returns a null value.</td>
</tr>
</tbody>
</table>
Additionally, if you specify the status attribute, the cfsearch tag returns the status structure, which contains the information in the following table:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>found</td>
<td>The number of documents that contain the search criteria.</td>
</tr>
<tr>
<td>searched</td>
<td>The number of documents searched. Corresponds to the recordsSearched column in the search results.</td>
</tr>
<tr>
<td>time</td>
<td>The number of milliseconds the search took, as reported by the Verity K2 search service.</td>
</tr>
<tr>
<td>suggestedQuery</td>
<td>An alternative query, as suggested by Verity, that may produce better results. This often contains corrected spellings of search terms. Present only when the suggestions tag attribute criteria is met.</td>
</tr>
<tr>
<td>Keywords</td>
<td>A structure that contains each search term as a key to an array of up to five possible alternative terms in order of preference. Present only when the suggestions tag attribute criteria is met.</td>
</tr>
</tbody>
</table>

You can use search form and results pages similar to the following examples to search a collection.

Create a search form

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>Searching a collection</title>
   </head>
   <body>
   <h2>Searching a collection</h2>
   <form method="post" action="collection_search_action.cfm">
   <p>Enter search term(s) in the box below. You can use AND, OR, NOT, and parentheses. Surround an exact phrase with quotation marks.</p>
   <p><input type="text" name="criteria" size="50" maxLength="50"></p>
   </form>
   </body>
   </html>
   ```

2. Save the file as collection_search_form.cfm.

Enter search target words in this form, which ColdFusion passes as the variable criteria to the action page, which displays the search results.

Create the results page

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>Search Results</title>
   </head>
   <body>
   <cfsearch
   name = "codecoll_results"
   collection = "CodeColl"
   ```
criteria = "#Form.criteria#"
contextPassages = "1"
contextBytes = "300"
maxrows = "100">

<h2>Search Results</h2>
<cfoutput>
Your search returned #codecoll_results.RecordCount# file(s).
</cfoutput>

<cfoutput query="codecoll_results">
<p>
File: <a href="#URL#">#Key#</a><br>
Document Title (if any): #Title#<br>
Score: #Score#<br>
Summary: #Summary#<br>
Highlighted Summary: #context#</p>
</cfoutput>
</body>
</html>

2  Save the file as collection_search_action.cfm.
3  View collection_search_form.cfm in the web browser.
4  Enter a target word(s) and click Search.

Note: As part of the indexing process, Verity automatically produces a summary of every document file or every query record set that gets indexed. The default summary result set column selects the best sentences, based on internal rules, up to a maximum of 500 characters. Every cfsearch operation returns summary information by default. For more information on this topic, see "Using Verity Search Expressions" on page 488. Alternatively, you can use the context result set column, which provides a context summary with highlighted search terms.

Enhancing search results

ColdFusion lets you enhance the results of searches by letting you incorporate search features that let users more easily find the information they need. Verity provides the following search enhancements:

•  Highlighting search terms
•  Providing alternative spelling suggestions
•  Narrowing searches using categories

Highlighting search terms

Term highlighting lets users quickly scan retrieved documents to determine whether they contain the desired information. This can be especially useful when searching lengthy documents, letting users quickly locate relevant information returned by the search.

To implement term highlighting, use the following cfsearch attributes in the search results page:
Create a search results page that includes term highlighting

1. Create a ColdFusion page with the following content:

   ```
   <html>
   <head>
   <title>Search Results</title>
   </head>
   <body>
   <cfsearch
      name = "codecoll_results"
      collection = "CodeColl"
      criteria = "#Form.Criteria#"
      ContextHighlightBegin="<b>"
      ContextHighlightEnd="</b>"
      ContextPassages="1"
      ContextBytes="500"
      maxrows = "100">
   <h2>Search Results</h2>
   <cfoutput>
      Your search returned #codecoll_results.RecordCount# file(s).
   </cfoutput>
   <cfoutput query="codecoll_results">
      <p>
      File: <a href="#URL#">#Key#</a><br>
      Document Title (if any): #Title#<br>
      Score: #Score#<br>
      Summary: #Summary#<br>
      Highlighted Summary: #context#</p>
   </cfoutput>
   </cfsearch>
   </body>
   </html>
   
2. Save the file as collection_search_action.cfm.

   **Note:** This overwrites the previous ColdFusion example page.

3. View collection_search_form.cfm in the web browser:

4. Enter a target word(s) and click Search.

Providing alternative spelling suggestions

Many unsuccessful searches are the result of incorrectly spelled query terms. Verity can automatically suggest alternative spellings for misspelled queries using a dictionary that is dynamically built from the search index.
To implement alternative spelling suggestions, you use the `cfsearch` tag's `suggestions` attribute with an integer value. If the number of documents returned by the search is less than or equal to the value you specify, Verity provides alternative search term suggestions. In addition to using the `suggestions` attribute, you may also use the `cfif` tag to output the spelling suggestions, and a link through which to search on the suggested terms.

**Note:** Using alternative spelling suggestions incurs a small performance penalty. This occurs because the `cfsearch` tag must also look up alternative spellings in addition to the specified search terms.

The following example specifies that if the number of search results returned is less than or equal to 5, an alternative search term—which is displayed using the `cfif` tag—is displayed with a link that the user can click to activate the alternate search.

### Create a search results page that provides alternative spelling suggestions

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>Search Results</title>
   </head>
   <body>
   <cfsearch
   name = "codecoll_results"
   collection = "CodeColl"
   criteria = "#Form.Criteria#"
   status = "info"
   suggestions="5"
   ContextPassages = "1"
   ContextBytes = "300"
   maxrows = "100">
   <h2>Search Results</h2>
   <cfoutput>
   Your search returned #codecoll_results.RecordCount# file(s).
   </cfoutput>
   <cfif info.FOUND LTE 5 AND isDefined("info.SuggestedQuery")>
   Did you mean:
   <a href="search.cfm?query=#info.SuggestedQuery#">#info.SuggestedQuery#</a>
   </cfif>
   <cfoutput query="codecoll_results">
   <p>
   File: <a href="#URL#">#Key#</a><br>
   Document Title (if any): #Title#<br>
   Score: #Score#<br>
   Summary: #Summary#<br>
   Highlighted Summary: #context#</p>
   </cfoutput>
   </body>
   </html>

2. Save the file as `collection_search_action.cfm`.  
   *Note:* This overwrites the previous ColdFusion example page.

3. View `collection_search_form.cfm` in the web browser:

4. Enter any misspelled target words and click Search.
Narrowing searches by using categories

Verity lets you organize your searchable documents into categories. Categories are groups of documents (or database tables) that you define, and then let users search within them. For example, if you wanted to create a search tool for a software company, you might create categories such as whitepapers, documentation, release notes, and marketing collateral. Users can then specify one or more categories in which to search for information. Thus, if users visiting the website wanted to learn about a conceptual aspect of your company's technology, they might restrict their search to the whitepaper and marketing categories.

Typically, you will want to provide users with pop-up menus or check boxes from which they can select categories to narrow their searches. Alternately, you might create a form that lets users enter both a category name in which to search, and search keywords.

Create a search application that uses categories

1. Create a collection with support for categories enabled.
2. Index the collection, specifying the category and categoryTree attributes appropriate to the collection.
   
   For more information on indexing Verity collections with support for categories, see “Indexing collections that contain categories” on page 476.
3. Create a search page that lets users search within the categories that you created.
   
   Create a search page using the cfsearch tag that lets users more easily search for information by restricting searches to the specified category and, if specified, its hierarchical tree.
   
   For more information on searching Verity collections with support for categories, see “Searching collections that contain categories” on page 477.

Creating collections with support for categories

You can either select Enable Category Support from the ColdFusion Administrator, or write a cfcollection tag that uses the category attribute. By enabling category support, you create a collection that contains a Verity Parametric Index (PI).

```cfcollection
   action = "action"
collection = "collectionName"
path = "path_to_verity_collection"
language = "English"
categories = "yes"
```

For more information on using the cfcollection tag to create Verity collections with support for categories, see cfcollection in the CFML Reference.

Indexing collections that contain categories

When you index a collection with support for categories enabled, you must do the following:

- Specify a category name using the category attribute. The name (or names) that you provide identifies the category so that users can specify searches on the documents that the collection contains. For example, you might create five categories named taste, touch, sight, sound, and smell. When performing a search, users could select from either a pop-up menu or check box to search within one or more of the categories, thereby limiting their search within a given range of topics.

```cfindex
   collection="#Form.IndexColl#"
   action="update"
   extensions=".htm, .html, .xls, .txt, .mif, .doc, .pdf"
   key="#Form.IndexDir#"
```
• Specify a hierarchical document tree (similar to a file system tree) within which you can limit searches, when you use the categoryTree attribute. With the categoryTree attribute enabled, ColdFusion limits searches to documents contained within the specified path.

To use the categoryTree attribute, you specify a hierarchical document tree by listing each category as a string, and separating them using forward slashes (/). The tree structure that you specify in a search is the root of the document tree from which you want the search to begin. The type=path attribute appends directory names to the end of the returned value (as it does when specifying the urlpath attribute).

**Note:** You can specify only a single category tree.

For more information on using the cfindex tag to create Verity collections with support for categories, see cfindex in the CFML Reference.

**Searching collections that contain categories**

When searching data in a collection created with categories, you specify category and categoryTree. The values supplied to these attributes specify what category should be searched for the specified search string (the criteria attribute). The category attribute can contain a comma separated list of categories to search. Both attributes can be specified at the same time.

```
<cfsearch collection="collectionName"
  name="results"
  maxrows = "100"
  criteria="search keywords"
  category="FAQ,Technote"
  categoryTree="Docs/Tags">
```

**Note:** If cfsearch is executed on a collection that was created without category information, an exception is thrown.

To search collections that contain categories, you use the cfsearch tag, and create an application page that searches within specified categories. The following example lets the user enter and submit the name of the collection, the category in which to search, and the document tree associated with the category through a form. By restricting the search in this way, the users are better able to retrieve the documents that contain the information they are looking for. In addition to searching with a specified category, this example also makes use of the contextHighlight attribute, which highlights the returned search results.

```
<cfparam name="collection" default="test-pi">
<cfoutput>
<form action="#CGI.SCRIPT_NAME#" method="POST">
  Collection Name: <input Type="text" Name="collection" value="#collection#">
  <P>
```

```
Category: <input type="text" name="category" value=""><br>
CategoryTree: <input type="text" name="categoryTree" value=""><br>
<br>
Search: <input type="text" name="criteria">
<input type="submit" value="Search">
<form>
</form>
</cfoutput>

<cfif isdefined("Form.criteria")>
  <cfoutput>
  Search results for: <b>#criteria#</b></cfoutput>
  <cfsearch collection="#form.collection#"
category="#form.category#"
categoryTree="#form.categoryTree#"
name="sr"
status="s"
criteria="#form.criteria#"
contextPassages="3"
contextBytes="300"
contextHighlightBegin="<i><b>"
contextHighlightEnd="</b></i>"
maxrows="100">
<cfdump var="#s#">
<cfoutput>
  <p>Number of records in query: #sr.recordcount#</p>
</cfoutput>
<cfdump var="#sr#">
<cfoutput><i>Query="sr"
  Title: <i>#title#</i></i><br>
  URL: #url#<br>
  Score: #score#<br>
  <hr>
  #context#<br>
  <hr>
  #summary#<br>
  <hr>
</cfoutput></cfif>

For more information on using the <code>cfindex</code> tag to create Verity collections with support for categories, see <code>cfsearch</code> in the CFML Reference.

**Retrieving information about the categories contained in a collection**

You can retrieve the category information for a collection by using the <code>cfcollection</code> tag's <code>categoryList</code> action. The <code>categoryList</code> action returns a structure that contains two keys:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>categories</td>
<td>The name of the category and its hit count, where hit count is the number of documents in the specified category.</td>
</tr>
<tr>
<td>categorytrees</td>
<td>The document tree (a/b/c) and hit count, where hit count is the number of documents at or below the branch of the document tree.</td>
</tr>
</tbody>
</table>

You can use the information returned by <code>categoryList</code> to display to users the number of documents available for searching, as well the document tree available for searching. You can also create a search interface that lets the user select what category to search within based on the results returned by <code>categoryList</code>. 
To retrieve information about the categories contained in a collection, you use the `cfcollection` tag, and create an application page that retrieves category information from the collection and displays the number of documents contained by each category. This example lets the user enter and submit the name of the collection via a form, and then uses the `categoryList` action to retrieve information about the number of documents contained by the collection, and the hierarchical tree structure into which the category is organized.

```html
<html>
<head>
<title>Category information</title>
</head>
<body>
<form action="#CGI.SCRIPT_NAME#" method="POST">
  Enter Collection Name: <input Type="text" Name="collection" value="#collection#"><br>
  <input Type="submit" Value="GetInfo">
</form>

<cfif isdefined("Form.collection")>
  <cfoutput>
    Getting collection info...
    <br>
    <cfflush>
    <cfcollection
      action="categoryList"
      collection="#collection#"
      name="out">
    <br>
    <cfset categories=out.categories>
    <cfset tree=out.categorytrees>
    <cfset klist=StructKeyList(categories)>
    <table border=1>
      <th>Category</th> <th>Documents</th>
      <cfloop index="x" list="#klist#">
        <tr>
          <td>#x#</td> <td align="center">#categories[x]#</td>
        </tr>
      </cfloop>
    </table>
    </cfoutput>
    <cfset klist=StructKeyList(tree)>
    <table border=1>
      <th>Category</th> <th>Documents</th>
      <cfloop index="x" list="#klist#">
        <tr>
          <td>#x#</td> <td align="center">#tree[x]#</td>
        </tr>
      </cfloop>
    </table>
  </cfoutput>
</cfif>
</body>
</html>

For more information on using the \texttt{cfcollection} tag to create Verity collections with support for categories, see \texttt{cfcollection} in \textit{CFML Reference}.

\section*{Working with data returned from a query}

Using Verity, you can search data returned by a query—such as a database record set—as if it were a collection of documents stored on your web server. Using Verity to search makes implementing a search interface much easier, as well as letting users more easily find information contained in database files. A database can direct the indexing process, by using different values for the \texttt{type} attribute of the \texttt{cfindex} tag. There are also several reasons and procedures for indexing the results of database and other queries.

\subsection*{Recordsets and types of queries}

When indexing record sets generated from a query (using the \texttt{cfquery}, \texttt{cfldap}, or \texttt{cfpop} tag), \texttt{cfindex} creates indexes based on the \texttt{type} attribute and its set value:

\begin{table}[h]
\centering
\begin{tabular}{|c|l|}
\hline
\textbf{Type} & \textbf{Attribute values} \\
\hline
File & The \texttt{key} attribute is the name of a column in the query that contains a full filename (including path). \\
Path & The \texttt{key} attribute is the name of a column in the query that contains a directory pathname. \\
Custom & The \texttt{key} attribute specifies a column name that can contain anything you want. In this case, the \texttt{body} attribute is required, and is a comma-delimited list of the names of the columns that contain the text data that is to be indexed. \\
\hline
\end{tabular}
\end{table}

The \texttt{cfindex} tag treats all collections the same, whether they originate from a database recordset, or if they are a collection of documents stored within your website's root folder.

\subsection*{Indexing data returned by a query}

Indexing the results of a query is similar to indexing physical files located on your website, with the added step that you must write a query that retrieves the data to search. The following are the steps to perform a Verity search on record sets returned from a query:

1. Create a collection.
2. Write a query that retrieves the data you want to search, and generate a record set.
3. Index the record set using the \texttt{cfindex} tag.
   \begin{itemize}
   \item The \texttt{cfindex} tag indexes the record set as if it were a collection of documents in a folder within your website.
   \end{itemize}
4. Search the collection.
   \begin{itemize}
   \item The information returned from the collection includes the database key and other selected columns. You can then use the information as-is, or use the key value to retrieve the entire row from the database table.
   \end{itemize}

You should use Verity to search databases in the following cases:

\begin{itemize}
\item You want to perform full-text search on database data. You can search Verity collections that contain textual data much more efficiently with a Verity search than using SQL to search database tables.
\end{itemize}
• You want to give your users access to data without interacting directly with the data source itself.
• You want to improve the speed of queries.
• You want users to be able to execute queries, but not update database tables.

Unlike indexing documents stored on your web server, indexing information contained in a database requires an additional step—you must first write a query (using the `cfquery`, `cfldap`, or `cfpop` tag) that retrieves the data you want to let your users search. You then pass the information retrieved by the query to a `cfindex` tag, which indexes the data.

When indexing data with the `cfindex` tag, you must specify which column of the query represents the filename, which column represents the document title, and which column (or columns) represents the document's body (the information that you want to make searchable).

When indexing a recordset retrieved from a database, the `cfindex` tag uses the following attributes that correspond to the data source:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>key</td>
<td>Primary key column of the data source table.</td>
</tr>
<tr>
<td>title</td>
<td>Specifies a query column name.</td>
</tr>
<tr>
<td>body</td>
<td>Columns that you want to search for the index.</td>
</tr>
<tr>
<td>type</td>
<td>If set to <code>custom</code>, this attribute specifies the columns that you want to index. If set to <code>file</code> or <code>path</code>, this is a column that contains either a directory path and filename, or a directory path that contains the documents to be indexed.</td>
</tr>
</tbody>
</table>

Using the `cfindex` tag to index tabular data is similar to indexing documents, with the exception that you refer to column names from the generated record set in the `body` attribute. In the following example, the `type` attribute is set to `custom`, specifying that the `cfindex` tag index the contents of the record set columns Emp_ID, FirstName, LastName, and Salary, which are identified using the `body` attribute. The Emp_ID column is listed as the `key` attribute, making it the primary key for the record set.

**Index a ColdFusion query**

1. Create a Verity collection for the data that you want to index.

   The following example assumes that you have a Verity collection named CodeColl. You can use the ColdFusion Administrator to create the collection, or you can create the collection programmatically by using the `cfcollection` tag. For more information, see “Creating a collection with the ColdFusion Administrator” on page 465 or “Creating a collection with the cfcollection tag” on page 466.

2. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>Adding Query Data to an Index</title>
   </head>
   <body>

   <!--- Retrieve data from the table. --->
   <cfquery name="getEmps" datasource="cfdocexamples">
      SELECT * FROM EMPLOYEE
   </cfquery>

   <!--- Update the collection with the above query results. --->
   <cfindex
      query="getEmps"
   </cfindex>
   ```
3  Save the file as `collection_db_index.cfm` in the `myapps` directory under the web root directory.

4  Open the file in the web browser to index the collection.

    The resulting record set appears.

**Search and display the query results**

1  Create a ColdFusion page with the following content:

```html
<html>
<head>
    <title>Searching a collection</title>
</head>
<body>

<h2>Searching a collection</h2>

<form method="post" action="collection_db_results.cfm">
    <p>Collection name: <input type="text" name="collname" size="30" maxLength="30"></p>
    <p>Enter search term(s) in the box below. You can use AND, OR, NOT, and parentheses. Surround an exact phrase with quotation marks.</p>
    <input type="text" name="criteria" size="50" maxLength="50">
    <p><input type="submit" value="Search"></p>
</form>

</body>
</html>
```

2  Save the file as `collection_db_search_form.cfm` in the `myapps` directory under the `web_root`.

    This file is similar to `collection_search_form.cfm`, except the form uses `collection_db_results.cfm`, which you create in the next step, as its action page.

3  Create another ColdFusion page with the following content:

```html
<html>
<head>
    <title>Search Results</title>
</head>

<body>

```

```xml
<cfsearch
collection="CodeColl"
action="Update"
type="Custom"
key="Emp_ID"
title="Emp_ID"
body="Emp_ID,FirstName,LastName,Salary">

<h2>Indexing Complete</h2>

<!--- Output the record set. --->
<p>Your collection now includes the following items:</p>
<cfoutput query="getEmps">
    <p>#Emp_ID# #FirstName# #LastName# #Salary#</p>
</cfoutput>
</body>
</html>
```
collection="#Form.collname#"
name="getEmps"
criteria="#Form.Criteria#"
maxrows = "100">

<!--- Output the record set. --->
<cfoutput>
Your search returned #getEmps.RecordCount# file(s).
</cfoutput>

<cfoutput query="getEmps">
<p><table>
<tr><td>Title: </td><td>#Title#</td></tr>
<tr><td>Score: </td><td>#Score#</td></tr>
<tr><td>Key: </td><td>#Key#</td></tr>
<tr><td>Summary: </td><td>#Summary#</td></tr>
<tr><td>Custom 1: </td><td>#Custom1#</td></tr>
<tr><td>Column list: </td><td>#ColumnList#</td></tr>
</table></p>
</cfoutput>

4 Save the file as collection_db_results.cfm in the myapps directory under the web_root.

5 View collection_db_search_form.cfm in the web browser and enter the name of the collection and search terms.

**Indexing a file returned by using a query**

You can index an individual file that uses a query by retrieving a table row whose contents are a filename. In this case, the key specifies the column that contains the complete filename. The file is indexed using the `cfindex` tag as if it were a document under the web server root folder.

In the following example, the `cfindex` tag's `type` attribute has been set to `file`, and the specified key is the name of the column that contains the full path to the file and the filename.

```
<cfquery name="getEmps" datasource="cfdocexamples">
SELECT * FROM EMPLOYEE WHERE EMP_ID = 1
</cfquery>
<cfindex
query="getEmps"
collection="CodeColl"
action="Update"
type="file"
key="Contract_File"
title="Contract_File"
body="Emp_ID, FirstName, LastName, Contract_File">
```

**Search and display the file**

1 Create a ColdFusion page that contains the following content:

```
<!--- Output the record set. --->
<p>Your collection now includes the following items:</p>
<cfoutput query="getEmps">
<p>#Emp_ID# #FirstName# #LastName# #Contract_File#</p>
</cfoutput>
```
Indexing a path returned by using a query

You can index a directory path to a document (or collection of documents) using a query by retrieving a row whose contents are a full directory path name. In this case, the key specifies the column that contains the complete directory path. Documents located in the directory path are indexed using the cfindex tag as if they were under the web server root folder.

In this example, the type attribute is set to path, and the key attribute is assigned the column name Project_Docs. The Project_Docs column contains directory paths, which Verity indexes as if they were specified as a fixed path pointing to a collection of documents without the use of a query.

Index a directory path within a query

1. Create a ColdFusion page that contains the following content:

   ```cfquery name="getEmps" datasource="cfdocexamples">
   SELECT * FROM EMPLOYEE WHERE Emp_ID = 15
   </cfquery>
   <!--- Update the collection with the above query results. --->
   <!--- Key specifies a column that contains a directory path. --->
   <cfindex
       query="getEmps"
       collection="CodeColl"
       action="update"
       type="path"
       key="Project_Docs"
       title="Project_Docs"
       body="Emp_ID,FirstName,LastName,Project_Docs">

   <h2>Indexing Complete</h2>
   <p>Your collection now includes the following items:</p>
   <cfoutput query="getEmps">
   <p>#Emp_ID# #FirstName# #LastName# #Project_Docs#</p>
   </cfoutput>

2. Save the file as indexdir.cfm in the myapps directory.

The ColdFusion cfindex tag indexes the contents of the specified directory path.

Search and display the directory path

1. Create a ColdFusion page that contains the following content:
<cfsearch  
    collection="#Form.collname#" 
    name="getEmps" 
    criteria="#Form.Criteria#" 
    maxrows = "100">  
</cfsearch>

<!--- Output the directory path contained in the record set. --->
<coutput>
Your search returned #getEmps.RecordCount# file(s).
</coutput>

<coutput query="getEmps">
<p><table>
<tr><td>Title: </td><td>#Title#</td></tr>
<tr><td>Score: </td><td>#Score#</td></tr>
<tr><td>Key: </td><td>#Key#</td></tr>
<tr><td>Summary: </td><td>#Summary#</td></tr>
<tr><td>Custom 1:</td><td>#Custom1#</td></tr>
<tr><td>Column list: </td><td>#ColumnList#</td></tr>
</table></p>
</coutput>

2  Save the file as displaydir.cfm.

### Indexing query results obtained from an LDAP directory

The widespread use of the Lightweight Directory Access Protocol (LDAP) to build searchable directory structures, internally and across the web, gives you opportunities to add value to the sites that you create. You can index contact information or other data from an LDAP-accessible server and let users search it.

When creating an index from an LDAP query, remember the following considerations:

- Because LDAP structures vary greatly, you must know the server's directory schema and the exact name of every LDAP attribute that you intend to use in a query.
- The records on an LDAP server can be subject to frequent change.

In the following example, the search criterion is records with a telephone number in the 617 area code. Generally, LDAP servers use the Distinguished Name (dn) attribute as the unique identifier for each record so that attribute is used as the key value for the index.

<!--- Run the LDAP query. --->
<cfldap name="OrgList" 
    server="myserver" 
    action="query" 
    attributes="o, telephonenumber, dn, mail" 
    scope="onelevel" 
    filter="(|(O=a*) (O=b*))" 
    sort="o" 
    start="c-US">
<!--- Output query record set. --->
<coutput query="OrgList">
  DN: #dn# <br>
  O: #o# <br>
  TELEPHONENUMBER: #telephonenumber# <br>
  MAIL: #mail# <br>
  ==============================<br>
</coutput>

<!--- Index the record set. --->

<cfindex action="update"
  collection="ldap_query"
  key="dn"
  type="custom"
  title="o"
  query="OrgList"
  body="telephonenumber">

<!--- Search the collection. --->
<!--- Use the wildcard * to contain the search string. --->
<cfsearch collection="ldap_query"
  name="s_ldap"
  criteria="*617*"
  maxrows = "100">

<!--- Output returned records. --->
<cfoutput query="s_ldap">
  #Key#, #Title#, #Body# <br>
</cfoutput>

Indexing cfpop query results

The contents of mail servers are generally volatile; specifically, the message number is reset as messages are added and deleted. To avoid mismatches between the unique message number identifiers on the server and in the Verity collection, you must re-index the collection before processing a search.

As with the other query types, you must provide a unique value for the key attribute and enter the data fields to index in the body attribute.

The following example updates the pop_query collection with the current mail for user1, and searches and returns the message number and subject line for all messages that contain the word action:

<!--- Run POP query. --->
<cfpop action="getall"
  name="p_messages"
  server="mail.company.com"
  userName="user1"
  password="user1">

<!--- Output POP query record set. --->
<cfoutput query="p_messages">
  #messagenumber# <br>
  #from# <br>
  #to# <br>
  #subject# <br>
  #body# <br>
</cfoutput>

<!--- Index record set. --->
<cfindex action="refresh"
  collection="pop_query"
  key="messagenumber"
  type="custom"
  title="subject"
  query="p_messages"
  body="body">

<!--- Search messages for the word "action". --->
<cfsearch collection="pop_query"
name="s_messages"
criteria="action"
maxrows = "100">

<!--- Output search record set. --->
<cfoutput query="s_messages">
    #key#, #title# <br>
</cfoutput>
Chapter 28: Using Verity Search Expressions

You can use Verity search expressions to refine your searches to yield the most accurate results.

Contents

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About Verity query types

When you search a Verity collection, you can use a simple, explicit, natural, or Internet query. The following table compares the query types:

<table>
<thead>
<tr>
<th>Query type</th>
<th>Content</th>
<th>Use of operators and modifiers</th>
<th>CFML example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>One or more words</td>
<td>Uses STEM operator and MANY modifier, by default</td>
<td><code>&lt;cfsearch name = &quot;band_search&quot; collection=&quot;bbb&quot; type = &quot;simple&quot; criteria=&quot;film&quot;&gt;</code></td>
</tr>
<tr>
<td>Explicit</td>
<td>Words, operators, modifiers</td>
<td>Must be specified</td>
<td><code>&lt;cfsearch name = &quot;my_search&quot; collection=&quot;bbb&quot; type = &quot;explicit&quot; criteria=&quot;&lt;WILDCARD&gt;'sl[iau]m'&quot;&quot;&gt;</code></td>
</tr>
<tr>
<td>Natural</td>
<td>One or more words</td>
<td>Uses STEM operator and MANY modifier, by default</td>
<td><code>&lt;cfsearch name = &quot;my_search&quot; collection=&quot;bbb&quot; type = &quot;natural&quot; criteria=&quot;Boston subway maps&quot;&gt;</code></td>
</tr>
<tr>
<td>Internet</td>
<td>Words, operators, modifiers</td>
<td></td>
<td><code>&lt;cfsearch name = &quot;my_search&quot; collection=&quot;bbb&quot; type = &quot;Internet&quot; criteria=&quot;Boston subway maps&quot;&gt;</code></td>
</tr>
</tbody>
</table>

The query type determines whether the search words that you enter are stemmed, and whether the retrieved words contribute to relevance-ranked scoring. Both of these conditions occur by default in simple queries. For more information on the STEM operator and MANY modifier, see "Stemming in simple queries" on page 489.

Note: Operators and modifiers are formatted as uppercase letters in this topic solely to enhance legibility. They might be all lowercase or uppercase.
Using simple queries

The simple query is the default query type and is appropriate for the vast majority of searches. When entering text on a search form, you perform a simple query by entering a word or comma-delimited strings, with optional wildcard characters. Verity treats each comma as a logical OR. If you omit the commas, Verity treats the expression as a phrase.

**Important:** Many web search engines assume a logical AND for multiple word searches, and search for a phrase only if you use quotation marks. Because Verity treats multiple word searches differently, it might help your users if you provide examples on your search page or a brief explanation of how to search.

The following table shows examples of simple searches:

<table>
<thead>
<tr>
<th>Example</th>
<th>Search result</th>
</tr>
</thead>
<tbody>
<tr>
<td>low,brass,instrument</td>
<td>low or brass or instrument</td>
</tr>
<tr>
<td>low brass instrument</td>
<td>the phrase, low brass instrument</td>
</tr>
<tr>
<td>film</td>
<td>film, films, filming, or filmed</td>
</tr>
<tr>
<td>filming AND fun</td>
<td>film, films, filming, or filmed, and fun</td>
</tr>
<tr>
<td>filming OR fun</td>
<td>film, films, filming, or filmed, or fun</td>
</tr>
<tr>
<td>filming NOT fun</td>
<td>film, films, filming, or filmed, but not fun</td>
</tr>
</tbody>
</table>

The operators AND and OR, and the modifier NOT, do not require angle brackets (<>). Operators typically require angle brackets and are used in explicit queries. For more information about operators and modifiers, see “Operators and modifiers” on page 497.

**Stemming in simple queries**

By default, Verity interprets words in a simple query as if you entered the STEM operator (and MANY modifier). The STEM operator searches for words that derive from a common stem. For example, a search for instructional returns files that contain instruct, instructs, instructions, and so on.

The STEM operator works on words, not word fragments. A search for “instrument” returns documents containing “instrument,” “instruments,” “instrumental,” and “instrumentation,” whereas a search for “instru” does not. (A wildcard search for instru* returns documents with these words, and also those with instruct, instructional, and so on.)

**Note:** The MANY modifier presents the files returned in the search as a list based on a relevancy score. A file with more occurrences of the search word has a higher score than a file with fewer occurrences. As a result, the search engine ranks files according to word density as it searches for the word that you specify, as well as words that have the same stem. For more information on the MANY modifier, see “Modifiers” on page 504.

In CFML, enter your search terms, operators, and modifiers in the **criteria** attribute of the **cfsearch** tag:

```cfml
<cfsearch name="search_name"
collection="bbb"
type="simple"
criteria="instructional"/>
```
Preventing stemming
When entering text on a search form, you can prevent Verity from implicitly adding the STEM operator by doing
one of the following:

• Perform an explicit query.
• Use the WORD operator. For more information, see "Operators" on page 497.
• Enclose the search term that has double-quotation marks with single-quotation marks, as follows:

```
<cfsearch name="search_name"
collection="bbb"
type="simple"
criteria=""instructional"
```

Using explicit queries
In an explicit query, the Verity search engine literally interprets your search terms. The following are two ways to
perform an explicit query:

• On a search form, use quotation marks around your search term(s).
• In CFML, use `type="explicit"` in the `cfsearch` tag.

When you put a search term in quotation marks, Verity does not use the STEM operator. For example, a search for
"instructional"—enclosed in quotation marks, as shown in “Preventing stemming” on page 490—does not return
files that contain instruct, instructs, instructions, and so on (unless the files also contain instructional).

**Note:** The Verity products and documentation refers to the Explicit parser as the BooleanPlus parser.

When you specify `type="explicit"` the search expression must be a valid Verity Query Language expression. As
a result, an individual search term must be in explicit quotation marks. The following table shows valid and invalid
criteria:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>criteria=&quot;government&quot;</td>
<td>Generates an error</td>
</tr>
<tr>
<td>criteria=&quot;'government'&quot; or criteria=&quot;&quot;government&quot;&quot;</td>
<td>Finds only government</td>
</tr>
<tr>
<td>criteria=&quot;&lt;WORD&gt;government&quot;</td>
<td>Finds only government</td>
</tr>
<tr>
<td>criteria=&quot;&lt;STEM&gt;government&quot;</td>
<td>Finds government, governments, and governmental</td>
</tr>
<tr>
<td>criteria=&quot;&lt;MANY&gt;&lt;STEM&gt;government&quot;</td>
<td>Finds government, governments, and governmental ranked by relevance</td>
</tr>
<tr>
<td>criteria=&quot;&lt;WILDCARD&gt;governmen*&quot;</td>
<td>Finds government, governments, and governmental</td>
</tr>
</tbody>
</table>

Using AND, OR, and NOT
Verity has many powerful operators and modifiers available for searching. However, users might only use the most
basic operators—AND, OR, and the modifier NOT. The following are a few important points:

• You can type operators in uppercase or lowercase letters.
• Verity reads operators from left to right.
• The AND operator takes precedence over the OR operator.
• Use parentheses to clarify the search. Terms enclosed in parentheses are evaluated first; innermost parentheses are evaluated first when there are nested parentheses.

• To search for a literal AND, OR, or NOT, enclose the literal term in double-quotation marks; for example:

   love "and" marriage

**Note:** Although NOT is a modifier, you use it only with the AND and OR operators. Therefore, it is sometimes casually referred to as an operator.

For more information, see “Operators and modifiers” on page 497.

The following table gives examples of searches and their results:

<table>
<thead>
<tr>
<th>Search term</th>
<th>Returns files that contain</th>
</tr>
</thead>
<tbody>
<tr>
<td>doctorate AND nausea</td>
<td>both doctorate and nausea</td>
</tr>
<tr>
<td>doctorate &quot;and&quot; nausea</td>
<td>the phrase doctorate and nausea</td>
</tr>
<tr>
<td>&quot;doctorate and nausea&quot;</td>
<td>the phrase doctorate and nausea</td>
</tr>
<tr>
<td>masters OR doctorate AND nausea</td>
<td>masters, or the combination of doctorate and nausea</td>
</tr>
<tr>
<td>masters OR (doctorate AND nausea)</td>
<td>masters, or the combination of doctorate and nausea</td>
</tr>
<tr>
<td>(masters OR doctorate) AND nausea</td>
<td>either masters or doctorate, and nausea</td>
</tr>
<tr>
<td>masters OR doctorate NOT nausea</td>
<td>either masters or doctorate, but not nausea</td>
</tr>
</tbody>
</table>

**Using wildcards and special characters**

Part of the strength of the Verity search is its use of wildcards and special characters to refine searches. Wildcard searches are especially useful when you are unsure of the correct spelling of a term. Special characters help you search for tags in your code.

**Searching with wildcards**

The following table shows the wildcard characters that you can use to search Verity collections:

<table>
<thead>
<tr>
<th>Wildcard</th>
<th>Description</th>
<th>Example</th>
<th>Search result</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>Matches any single alphanumeric character.</td>
<td>apple?</td>
<td>apples or applet</td>
</tr>
<tr>
<td>*</td>
<td>Matches zero or more alphanumeric characters. Avoid using the asterisk as the</td>
<td>app*ed</td>
<td>Appleseed, applied, appropriated,</td>
</tr>
<tr>
<td></td>
<td>first character in a search string. An asterisk is ignored in a set, (()) or</td>
<td></td>
<td>and so on</td>
</tr>
<tr>
<td></td>
<td>an alternative pattern ({}).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[]</td>
<td>Matches any one of the characters in the brackets. Square brackets indicate</td>
<td>&lt;WILDCARD&gt; 's[l\au]\m'</td>
<td>slim, slam, or slum</td>
</tr>
<tr>
<td></td>
<td>an implied OR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>{}</td>
<td>Matches any one of a set of patterns separated by a comma,</td>
<td>&lt;WILDCARD&gt; 'hoist[s,ing,ed]'</td>
<td>hoists, hoisting, or hoisted</td>
</tr>
<tr>
<td>^</td>
<td>Matches any character not in the set.</td>
<td>&lt;WILDCARD&gt; 'sl[^\a]m'</td>
<td>slum, but not slim or slam</td>
</tr>
<tr>
<td>-</td>
<td>Specifies a range for a single character in a set.</td>
<td>&lt;WILDCARD&gt; 'c[a-r]t'</td>
<td>cat, cot, but not cut (that is, every word beginning with c, ending with t, and containing any single letter from a to r)</td>
</tr>
</tbody>
</table>

To search for a wildcard character as a literal, place a backslash character before it:
To match a question mark or other wildcard character, precede the ? with one backslash. For example, type the following in a search form: Checkers?.

To match a literal asterisk, you precede the * with two backslashes, and enclose the search term with either single or double quotation marks. For example, type the following in a search form: 'M\*' (or "M\*") The following is the corresponding CFML code:

```cfml
<cfsearch name = "quick_search"
   collection="bbb"
   type = "simple"
   criteria="'M\*'">
```

Note: The last line is equivalent to criteria="'M\*'".

### Searching for special characters

The search engine handles a number of characters in particular ways as the following table describes:

<table>
<thead>
<tr>
<th>Characters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>,(){}</td>
<td>These characters end a text token. A token is a variable that stores configurable properties. It lets the administrator or user configure various settings and options.</td>
</tr>
<tr>
<td>= &gt; &lt; !</td>
<td>These characters also end a text token. They are terminated by an associated end character.</td>
</tr>
<tr>
<td><code>\</code></td>
<td>These characters signify the start of a delimited token. They are terminated by an associated end character.</td>
</tr>
</tbody>
</table>

To search for special characters as literals, precede the following nonalphanumeric characters with a backslash character (\) in a search string:

- comma (,)
- left parenthesis ( 
- right parenthesis )
- double-quotation mark ("")
- backslash (\)
- left curly brace ({)
- left bracket ([)
- less than sign (<)
- backquote (`)

In addition to the backslash character, you can use paired backquote characters (`) to interpret special characters as literals. For example, to search for the wildcard string “a{b” you can surround the string with back quotation marks, as follows:

```
\`a{b`
```

To search for a wildcard string that includes the literal backquote character (`) you must use two backquote characters together and surround the entire string in back quotation marks:

```
`*n`\`t`
```

You can use paired back quotation marks or backslashes to escape special characters. There is no functional difference between the two. For example, you can query for the term: <DDA> using \<DDA\> or `\<DDA>` as your search term.
Using natural queries

The Natural parser supports searching for similar documents, a search method sometimes referred to as similarity searching. The Natural parser supports searching the full text of documents only. The Natural parser does not support searching collection fields and zones. The Natural parser does not support Verity query language except for topics.

Note: The Verity products and documentation refer to the Natural parser as the Query-By-Example parser, as well as the Free Text parser.

Meaningful words are automatically treated as if they were preceded by the MANY modifier and the STEM operator. By implicitly applying the STEM operator, the search engine searches not only for the meaningful words themselves, but also for words that have the same stem. By implicitly applying the MANY modifier, Verity calculates each document’s score based on the word density it finds for meaningful words; the denser the occurrences of a word in a document, the higher the document’s score.

By default, common words (such as the, has, and for) are stripped away, and the query is built based on the more significant words (such as personnel, interns, schools, and mentors). Therefore, the results of a natural language search are likely to be less precise than a search performed using the simple or explicit parser.

The Natural parser interprets topic names as topic objects. This means that if the specified text block contains a topic name, the query expression represented by the topic is considered in the search.

Using Internet queries

With the Internet query parser, users can search entire documents or parts of documents (zones and fields) entering words, phrases, and plain language similar to that used by many web search engines. ColdFusion supports two Internet query parsers in the cfsearch type attribute.

Internet: Uses standard, web-style query syntax. For more information, see “Query syntax” on page 494.

Internet_basic: Similar to Internet. This query parser enhances performance, but produces less accurate relevancy statistics.

Note: Verity also includes the Internet_BasicWeb and Internet_AdvancedWeb query parsers, which are not directly supported by ColdFusion.

Search terms

In a search form enabled with the Internet query parser, users can enter words, phrases, and plain language. The Internet parser does not support the Verity query language (VQL).

Words

To search for multiple words, separate them with spaces.

Phrases

To search for an exact phrase, surround it with double-quoted marks. A string of capitalized words is assumed to be a name. Separate a series of names with commas. Commas aren't needed when the phrases are surrounded by quotation marks.
The following example searches for a document that contains the phrases “San Francisco” and “sourdough bread”:

"San Francisco" "sourdough bread"

**Plain language**

To search with plain language, enter a question or concept. The Internet Query Parser identifies the important words and searches for them. For example, enter a question such as:

`Where is the sales office in San Francisco?`

This query produces the same results as entering:

`sales office San Francisco`

**Including and excluding search terms**

You can limit searches by excluding or requiring search terms, or by limiting the areas of the document that are searched.

A minus sign (–) immediately preceding a search term (word or phrase) excludes documents containing the term.

A plus sign (+) immediately preceding a search term (word or phrase) means returned documents are guaranteed to contain the term.

If neither sign is associated with the search term, the results may include documents that do not contain the specified term as long as they meet other search criteria.

**Field searches**

The Internet parser lets users perform field searches. The fields that are available for searching depend on field extraction rules based on the document type of the documents in the collection.

To search a document field, type the name of the field, a colon (:), and the search term with no spaces.

`field:term`

If you enter a minus sign (–) immediately preceding field, documents that contain the specified term are excluded from the search results. For example, if you enter `-field:term`, documents that contain the specified term in the specified field are excluded from the results of the search.

If you enter a plus sign (+) immediately proceeding the field search specification, such as `+field:term`, documents are included in the search results only if the search term is present in the specified field.

Field searches are enabled by the `enableField` parameter in a template file. This parameter, set to 0 by default, must be set to 1 to allow searching a document field.

*Important:* The `enableField` parameter is the only thing in a template file that should be modified.

**Query syntax**

The query syntax is very similar to the syntax that users expect to use on the web. Queries are interpreted according to the following rules:

- Individual search terms are separated by whitespace characters, such as a space, tab, or comma, for example:
  
  `cake recipes`
- Search phrases are entered within double-quotation marks, for example:
"chocolate cake" recipe

- Exclude terms with the negation operator, minus (-), or the NOT operator, for example:
  - cake recipes -rum
  - cake recipes NOT rum

- Require a compulsory term with the unary inclusion operator, plus sign (+); in this example, the term chocolate must be included:
  - cake recipes +chocolate

1. Require compulsory terms with the binary inclusion operator AND; in this example, the terms recipes and chocolate must be included:
  - cake recipes and chocolate

Field searches

You can search fields or zones by specifying name: term, where:

name is the name of the field or zone
term is an individual search term or phrase

For example:

bakery city:"San Francisco"
bakery city:Sunnyvale

For more information, see “Refining your searches with zones and fields” on page 505.

Pass-through of terms

Search terms are passed through to the VDK-level and are interpreted as Verity Query Language (VQL) syntax. No issues arise if the terms contain only alphabetic or numeric characters. Other kinds of characters might be interpreted by the language you’re using. If a term contains a character that is not handled by the specified language, it might be interpreted as VQL. For example, a search term that includes an asterisk (*) might be interpreted as a wildcard.

Stop words

The configurable Internet query parser uses its own stop-word list, qp_inet.stp, to specify terms to ignore for natural language processing.

Note: You can override the “stop out” by using quotation marks around the word.

For example, the following stop words are provided in the query parser’s stop-word file for the English (Basic) template:

<table>
<thead>
<tr>
<th>a</th>
<th>did</th>
<th>i</th>
<th>or</th>
<th>what</th>
</tr>
</thead>
<tbody>
<tr>
<td>also</td>
<td>do</td>
<td>l’m</td>
<td>should</td>
<td>when</td>
</tr>
<tr>
<td>an</td>
<td>does</td>
<td>if</td>
<td>so</td>
<td>where</td>
</tr>
<tr>
<td>and</td>
<td>find</td>
<td>in</td>
<td>than</td>
<td>whether</td>
</tr>
</tbody>
</table>
Verity provides a populated stop-word file for the English and English (Advanced) languages. You do not need to modify the qp_inet.stp file for these languages. If you use the configurable Internet query parser for another language, you must provide your own qp_inet.stp file that contains the stop words that you want to ignore in that language. This stop-word file must contain, at a minimum, the language-equivalent words for `or` and `<or>`.

**Note:** The configurable Internet query parser's stop-word file contains a different word list than the vdk30.stp word file, which is used for other purposes, such as summarization.

## Composing search expressions

The following rules apply to the composition of search expressions.

### Case sensitivity

Verity searches are case-sensitive only when the search term is entered in mixed case. For example, a search for `zeus` finds zeus, Zeus, or ZEUS; however, a search for `Zeus` finds only Zeus.

To have your application always ignore the case that the user types, use the ColdFusion `LCase()` function in the `criteria` attribute of `cfsearch`. The following code converts user input to lowercase, thereby eliminating case-sensitivity concerns:

```coldfusion
<cfsearch name="results"
collection="#form.collname#"
criteria="#LCase(form.criteria)#"
type="#form.type#"/>
```

### Prefix and infix notation

By default, Verity uses *infix notation*, in which precedence is implicit in the expression; for example, the AND operator takes precedence over the OR operator.

You can use *prefix notation* with any operator except an evidence operator (typically, STEM, WILDCARD, or WORD; for a description of evidence operators, see “Evidence operators” on page 501). In prefix notation, the expression explicitly specifies precedence. Rather than repeating an operator, you can use prefix notation to list the operator once and list the search targets in parentheses. For example, the following expressions are equivalent:

- Moses <NEAR> Larry <NEAR> Jerome <NEAR> Daniel <NEAR> Jacob
- <NEAR>(Moses,Larry,Jerome,Daniel,Jacob)
The following prefix notation example searches first for documents that contain Larry and Jerome, and then for documents that contain Moses:

OR (Moses, AND (Larry, Jerome))

The infix notation equivalent of this is as follows:

Moses OR (Larry AND Jerome)

**Commas in expressions**

If an expression includes two or more search terms within parentheses, a comma is required between the elements (whitespace is ignored). The following example searches for documents that contain any combination of Larry and Jerome together:

AND (Larry, Jerome)

**Precedence rules**

Expressions are read from left to right. The AND operator takes precedence over the OR operator; however, terms enclosed in parentheses are evaluated first. When the search engine encounters nested parentheses, it starts with the innermost term.

<table>
<thead>
<tr>
<th>Example</th>
<th>Search result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moses AND Larry OR Jerome</td>
<td>Documents that contain Moses and Larry, or Jerome</td>
</tr>
<tr>
<td>(Moses AND Larry) OR Jerome</td>
<td>(Same as above)</td>
</tr>
<tr>
<td>Moses AND (Larry OR Jerome)</td>
<td>Documents that contain Moses and either Larry or Jerome</td>
</tr>
</tbody>
</table>

**Delimiters in expressions**

You use angle brackets (<>), double quotation marks ("), and backslashes (\) to delimit various elements in a search expression, as the following table describes:

<table>
<thead>
<tr>
<th>Character</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;&gt;</td>
<td>Left and right angle brackets are reserved for designating operators and modifiers. They are optional for the AND, OR, and NOT, but required for all other operators.</td>
</tr>
<tr>
<td>&quot;</td>
<td>Use double quotation marks in expressions to search for a word that is otherwise reserved as an operator or modifier, such as AND, OR, and NOT.</td>
</tr>
<tr>
<td>\</td>
<td>To include a backslash in a search expression, insert two backslashes for each backslash character that you want included in the search; for example, C:\CFusion\bin.</td>
</tr>
</tbody>
</table>

**Operators and modifiers**

You are probably familiar with searches containing AND, OR, and NOT. Verity has many additional operators and modifiers, of various types, that offer you a high degree of specificity in setting search parameters.

**Operators**

An operator represents logic to be applied to a search element. This logic defines the qualifications that a document must meet to be retrieved. You can use operators to refine your search or to influence the results in other ways.
For example, you can construct an HTML form for conducting searches. In the form, you can search for a single term. You can refine the search by limiting the search scope in a number of ways. Operators are available for limiting a query to a sentence or paragraph, and you can search words based on proximity.

Ordinarily, you use operators in explicit searches, as follows:

"<operator>search_string"

The following operator types are available:

<table>
<thead>
<tr>
<th>Operator type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>Identifies a concept in a document by combining the meanings of search elements.</td>
</tr>
<tr>
<td>Relational</td>
<td>Searches fields in a collection.</td>
</tr>
<tr>
<td>Evidence</td>
<td>Specifies basic and intelligent word searches.</td>
</tr>
<tr>
<td>Proximity</td>
<td>Specifies the relative location of words in a document.</td>
</tr>
<tr>
<td>Score</td>
<td>Manipulates the score returned by a search element. You can set the score percentage display to four decimal places.</td>
</tr>
</tbody>
</table>

The following table shows the operators, according to type, that are available for conducting searches of ColdFusion Verity collections:

<table>
<thead>
<tr>
<th>Concept</th>
<th>Relational</th>
<th>Evidence</th>
<th>Proximity</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCRUE</td>
<td>&lt;</td>
<td>STEM</td>
<td>NEAR</td>
<td>YESNO</td>
</tr>
<tr>
<td>ALL</td>
<td>&lt;=</td>
<td>WILDCARD</td>
<td>NEAR/N</td>
<td>PRODUCT</td>
</tr>
<tr>
<td>AND</td>
<td>=</td>
<td>WORD</td>
<td>PARAGRAPH</td>
<td>SUM</td>
</tr>
<tr>
<td>ANY</td>
<td>&gt;</td>
<td>THESAURUS</td>
<td>PHRASE</td>
<td>COMPLEMENT</td>
</tr>
<tr>
<td>OR</td>
<td>&gt;=</td>
<td>SOUNDEX</td>
<td>SENTENCE</td>
<td></td>
</tr>
<tr>
<td>CONTAINS</td>
<td></td>
<td>TYPO/N</td>
<td>IN</td>
<td></td>
</tr>
<tr>
<td>MATCHES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STARTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBSTRING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Concept operators**

Concept operators combine the meaning of search elements to identify a concept in a document. Documents retrieved using concept operators are ranked by relevance. The following table describes each concept operator:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AND</td>
<td>Selects documents that contain all the search elements that you specify.</td>
</tr>
<tr>
<td>OR</td>
<td>Selects documents that show evidence of at least one of the search elements that you specify.</td>
</tr>
</tbody>
</table>
Relational operators search document fields (such as AUTHOR) that you defined in the collection. Documents that contain specified field values are returned. Documents retrieved using relational operators are not ranked by relevance, and you cannot use the MANY modifier with relational operators.

You use the following operators for numeric and date comparisons:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>Equal</td>
</tr>
<tr>
<td>!=</td>
<td>Not equal</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal to</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to</td>
</tr>
</tbody>
</table>

For example, to search for documents that contain values for 1999 through 2002, you perform either of the following searches:

- An explicit search using the = operator: >=1999,<=2002

If a document field named PAGES is defined, you can search for documents that are 5 pages or fewer by entering PAGES < 5 in your search. Similarly, if a document field named DATE is defined, you can search for documents dated prior to and including December 31, 1999 by entering DATE <= 12-31-99 in your search.

The following relational operators compare text and match words and parts of words:
For example, assume a document field named SOURCE includes the following values:

- Computer
- Computerworld
- Computer Currents
- PC Computing

To locate documents whose source is Computer, enter the following:

```
SOURCE <MATCHES> computer
```

To locate documents whose source is Computer, Computerworld, and Computer Currents, enter the following:

```
SOURCE <MATCHES> computer*
```

To locate documents whose source is Computer, Computerworld, Computer Currents, and PC Computing, enter the following:

```
SOURCE <MATCHES> *comput*
```

For an example of ColdFusion code that uses the CONTAINS relational operator, see “Field searches” on page 506.

You can use the SUBSTRING operator to match a character string with data stored in a specified data source. In the example described in this section, a data source called TEST1 contains the table YearPlaceText, which contains three columns: Year, Place, and Text. Year and Place make up the primary key. The following table shows the TEST1 schema:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| CONTAINS | selects documents by matching the word or phrase that you specify with the values stored in a specific document field. Documents are selected only if the search elements specified appear in the same sequential and contiguous order in the field value. | • In a document field named TITLE, to retrieve documents whose titles contain music, musical, or musician, search for TITLE <CONTAINS> Musi*.  
• To retrieve CFML and HTML pages whose meta tags contain Framingham as a content word, search for KEYWORD <CONTAINS> Framingham. |
| MATCHES | selects documents by matching the query string with values stored in a specific document field. Documents are selected only if the search elements specified match the field value exactly. If a partial match is found, a document is not selected. When you use the MATCHES operator, you specify the field name to search, and the word, phrase, or number to locate. You can use ? and * to represent individual and multiple characters, respectively, within a string. For examples, see the text immediately following this table. |
| STARTS | selects documents by matching the character string that you specify with the starting characters of the values stored in a specific document field. In a document field named REPORTER, to retrieve documents written by Clark, Clarks, and Clarkson, search for REPORTER <STARTS> Clark. |
| ENDS | selects documents by matching the character string that you specify with the ending characters of the values stored in a specific document field. In a document field named OFFICER, to retrieve arrest reports written by Tanner, Garner, and Milner, search for OFFICER <ENDS> ner. |
| SUBSTRING | selects documents by matching the query string that you specify with any portion of the strings in a specific document field. In a document field named TITLE, to retrieve documents whose titles contain words such as solution, resolution, solve, and resolve, search for TITLE <SUBSTRING> sol. |
The following application page matches records that have 1990 in the TEXT column and are in the Place Utah. The search operates on the collection that contains the TEXT column and then narrows further by searching for the string *Utah* in the CF_TITLE document field. Document fields are defaults defined in every collection corresponding to the values that you define for URL, TITLE, and KEY in the `cfindex` tag.

```latex
<cfquery name="GetText"
  datasource="TEST1">
  SELECT Year || Place AS Identifier, text
  FROM YearPlaceText
</cfquery>

<cfindex collection="testcollection"
  action="Update"
  type="Custom"
  title="Identifier"
  key="Identifier"
  body="TEXT"
  query="GetText">
<cfsearch name="GetText_Search"
  collection="testcollection"
  type="Explicit"
  criteria="1990 and CF_TITLE <SUBSTRING> Utah">
<cfoutput>
  Record Counts: <br>
  #GetText.RecordCount# <br>
  #GetText_Search.RecordCount# <br>
</cfoutput>

Query Results --- Should be 5 rows <br>
<cfoutput query="Gettext">
  #Identifier# <br>
</cfoutput>

Search Results -- should be 1 row <br>
<cfoutput query="GetText_Search">
  #GetText_Search.TITLE# <br>
</cfoutput>

**Evidence operators**

Evidence operators let you specify a basic word search or an intelligent word search. A *basic word search* finds documents that contain only the word or words specified in the query. An *intelligent word search* expands the query terms to create an expanded word list so that the search returns documents that contain variations of the query terms.

Documents retrieved using evidence operators are not ranked by relevance unless you use the MANY modifier.

The following table describes the evidence operators:

<table>
<thead>
<tr>
<th>Year</th>
<th>Place</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Utah</td>
<td>Text about Utah 1990</td>
</tr>
<tr>
<td>1990</td>
<td>Oregon</td>
<td>Text about Oregon 1990</td>
</tr>
<tr>
<td>1991</td>
<td>Utah</td>
<td>Text about Utah 1991</td>
</tr>
<tr>
<td>1991</td>
<td>Oregon</td>
<td>Text about Oregon 1991</td>
</tr>
<tr>
<td>1992</td>
<td>Utah</td>
<td>Text about Utah 1992</td>
</tr>
</tbody>
</table>
The following example uses an evidence operator:

```
<cfsearch name = "quick_search"
   collection="bbb"
   type = "explicit"
   criteria="<WORD>film">
```

Proximity operators

Proximity operators specify the relative location of specific words in the document. To retrieve a document, the specified words must be in the same phrase, paragraph, or sentence. In the case of NEAR and NEAR/N operators, retrieved documents are ranked by relevance based on the proximity of the specified words. Proximity operators can be nested; phrases or words can appear within SENTENCE or PARAGRAPH operators, and SENTENCE operators can appear within PARAGRAPH operators.

The following table describes the proximity operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEM</td>
<td>Expands the search to include the word that you enter and its variations. The STEM operator is automatically implied in any simple query.</td>
<td><code>&lt;STEM&gt;believe</code> retrieves matches such as “believe,” “believing,” and “believer”.</td>
</tr>
<tr>
<td>WILDCARD</td>
<td>Matches wildcard characters included in search strings. Certain characters automatically indicate a wildcard specification, such as apostrophe (*) and question mark(?).</td>
<td><code>spam*</code> retrieves matches such as, spam, spammer, and spamming.</td>
</tr>
<tr>
<td>WORD</td>
<td>Performs a basic word search, selecting documents that include one or more instances of the specific word that you enter. The WORD operator is automatically implied in any SIMPLE query.</td>
<td><code>&lt;WORD&gt;logic</code> retrieves logic, but not variations such as logical and logician.</td>
</tr>
<tr>
<td>THESAURUS</td>
<td>Expands the search to include the word that you enter and its synonyms. Collections do not have a thesaurus by default; to use this feature you must build one.</td>
<td><code>&lt;THESAURUS&gt;altitude</code> retrieves documents containing synonyms of the word altitude, such as height or elevation.</td>
</tr>
<tr>
<td>SOUNDEX</td>
<td>Expands the search to include the word that you enter and one or more words that “sound like,” or whose letter pattern is similar to, the word specified. Collections do not have sound-alike indexes by default; to use this feature you must build sound-alike indexes.</td>
<td><code>&lt;SOUNDEX&gt;sale</code> retrieves words such as sale, sell, seal, shell, soul, and scale.</td>
</tr>
<tr>
<td>TYPO/N</td>
<td>Expands the search to include the word that you enter plus words that are similar to the query term. This operator performs “approximate pattern matching” to identify similar words. The optional N variable in the operator name expresses the maximum number of errors between the query term and a matched term, a value called the error distance. If N is not specified, the default error distance is 2.</td>
<td><code>&lt;TYPO&gt;swept</code> retrieves kept.</td>
</tr>
</tbody>
</table>
The following example uses a proximity operator:

```cfc
<cfsearch name="quick_search"
  collection="bbb"
  type = "explicit"
  criteria="red<near>socks">
```

For an example using the IN proximity operator to search XML documents, see "Zone searches" on page 505.

### Score operators

Score operators control how the search engine calculates scores for retrieved documents. The maximum score that a returned search element can have is 1.000. You can set the score to display a maximum of four decimal places.

When you use a score operator, the search engine first calculates a separate score for each search element found in a document, and then performs a mathematical operation on the individual element scores to arrive at the final score for each document.

The document's score is available as a result column. You can use the SCORE result column to get the relevancy score of any document retrieved, for example:

```cfc
<cfoutput>
  <a href="#Search1.URL#">#Search1.Title#</a><br>
  Document Score=#Search1.SCORE#<BR>
</cfoutput>
```

The following table describes the score operators:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEAR</td>
<td>Selects documents containing specified search terms. The closer the search terms are to one another within a document, the higher the document's score. The document with the smallest possible region containing all search terms always receives the highest score. Documents whose search terms are not within 1000 words of each other are not selected.</td>
<td>war &lt;NEAR&gt; peace retrieves documents that contain stemmed variations of these words within close proximity to each other (as defined by Verity). To control search proximity, use NEAR/N.</td>
</tr>
<tr>
<td>NEAR/N</td>
<td>Selects documents containing two or more search terms within N number of words of each other, where N is an integer between 1 and 1024. NEAR/1 searches for two words that are next to each other. The closer the search terms are within a document, the higher the document's score. You can specify multiple search terms using multiple instances of NEAR/N as long as the value of N is the same.</td>
<td>commute &lt;NEAR/10&gt; bicycle &lt;NEAR/10&gt; train &lt;NEAR/10&gt; retrieves documents that contain stemmed variations of these words within 10 words of each other.</td>
</tr>
<tr>
<td>PARAGRAPH</td>
<td>Selects documents that include all of the words you specify within the same paragraph. To search for three or more words or phrases in a paragraph, you must use the PARAGRAPH operator between each word or phrase.</td>
<td>&lt;PARAGRAPH&gt; (mission, goal, statement) retrieves documents that contain these terms within a paragraph.</td>
</tr>
<tr>
<td>PHRASE</td>
<td>Selects documents that include a phrase you specify. A phrase is a grouping of two or more words that occur in a specific order.</td>
<td>&lt;PHRASE&gt; (mission, oak) returns documents that contain the phrase mission oak.</td>
</tr>
<tr>
<td>SENTENCE</td>
<td>Selects documents that include all of the words you specify within the same sentence.</td>
<td>&lt;SENTENCE&gt; (jazz, musician) returns documents that contain these words in the same sentence.</td>
</tr>
<tr>
<td>IN</td>
<td>Selects documents that contain specified values in one or more document zones. A document zone represents a region of a document, such as the document's summary, date, or body text. To search for a term only within the one or more zones that have certain conditions, you qualify the IN operator with the WHEN operator.</td>
<td>Chang &lt;IN&gt; author searches document zones named author for the word Chang.</td>
</tr>
</tbody>
</table>
You combine modifiers with operators to change the standard behavior of an operator in some way. The following table describes the available modifiers:

<table>
<thead>
<tr>
<th>Modifier</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASE</td>
<td>Specifies a case-sensitive search. Normally, Verity searches are case-insensitive for search text entered in all uppercase or all lowercase, and case-sensitive for mixed-case search strings.</td>
<td><code>&lt;CASE&gt;Java OR &lt;CASE&gt;java</code> retrieves documents that contain Java or java, but not JAVA.</td>
</tr>
<tr>
<td>MANY</td>
<td>Counts the density of words, stemmed variations, or phrases in a document and produces a relevance-ranked score for retrieved documents. Use with the following operators: • WORD • WILDCARD • STEM • PHRASE • SENTENCE • PARAGRAPH</td>
<td><code>&lt;PARAGRAPH&gt;&lt;MANY&gt;javascript &lt;AND&gt; vbscript.</code> You cannot use the MANY modifier with the following operators: • AND • OR • ACCRUE • Relational operators</td>
</tr>
<tr>
<td>NOT</td>
<td>Excludes documents that contain the specified word or phrase. Use only with the AND and OR operators.</td>
<td>Java <code>&lt;AND&gt;</code> programming <code>&lt;NOT&gt;</code> coffee retrieves documents that contain Java and programming, but not coffee.</td>
</tr>
<tr>
<td>ORDER</td>
<td>Specifies that the search elements must occur in the same order in which you specify them in the query. Use with the following operators: • PARAGRAPH • SENTENCE • NEAR/N</td>
<td>Place the ORDER modifier before any operator.</td>
</tr>
</tbody>
</table>
Refining your searches with zones and fields

One of the strengths of Verity is its ability to perform full-text searches on documents of many formats. However, there are often times when you want to restrict a search to certain portions of a document, to improve search relevance. If a Verity collection contains some documents about baseball and other documents about caves, a search for the word bat might retrieve several irrelevant results.

If the documents are structured documents, you can take advantage of the ability to search zones and fields. The following are some examples of structured documents:

- Documents created with markup languages (XML, SGML, HTML)
- Internet Message Format documents
- Documents created by many popular word-processing applications

Note: Although your word processor might open with what appears to be a blank page, the document has many regions such as title, subject, and author. Refer to your application’s documentation or online help system for how to view a document’s properties.

Zone searches

You can perform zone searches on markup language documents. The Verity zone filter includes built-in support for HTML and several file formats; for a list of supported file formats, see “Building a Search Interface” on page 459. Verity searches XML files by treating the XML tags as zones. When you use the zone filter, the Verity engine builds zone information into the collection’s full-word index. This index, enhanced with zone information, permits quick and efficient searches over zones. The zone filter can automatically define a zone, or you can define it yourself in the style.zon file. You can use zone searching to limit your search to a particular zone. This can produce more accurate, but not necessarily faster, search results than searching an entire file.

Note: The contents of a zone cannot be returned in the results list of an application.

Examples

The following examples perform zone searching on XML files. In a list of rock bands, you could have XML files with tags for the instruments and for comments. In the following XML file, the word Pete appears in a comment field:

```xml
<bonda.xml>
  <Lead_Guitar>Dan</Lead_Guitar>
  <Rhythm_Guitar>Jake</Rhythm_Guitar>
  <Bass_Guitar>Mike</Bass_Guitar>
  <Drums>Chris</Drums>
  <COMMENT_A>Dan plays guitar, better than Pete.</COMMENT_A>
  <COMMENT_B>Jake plays rhythm guitar.</COMMENT_B>
</bonda.xml>
```

The following CFML code shows a search for the word Pete:

```cfmle
<cfsearch name="band_search"
  collection="my_collection"
  type = "simple"
  criteria="Pete">
</cfsearch>
```

The above search for Pete returns this XML file because this search target is in the COMMENT_A field. In contrast, Pete is the lead guitarist in the following XML file:

```xml
<bond.xml>
  <Lead_Guitar>Pete</Lead_Guitar>
  <Rhythm_Guitar>Roger</Rhythm_Guitar>
```

To retrieve only the files in which Pete is the lead guitarist, perform a zone search using the IN operator according to the following syntax:

\{(query) \<IN\> (zone1, zone2, ...)\}

**Note:** As with other operators, IN might be uppercase or lowercase. Unlike AND, OR, or NOT, you must enclose IN within brackets.

Thus, the following explicit search retrieves files in which Pete is the lead guitarist:

(Pete) \<in\> Lead_Guitar

This is expressed in CFML as follows:

```
<cfsearch name = "band_search"
   collection="my_collection"
   type = "explicit"
   criteria="/\(Pete\) \<in\> Lead_Guitar">
```

To retrieve files in which Pete plays either lead or rhythm guitar, use the following explicit search:

(Pete) \<in\> (Lead_Guitar, Rhythm_Guitar)

This is expressed in CFML as follows:

```
<cfsearch name = "band_search"
   collection="bbb"
   type = "explicit"
   criteria="/\(Pete\) \<in\> (Lead_Guitar, Rhythm_Guitar)" >
```

**Field searches**

*Fields* are extracted from the document and stored in the collection for retrieval and searching, and can be returned on a results list. Zones, on the other hand, are merely the definitions of “regions” of a document for searching purposes, and are not physically extracted from the document in the same way that fields are extracted.

You must define a region of text as a zone before it can be a field. Therefore, it can be only a zone, or it can be both a field and a zone. Whether you define a region of text as a zone only or as both a field and a zone depends on your particular requirements.

A field must be defined in the style file, style.ufl, before you create the collection. To map zones to fields (to display field data), you must define and add these extra fields to style.ufl.

You can specify the values for the `cfindex` attributes `TITLE`, `KEY`, and `URL` as document fields for use with relational operators in the `criteria` attribute. (The `SCORE` and `SUMMARY` attributes are automatically returned by a `cfsearch`; these attributes are different for each record of a collection as the search criteria changes.) Text comparison operators can reference the following document fields:

- `cf_title`
- `cf_key`
- `cf_url`
- `cf_custom1`
- `cf_custom2`
Text comparison operators can also reference the following automatically populated document fields:

- title
- key
- url
- vdksummary
- author
- mime-type

To explore how to use document fields to refine a search, consider the following database table, named Calls. This table has four columns and three records, as the following table shows:

<table>
<thead>
<tr>
<th>call_ID</th>
<th>Problem_Description</th>
<th>Short_Description</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Can't bold text properly under certain conditions</td>
<td>Bold Problem</td>
<td>HomeSite+</td>
</tr>
<tr>
<td>2</td>
<td>Certain optional attributes are acting as required attributes</td>
<td>Attributes Problem</td>
<td>ColdFusion</td>
</tr>
<tr>
<td>3</td>
<td>Can't do a File/Open in certain cases</td>
<td>File Open Problem</td>
<td>HomeSite+</td>
</tr>
</tbody>
</table>

A Verity search for the word certain returns three records. However, you can use the document fields to restrict your search; for example, a search to retrieve HomeSite+ problems with the word certain in the problem description.

These are the requirements to run this procedure:

- Create and populate the Calls table in a database of your choice
- Create a collection named Training (you can do this in CFML or in the ColdFusion Administrator).

The following table shows the relationship between the database column and `cfindex` attribute:

<table>
<thead>
<tr>
<th>Database column</th>
<th>The cfindex attribute</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>call_ID</td>
<td>key</td>
<td>The primary key of a database table is often a key attribute.</td>
</tr>
<tr>
<td>Problem_Description</td>
<td>body</td>
<td>This column is the information to be indexed.</td>
</tr>
<tr>
<td>Short_Description</td>
<td>title</td>
<td>A short description is conceptually equivalent to a title, as in a running title of a journal article.</td>
</tr>
<tr>
<td>Product</td>
<td>custom1</td>
<td>This field refines the search.</td>
</tr>
</tbody>
</table>

You begin by selecting all data in a query:

```
<cfquery name = "Calls" datasource = "MyDSN">
    Select * from Calls
</cfquery>
```

The following code shows the `cfindex` tag for indexing the collection (the `type` attribute is set to custom for tabular data):

```
<cfindex
    query = "Calls"
    collection = "training"
    action = "UPDATE"
    type = "CUSTOM"
```
To perform the refined search for HomeSite+ problems with the word certain in the problem description, the `cfsearch` tag uses the CONTAINS operator in its `criteria` attribute:

```cfsearch
collection = "training"
name = "search_calls"
criteria = "certain and CF_CUSTOM1 <CONTAINS> HomeSite"
```

The following code displays the results of the refined search:

```<table border="1" cellspacing="5">
<tr>
<th align="LEFT">KEY</th>
<th align="LEFT">TITLE</th>
<th align="LEFT">CUSTOM1</th>
</tr>
<cfoutput query = "search_calls">
<tr>
<td>#KEY#</td>
<td>#TITLE#</td>
<td>#CUSTOM1#</td>
</tr>
</cfoutput>
</table>```
Part 5: Requesting and Presenting Information

This part contains the following topics:

- Introduction to Retrieving and Formatting Data ............................................................... 511
- Building Dynamic Forms with cfform Tags ....................................................................... 530
- Validating Data .................................................................................................................. 553
- Creating Forms in Flash .................................................................................................... 576
- Creating Skinnable XML Forms ....................................................................................... 594
- Using Ajax UI Components and Features ....................................................................... 613
- Using Ajax Data and Development Features .................................................................. 647
- Using the Flash Remoting Service ................................................................................... 674
- Using Flash Remoting Update ........................................................................................ 688
- Using the LiveCycle Data Services ES Assembler ......................................................... 691
- Using Server-Side ActionScript ...................................................................................... 706
Chapter 29: Introduction to Retrieving and Formatting Data

ColdFusion lets you retrieve and format data. You can use forms to get user data and control the data that is displayed by a dynamic web page. You can also populate a table with query results and use ColdFusion functions to format and manipulate data. To use these features, you should be familiar with HTML forms.

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Working with action pages .............................................................. 514
Working with queries and data ......................................................... 518
Returning results to the user ........................................................... 521
Dynamically populating list boxes .................................................... 524
Creating dynamic check boxes and multiple-selection list boxes ........... 526

Using forms in ColdFusion

ColdFusion lets you use a variety of types of forms. You can use plain HTML or CFML, and you can generate HTML, Flash, or skinned XML forms. This section describes your form options and introduces a basic ColdFusion form.

ColdFusion forms tags

You can use HTML or CFML tags to define your form. ColdFusion includes the following CFML tags that correspond to HTML tags, but provide additional functionality:

- cfapplet
- cfform
- cfinput
- cfselect
- cftextarea

These tags support all the attributes of their HTML counterparts, plus ColdFusion attributes and features.

ColdFusion also provides the following forms tags that have no direct equivalent in HTML:

- cfcalendar  Lets users select dates from a Flash month-by-month calendar.
- cgrid  Displays and lets users enter data in a row and column grid format; can get data directly from a query.
- cfslider  Lets users input data by moving a sliding marker.
- cftree  Displays data in a hierarchical tree format with graphical indicators; can get data directly from a query.

ColdFusion Form tag features

ColdFusion forms tags provide the following features:
**Built-in validation support:** You can validate data in the client browser or on the server. You can specify that a field is required, contains a specific type of data, has a maximum length, or is in a range of values. You can also use data masking to control user input. For more information on validation, see “Validating Data” on page 553.

**Note:** ColdFusion also provides a method of doing on-server validation of HTML form controls.

**Flash format forms and elements:** You can display a form as Flash, which works identically on a variety of platforms and provides additional display features not available in HTML. These features include accordion-style and multiple-tab form panes and automatic element positioning. You can also display cftree, cfgrid, and cfcalendar form elements as Flash items in an otherwise-HTML form. For more information on Flash forms and form elements, see “Creating Forms in Flash” on page 576.

**XML Skinable forms:** ColdFusion can generate XML forms and apply XSLT skins to format the forms. XML format forms let you separate the form presentation from the form logic and data field information. They give you detailed control over the appearance of the forms by applying custom skins, and let you create custom controls. For more information on XML skinnable forms, see “Creating Skinnable XML Forms” on page 594.

**Direct support for ColdFusion variables:** You can easily use ColdFusion variables directly to populate your form controls. For example, you can specify a query result to populate the cfgrid and cftree tags.

These features make CFML forms tags powerful and flexible, and let you easily develop fully featured, pleasing forms.

This topic uses CFML tags, but does not describe or use most of their special features. “Building Dynamic Forms with cfform Tags” on page 530 describes how to use many of the tags that are specific to ColdFusion, such as cftree and cfgrid.

**Creating a basic form**

The following simple form shows how you can create a form that lets a user enter data. This form uses basic CFML form tags. It does not use any of the advanced features of ColdFusion, such as validation, Flash or XML format, or special input controls. You could convert it to a purely HTML form by removing the initial “cf” prefix from the tag names, and the form would work.

The following table shows the format of form control tags:
The following listing shows the form source in detail. To test the form and use it as input for later examples in this topic, save this code as formpage.cfm.

```html
<html>
<head>
<title>Input form</title>
</head>
<body>

<!--- Specify the action page in the form tag. The form variables will pass to this page when the form is submitted. --->

<cfform action="actionpage.cfm" method="post">

<!--- Text box. --->
<p>
First Name: <cfinput type="Text" name="FirstName" size="20" maxlength="35"><br>
Last Name: <cfinput type="Text" name="LastName" size="20" maxlength="35"><br>
Salary: <cfinput type="Text" name="Salary" size="10" maxlength="10">
</p>

<!--- List box. --->
<p>
City
<cfselect name="City">
<option value="Arlington">Arlington
<option value="Boston">Boston
<option value="Cambridge">Cambridge
<option value="Minneapolis">Minneapolis
<option value="Seattle">Seattle
</cfselect>
</p>

<!--- Radio buttons. --->
<p>
Department:<br>
Department:<br>
Department:
</p>

<!--- Check box. --->
<p>
</p>
```

<table>
<thead>
<tr>
<th>Control</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text control</td>
<td><code>&lt;cfinput type=&quot;Text&quot; name=&quot;ControlName&quot; size=&quot;Value&quot; maxlength=&quot;Value&quot;&gt;</code></td>
</tr>
</tbody>
</table>
| List (select) box | `<cfselect name="ControlName">
<option value="Value1">DisplayName1
<option value="Value2">DisplayName2
<option value="Value3">DisplayName3
</cfselect>` |
| Radio buttons   | `<cfinput type="Radio" name="ControlName" value="Value">DisplayName` |
| Check box       | `<cfinput type="Checkbox" name="ControlName" value="Yes|No">Yes`    |
| Reset button    | `<cfinput type="Reset" name="ControlName" value="DisplayValue">`    |
| Submit button   | `<cfinput type="Submit" name="ControlName" value="DisplayValue">`   |
Forms guidelines
When using forms, keep the following guidelines in mind:

• To make the coding process easy to follow, name form controls the same as target database fields. For example, if a text control corresponds to a data source FirstName field, use FirstName as the control name.

• For ease of use, limit radio buttons to between three and five mutually exclusive options. If you need more options, consider a drop-down list.

• Use list boxes to allow the user to choose from many options or to choose multiple items from a list.

• Check boxes, radio buttons, and list boxes do not pass data to action pages unless they are selected on a form. If you try to reference these variables on the action page, you receive an error if they are not present. For information on how to determine whether a variable exists on the action page, see "Testing for a variable's existence" on page 517.

• You can dynamically populate drop-down lists using query data. For more information, see “Dynamically populating list boxes” on page 524.

Working with action pages
When the user submits a form, ColdFusion runs the action page specified by the cfform or form tag action attribute. A ColdFusion action page is like any other application page, except that you can use the form variables that are passed to it from an associated form. The following sections describe how to create effective action pages.

Processing form variables on action pages
The action page gets a form variable for every form control that contains a value when the form is submitted.

**Note:** If multiple controls have the same name, one form variable is passed to the action page with a comma-delimited list of values.

A form variable's name is the name that you assigned to the form control on the form page. Refer to the form variable by name within tags, functions, and other expressions on an action page.

On the action page, the form variables are in the Form scope, so you should prefix them with "Form." to explicitly tell ColdFusion that you are referring to a form variable. For example, the following code references the LastName form variable for output on an action page:

```cfoutput>
    #Form.LastName#
</cfoutput>```
The Form scope also contains a list variable called `form.fieldnames`. It contains a list of all form variables submitted to the action page. If no form variables are passed to the action page, ColdFusion does not create the `form.fieldnames` list.

**Using form data to generate SQL statements**

As described in previous chapters, you can retrieve a record for every employee in a database table by composing a query like the following:

```coldfusion
<cfquery name="GetEmployees" datasource="cfdocexamples">
    SELECT FirstName, LastName, Contract
    FROM Employee
</cfquery>
```

When you want to return information about employees that matches user search criteria, you use the SQL WHERE clause with a SQL SELECT statement. When the WHERE clause is processed, it filters the query data based on the results of the comparison.

For example, to return employee data for only employees with the last name of Smith, you build a query that looks like the following:

```coldfusion
<cfquery name="GetEmployees" datasource="cfdocexamples">
    SELECT FirstName, LastName, Contract
    FROM Employee
    WHERE LastName = 'Smith'
</cfquery>
```

However, instead of putting the LastName directly in the SQL WHERE clause, you can use the text that the user entered in the form for comparison:

```coldfusion
<cfquery name="GetEmployees" datasource="cfdocexamples">
    SELECT FirstName, LastName, Salary
    FROM Employee
    WHERE LastName = <cfqueryparam value="#Form.LastName#" CFSQLType="CF_SQL_VARCHAR">
</cfquery>
```

For security, this example encapsulates the form variable within the `cfqueryparam` tag to ensure that the user passed a valid string value for the LastName. For more information on using the `cfqueryparam` tag with queries and on dynamic SQL, see "Accessing and Retrieving Data" on page 392.

**Creating action pages**

Use the following procedure to create an action page for the formpage.cfm page that you created in the previous example.

**Create an action page for the form**

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>Retrieving Employee Data Based on Criteria from Form</title>
   </head>

   <body>
   <cfquery name="GetEmployees" datasource="cfdocexamples">
       SELECT FirstName, LastName, Salary
       FROM Employee
   </cfquery>
   ```
WHERE LastName=<cfqueryparam value="#Form.LastName#" CFSQLType="CF_SQL_VARCHAR">
</cfquery>

<h4>Employee Data Based on Criteria from Form</h4>

<cfoutput query="GetEmployees">
#FirstName#
#LastName#
#Salary#<br>
</cfoutput>

<br>
<cfoutput>Contractor: #Form.Contractor#</cfoutput>
</body>
</html>

2 Save the page as actionpage.cfm in the myapps directory.
3 View the formpage.cfm page in your browser.
4 Enter data, for example, Smith, in the Last Name box and submit the form.

The browser displays a line with the first and last name and salary for each entry in the database that match the name you typed, followed by a line with the text “Contractor: Yes”.
5 Click Back in your browser to redisplay the form.
6 Remove the check mark from the check box and submit the form again.

This time an error occurs because the check box does not pass a variable to the action page. For information on modifying the actionpage.cfm page to fix the error, see “Testing for a variable’s existence” on page 517.

Reviewing the code

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfquery name=&quot;GetEmployees&quot; datasource=&quot;cfdocexamples&quot;&gt;</td>
<td>Queries the data source cfdocexamples and names the query GetEmployees.</td>
</tr>
<tr>
<td>SELECT FirstName, LastName, Salary FROM Employee WHERE LastName=&lt;cfqueryparam value=&quot;#Form.LastName#&quot; CFSQLType=&quot;CF_SQL_VARCHAR&quot;&gt;</td>
<td>Retrieves the FirstName, LastName, and Salary fields from the Employee table, but only if the value of the LastName field matches what the user entered in the LastName text box in the form on formpage.cfm.</td>
</tr>
<tr>
<td>&lt;cfoutput query=&quot;GetEmployees&quot;&gt;</td>
<td>Displays results of the GetEmployees query.</td>
</tr>
<tr>
<td>#FirstName# #LastName# #Salary#&lt;br&gt;</td>
<td>Displays the value of the FirstName, LastName, and Salary fields for a record, starting with the first record, then goes to the next line. Keep displaying the records that match the criteria you specified in the SELECT statement, followed by a line break, until you run out of records.</td>
</tr>
<tr>
<td>&lt;/cfoutput&gt;</td>
<td>Closes the cfoutput block.</td>
</tr>
<tr>
<td>&lt;br&gt; &lt;cfoutput&gt;Contractor: #Form.Contractor#&lt;/cfoutput&gt;</td>
<td>Displays a blank line followed by the text “Contractor:” and the value of the form Contractor check box. A more complete example would test to ensure the existence of the variable and would use the variable in the query.</td>
</tr>
</tbody>
</table>
Testing for a variable’s existence

Before relying on a variable’s existence in an application page, you can test to see if it exists using the ColdFusion `IsDefined` function. A function is a named procedure that takes input and operates on it. For example, the `IsDefined` function determines whether a variable exists. CFML provides a large number of functions, which are documented in the CFML Reference.

The following code prevents the error in the previous example by checking to see whether the Contractor Form variable exists before using it:

```coldfusion
<cfif IsDefined("Form.Contractor")>
  <cfoutput>Contractor: #Form.Contractor#</cfoutput>
</cfif>
```

The argument passed to the `IsDefined` function must always be enclosed in double-quotation marks. For more information on the `IsDefined` function, see the CFML Reference.

If you attempt to evaluate a variable that you did not define, ColdFusion cannot process the page and displays an error message. To help diagnose such problems, turn on debugging in the ColdFusion Administrator. The Administrator debugging information shows which variables are being passed to your application pages.

Requiring users to enter values in form fields

One of the limitations of HTML forms is the inability to define input fields as required. Because this is a particularly important requirement for database applications, ColdFusion lets you require users to enter data in fields. To specify a field as required, you can do either of the following:

- Use the `required` attribute of the `cfinput`, `cfselect`, `cftextarea`, and `cftree` tags.
- Use a hidden field that has a name attribute composed of the field name and the suffix `_required`. You can use this technique with CFML and HTML form tags.

For example, to require that the user enter a value in the FirstName field of a `cfinput` tag, use the following syntax:

```coldfusion
<cfinput type="Text" name="FirstName" size="20" maxlength="35" required="Yes" />
```

To require that the user enter a value in the FirstName field of an HTML `input` tag, use the following syntax:

```html
<input type="Text" name="FirstName" size="20" maxlength="35" required="Yes" />

<input type="hidden" name="FirstName_required" value="You must enter your first name." />
```

In either of these examples, if the user leaves the FirstName field empty, ColdFusion rejects the form submittal and returns a message informing the user that the field is required. You can customize the contents of this error message.

If you use a `required` attribute, you customize the message by using the `message` attribute, as follows:

```coldfusion
<cfinput type="Text" name="FirstName" size="20" maxlength="35" required="Yes" message="You must enter your first name.">
```

If you use a hidden field tag, you customize the message using the `value` attribute of the hidden field, as follows:

```html
<input type="hidden" name="FirstName_required" value="You must enter your first name.">
```

Form variable notes and considerations

When using form variables in an action page, keep the following guidelines in mind:

- A form variable is available on the action page and pages that it includes.
- Prefix form variables with "Form." when referencing them on the action page.
• Surround variable values with number signs (#) for output.
• Variables for check boxes, radio buttons, and list boxes with size attributes greater than 1 only get passed to the action page if you select an option. Text boxes, passwords, and textarea fields pass an empty string if you do not enter text.
• An error occurs if the action page tries to use a variable that was not passed.
• If multiple controls have the same name, one form variable is passed to the action page with a comma-delimited list of values.
• You can validate form variable values on the client or the server.

Working with queries and data

The ability to generate and display query data is one of the most important and flexible features of ColdFusion. The following sections describe more about using queries and displaying their results. Some of these tools are effective for presenting any data, not just query results.

Using HTML tables to display query results

You can use HTML tables to specify how the results of a query appear on a page. To do so, you put the cfoutput tag inside the table tags. You can also use the HTML th tag to put column labels in a header row. To create a row in the table for each row in the query results, put the tr block inside the cfoutput tag.

In addition, you can use CFML functions to format individual pieces of data, such as dates and numeric values.

Put the query results in a table
1 Open the ColdFusion actionpage.cfm page in your editor.
2 Modify the page so that it appears as follows:

```html
<html>
<head>
<title>Retrieving Employee Data Based on Criteria from Form</title>
</head>

<body>
<cfquery name="GetEmployees" datasource="cfdocexamples">
    SELECT FirstName, LastName, Salary
    FROM Employee
    WHERE LastName=#Form.LastName#
</cfquery>
<h4>Employee Data Based on Criteria from Form</h4>
<table>
    <tr>
        <th>First Name</th>
        <th>Last Name</th>
        <th>Salary</th>
    </tr>
    <cfoutput query="GetEmployees">
        <tr>
            <td>#FirstName#</td>
            <td>#LastName#</td>
            <td>#Salary#</td>
        </tr>
    </cfoutput>
</table>
</body>
</html>
```
Save the page as actionpage.cfm in the myapps directory.

View the formpage.cfm page in your browser.

Enter Smith in the Last Name text box and submit the form.

The records that match the criteria specified in the form appear in a table.

**Reviewing the code**

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;table&gt;</code></td>
<td>Puts data into a table.</td>
</tr>
<tr>
<td><code>&lt;tr&gt;</code></td>
<td>In the first row of the table, includes three columns, with the headings: First Name, Last Name, and Salary.</td>
</tr>
<tr>
<td><code>&lt;cfoutput query=&quot;GetEmployees&quot;&gt;</code></td>
<td>Tells ColdFusion to display the results of the GetEmployees query.</td>
</tr>
<tr>
<td><code>&lt;tr&gt;</code></td>
<td>For each record in the query, creates a new row in the table, with three columns that display the values of the FirstName, LastName, and Salary fields of the record.</td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td>Ends the output region.</td>
</tr>
<tr>
<td><code>&lt;/table&gt;</code></td>
<td>Ends the table.</td>
</tr>
</tbody>
</table>

**Formatting individual data items**

You can format individual data items. For example, you can format the salary data as monetary values. To format the salary data using the dollar format, you use the CFML function `DollarFormat(number)`.

**Change the format of the Salary**

1. Open the file actionpage.cfm in your editor.
2. Change the following line:
   
   `<td>#Salary#</td>`
   
   to
   
   `<td>#DollarFormat(Salary)#</td>`
3. Save the page.
Building flexible search interfaces

One option with forms is to build a search based on the form data. For example, you could use form data as part of the WHERE clause to construct a database query.

To give users the option to enter multiple search criteria in a form, you can wrap conditional logic around a SQL AND clause as part of the WHERE clause. The following action page allows users to search for employees by department, last name, or both.

Note: ColdFusion provides the Verity search utility that you can also use to perform a search. For more information, see "Building a Search Interface" on page 459.

Build a more flexible search interface

1. Open the ColdFusion actionpage.cfm page in your editor.

2. Modify the page so that it appears as follows:

```html
<html>
<head>
<title>Retrieving Employee Data Based on Criteria from Form</title>
</head>
<body>
<cfquery name="GetEmployees" datasource="cfdocexamples">
  SELECT Departmt.Dept_Name,
  Employee.FirstName,
  Employee.LastName,
  Employee.StartDate,
  Employee.Salary
  FROM Departmt, Employee
  WHERE Departmt.Dept_ID = Employee.Dept_ID
  <cfif IsDefined("Form.Department")>
    AND Departmt.Dept_Name=<cfqueryparam value="#Form.Department#" CFSQLType="CF_SQL_VARCHAR">
  </cfif>
  <cfif Form.LastName IS NOT ">
    AND Employee.LastName=<cfqueryparam value="#Form.LastName#" CFSQLType="CF_SQL_VARCHAR">
  </cfif>
</cfquery>
<h4>Employee Data Based on Criteria from Form</h4>
<table>
<tr>
  <th>First Name</th>
  <th>Last Name</th>
  <th>Salary</th>
</tr>
<cfoutput query="GetEmployees">
<tr>
  <td>#FirstName#</td>
  <td>#LastName#</td>
  <td>#Salary#</td>
</tr>
</cfoutput>
</table>
</body>
</html>
```

3. Save the file.

4. View the formpage.cfm page in your browser.
5  Select a department, optionally enter a last name, and submit the form.

Reviewing the code

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>SELECT  Departmt.Dept_Name, Employee.FirstName, Employee.LastName, Employee.StartDate, Employee.Salary</code> FROM Departmt, Employee WHERE Departmt.Dept_ID = Employee.Dept_ID</td>
<td>Retrieves the fields listed from the Departmt and Employee tables, joining the tables based on the Dept_ID field in each table.</td>
</tr>
<tr>
<td><code>&lt;cfif IsDefined(&quot;FORM.Department&quot;)&gt;</code> AND Departmt.Dept_Name = <code>&lt;cfqueryparam value=&quot;#Form.Department#&quot; CFSQLType=&quot;CF_SQL_VARCHAR&quot;&gt;</code> &lt;/cfif&gt;</td>
<td>If the user specified a department on the form, only retrieves records where the department name is the same as the one that the user specified. You must use number signs (#) in the SQL AND statement to identify Form.Department as a ColdFusion variable, but not in the IsDefined function.</td>
</tr>
<tr>
<td><code>&lt;cfif Form.LastName IS NOT &quot;&quot;</code> AND Employee.LastName = <code>&lt;cfqueryparam value=&quot;#Form.LastName#&quot; CFSQLType=&quot;CF_SQL_VARCHAR&quot;&gt;</code> &lt;/cfif&gt;</td>
<td>If the user specified a last name in the form, only retrieves the records in which the last name is the same as the one that the user entered in the form.</td>
</tr>
</tbody>
</table>

Returning results to the user

When you return your results to the user, you must make sure that your pages respond to the user’s needs and are appropriate for the type and amount of information. In particular, you must consider the following situations:

- When there are no query results
- When you return partial results

Handling no query results

Your code must accommodate the cases in which a query does not return any records. To determine whether a search has retrieved records, use the `RecordCount` query variable. You can use the variable in a conditional logic expression that determines how to display search results appropriately to users.

Note: For more information on query variables, including `RecordCount`, see "Accessing and Retrieving Data" on page 392.

For example, to inform the user when no records were found by the `GetEmployees` query, insert the following code before displaying the data:

```cfm
<cfif GetEmployees.RecordCount IS "0">
    No records match your search criteria. <br>
    <cfelse>
    You must do the following:
    - Prefix `RecordCount` with the query name.
    - Add a procedure after the `cfif` tag that displays a message to the user.
    - Add a procedure after the `cfelse` tag to format the returned data.
</cfif>
```
Follow the second procedure with a </cfif> tag end to indicate the end of the conditional code.

**Return search results to users**
1. Edit the actionpage.cfm page.
2. Change the page so that it appears as follows:

   ```html
   <html>
   <head>
   <title>Retrieving Employee Data Based on Criteria from Form</title>
   </head>

   <body>
   <cfquery name="GetEmployees" datasource="cfdocexamples">
   SELECT Departmt.Dept_Name, Employee.FirstName, Employee.LastName, Employee.StartDate, Employee.Salary
   FROM Departmt, Employee
   WHERE Departmt.Dept_ID = Employee.Dept_ID
   <cfif isdefined("Form.Department")>
   AND Departmt.Dept_Name = <cfqueryparam value="#Form.Department#" CFSQLType="CF_SQL_VARCHAR">
   </cfif>
   <cfif Form.LastName is not "">
   AND Employee.LastName = <cfqueryparam value="#Form.LastName#" CFSQLType="CF_SQL_VARCHAR">
   </cfif>
   </cfquery>

   <cfif GetEmployees.recordcount is "0">
   No records match your search criteria. <br>
   Please go back to the form and try again.
   </cfelse>
   <h4>Employee Data Based on Criteria from Form</h4>
   <table>
   <tr>
   <th>First Name</th>
   <th>Last Name</th>
   <th>Salary</th>
   </tr>
   <cfoutput query="GetEmployees">
   <tr>
   <td>#FirstName#</td>
   <td>#LastName#</td>
   <td>#Salary#</td>
   </tr>
   </cfoutput>
   </table>
   </cfif>
   </body>
   </html>

3. Save the file.
4. Return to the form, enter search criteria, and submit the form.
5. If no records match the criteria you specified, the message appears.
Returning results incrementally

You can use the cfflush tag to incrementally display long-running requests to the browser before a ColdFusion page is fully processed. This tag lets you give the user quick feedback when it takes a long time to complete processing a request. For example, when a request takes time to return results, you can use the cfflush tag to display the message, "Processing your request -- please wait." You can also use it to incrementally display a long list as it gets retrieved.

The first time you use the cfflush tag on a page, it sends to the browser all of the HTML headers and any other available HTML. Subsequent cfflush tags on the page send only the output that ColdFusion generated after the previous flush.

You can specify an interval attribute to tell ColdFusion to flush the output each time that at least the specified number of bytes become available. (The count does not include HTML headers and any data that is already available when you make this call.) You can use the cfflush tag in a cfloop tag to incrementally flush data as it becomes available. This format is particularly useful when a query responds slowly with large amounts of data.

When you flush data, make sure that a sufficient amount of information is available, because some browsers might not respond if you flush only a very small amount. Similarly, if you use an interval attribute, set it for a reasonable size, such as a few hundred bytes or more, but not many thousands of bytes.

Limitations of the cfflush tag: Because the cfflush tag sends data to the browser when it executes, it has several limitations, including the following:

- Using any of the following tags or functions on a page anywhere after the cfflush tag can cause errors or unexpected results: cfcontent, cfcookie, cfform, cfheader, cfhtmlhead, cflocation, and SetLocale. (These tags and functions normally modify the HTML header, but cannot do so after a cfflush tag, because the cfflush tag sends the header.)
- If you save Client variables as cookies, any client variables that you set after a cfflush tag are not saved in the browser.
- You can catch cfflush errors, except Cookie errors, with a cfcatch type="template" tag. Catch cookie errors with a cfcatch type="Any" tag.

Example: using the cfloop tag and Rand function

The following example uses the cfloop tag and the Rand random number generating function to artificially delay the generation of data for display. It simulates a situation in which it takes time to retrieve the first data and additional information becomes available slowly.

```html
<html>
<head>
  <title>Your Magic numbers</title>
</head>

<body>
<h1>Your Magic numbers</h1>
<p>It will take us a little while to calculate your ten magic numbers. It takes a lot of work to find numbers that truly fit your personality. So relax for a minute or so while we do the hard work for you.</p>
<h2>We are sure you will agree it was worth the short wait!</h2>
<cfflush>
```
Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;h2&gt;We are sure you will agree it was worth the short wait!&lt;/h2&gt; &lt;cfflush&gt;</td>
<td>Sends the HTML header and all HTML output to the &lt;cfflush&gt; tag to the user. This displays the explanatory paragraph and H2 tag contents.</td>
</tr>
<tr>
<td>&lt;cfflush interval=10&gt;</td>
<td>Flushes additional data to the user whenever at least 10 bytes are available.</td>
</tr>
<tr>
<td>&lt;cfloop index=&quot;randomindex&quot; from=&quot;1&quot; to=&quot;200000&quot; step=&quot;1&quot;&gt; &lt;cfset random=rand()&gt;</td>
<td>Inserts an artificial delay by using the Rand function to calculate many random numbers.</td>
</tr>
<tr>
<td>&lt;cfloop index=&quot;Myindex&quot; from=&quot;1&quot; to=&quot;10&quot; step=&quot;1&quot;&gt; &lt;cfloop index=&quot;randomindex&quot; from=&quot;1&quot; to=&quot;100000&quot; step=&quot;1&quot;&gt; &lt;cfset random=rand()&gt;</td>
<td>Generates and displays 10 random numbers. This code uses two loops. The outer loop repeats ten times, once for each number to display. The inner loop uses the Rand function to create another delay by generating more (unused) random numbers. It then calls the RandRange function to generate a six-digit random number for display.</td>
</tr>
</tbody>
</table>

Dynamically populating list boxes

The code in “Creating a basic form” on page 512 hard-coded the form’s list box options. Instead of manually entering the information on a form, you can dynamically populate a list box with database fields. When you write code this way, the form page automatically reflects the changes that you make to the database.

You use two tags to dynamically populate a list box:

- Use the cfquery tag to retrieve the column data from a database table.
- Use the cfselect tag with the query attribute to dynamically populate the options of this form control.
Dynamically populate a list box

1. Open the formpage.cfm page.

2. Modify the file so that it appears as follows:

```html
<html>
<head>
<title>Input form</title>
</head>
<body>
<cfquery name="GetDepartments" datasource="cfdocexamples">
    SELECT DISTINCT Location
    FROM Department
</cfquery>

<!--- Define the action page in the form tag. The form variables pass to this page when the form is submitted --->
<cfform action="actionpage.cfm" method="post">

<!--- Text box. --->
<p>
First Name: <cfinput type="Text" name="FirstName" size="20" maxlength="35"><br>
Last Name: <cfinput type="Text" name="LastName" size="20" maxlength="35"><br>
Salary: <cfinput type="Text" name="Salary" size="10" maxlength="10">
</p>

<!--- List box. --->
City
<cfset optsize=getDepartments.recordcount + 1>
<cfselect name="City" query="GetDepartments" value="Location" size="#optsize#">
    <option value="">Select All</option>
</cfselect>

<!--- Radio buttons. --->
<p>
Department:<br>
<cfinput type="radio" name="Department" value="Training">Training<br>
<cfinput type="radio" name="Department" value="Sales">Sales<br>
<cfinput type="radio" name="Department" value="Marketing">Marketing<br>
<cfinput type="radio" name="Department" value="HR">HR<br>
</p>

<!--- Check box. --->
<p>
Contractor? <cfinput type="checkbox" name="Contractor" value="Yes" checked>Yes
</p>

<!--- Reset button. --->
<cfinput type="reset" name="ResetForm" value="Clear Form">

<!--- Submit button. --->
<cfinput type="submit" name="SubmitForm" value="Submit">
</cfform>
</body>
</html>
```

3. Save the page as formpage.cfm.

4. View the formpage.cfm page in a browser.
The changes that you just made appear in the form.

Remember that you need an action page to submit values.

### Reviewing the code

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfquery name=&quot;GetDepartments&quot; datasource=&quot;cfdocexamples&quot;&gt; SELECT DISTINCT Location FROM Departmt &lt;/cfquery&gt;</code></td>
<td>Gets the locations of all departments in the Departmt table. The DISTINCT clause eliminates duplicate location names from the returned query results.</td>
</tr>
<tr>
<td><code>&lt;cfset optsize=getDepartments.recordcount + 1&gt;</code></td>
<td>Sets the optsize variable to the number of entries to add dynamically to the selection list, plus one for the manually coded Select All option.</td>
</tr>
<tr>
<td><code>&lt;cfselect name=&quot;City&quot; query=&quot;GetDepartments&quot; value=&quot;Location&quot; size=&quot;#optsize#&quot;&gt; &lt;option value=&quot;&quot;&gt;Select All &lt;/option&gt;</code></td>
<td>Populates the City selection list from the Location column of the GetDepartments query. The control has one option for each row returned by the query. Adds an option that allows users to select all locations. If the user selects this option, the form value is an empty string. The action page must check for the empty string and handle it appropriately.</td>
</tr>
</tbody>
</table>

### Creating dynamic check boxes and multiple-selection list boxes

When an HTML or CFML form contains a list of check boxes with the same name or a multiple-selection list box (that is, a box in which users can select multiple items from the list), the user’s entries are made available as a comma-delimited list with the selected values. These lists can be very useful for a wide range of input types.

**Note:** If the user does not select a check box or make a selection from a list box, no variable is created. The `cfinput` and `cfupdate` tags do not work correctly if there are no values. To prevent errors, make the form fields required, use dynamic SQL, or use the `cfparam` tag to set a default value for the form field.

### Check boxes

When you put a series of check boxes with the same name in a form, the variable that is created contains a comma-delimited list of values. The values can be either numeric values or alphanumeric strings. These two types of values are treated slightly differently.

#### Handling numeric values

Suppose you want a user to select one or more departments using check boxes. You then query the database to retrieve detailed information on the selected department(s). The code for a simple set of check boxes that lets the user select departments looks like the following:

```cfml
<cfinput type="checkbox" name="SelectedDepts" value="1"> Training<br>
<cfinput type="checkbox" name="SelectedDepts" value="2"> Engineering<br>
<cfinput type="checkbox" name="SelectedDepts" value="3"> Marketing<br>
```
The user sees the name of the department, but the value attribute of each check box is a number that corresponds to the underlying database primary key for the department's record.

If the user checks the Marketing and Sales items, the value of the SelectedDepts form field is 2, 4 and you use the SelectedDepts value in the following SQL statement:

```sql
SELECT * 
FROM Department 
WHERE Dept_ID IN ( #Form.SelectedDepts# )
```

The ColdFusion server sends the following statement to the database:

```sql
SELECT * 
FROM Department 
WHERE Dept_ID IN ( 2, 4 )
```

**Handling string values**

To search for a database field that contains string values (instead of numeric), you must modify the checkbox and cfquery syntax to make sure that the string values are sent to the data source in single-quotiation marks (').

The first example searched for department information based on a numeric primary key field called Dept_ID. Suppose, instead, that the primary key is a database field called Dept_Name that contains string values. In that case, your code for check boxes should look like the following:

```html
<cfinput type="checkbox" name="SelectedDepts" value="Training"> Training<br>
<cfinput type="checkbox" name="SelectedDepts" value="Marketing"> Marketing<br>
<cfinput type="checkbox" name="SelectedDepts" value="HR"> HR<br>
<cfinput type="checkbox" name="SelectedDepts" value="Sales"> Sales<br>
```

If the user checked Marketing and Sales, the value of the SelectedDepts form field would be the list Marketing, Sales and you use the following SQL statement:
SELECT *
    FROM Department
    WHERE Dept_Name IN (#ListQualify(Form.SelectedDepts,"'")#)

In SQL, all strings must be surrounded in single-quotation marks. The ListQualify function returns a list with the specified qualifying character (here, a single-quotation mark) around each item in the list.

If you select the second and fourth check boxes in the form, the following statement gets sent to the database:

```
SELECT *
    FROM Department
    WHERE Dept_Name IN ('Marketing','Sales')
```

### Multiple selection lists

A multiple-selection list box is defined by a `select` or `cfselect` tag with a `multiple` or `multiple="yes"` attribute and a `size` attribute value greater than 1. ColdFusion treats the result when a user selects multiple choices from a multiple-selection list box like the results of selecting multiple check boxes. The data made available to your page from any multiple-selection list box is a comma-delimited list of the entries selected by the user; for example, a list box could contain the four entries: Training, Marketing, HR, and Sales. If the user selects Marketing and Sales, the form field variable value is Marketing,Sales.

You can use multiple-selection lists to search a database in the same way that you use check boxes. The following sections describe how you can use different types of multiple-selection data values.

#### Handling numeric values

Suppose you want the user to select departments from a multiple-selection list box. The query retrieves detailed information on the selected department(s), as follows:

```
<cfselect name="SelectDepts" multiple>
    <option value="1">Training
    <option value="2">Marketing
    <option value="3">HR
    <option value="4">Sales
</cfselect>
```

If the user selects the Marketing and Sales items, the value of the SelectDepts form field is 2,4. If this parameter is used in the following SQL statement:

```
SELECT *
    FROM Department
    WHERE Dept_ID IN (#form.SelectDepts#)
```

The following statement is sent to the database:

```
SELECT *
    FROM Department
    WHERE Dept_ID IN (2,4)
```

#### Handling string values

Suppose you want the user to select departments from a multiple-selection list box. The database search field is a string field. The query retrieves detailed information on the selected departments, as follows:

```
<cfselect name="SelectDepts" multiple>
    <option value="Training">Training
    <option value="Marketing">Marketing
    <option value="HR">HR
</cfselect>
```

Select one or departments to get more information on:

```
<cfselect name="SelectDepts" multiple>
    <option value="1">Training
    <option value="2">Marketing
    <option value="3">HR
    <option value="4">Sales
</cfselect>
```

If the user selects the Marketing and Sales items, the value of the SelectDepts form field is 2,4. If this parameter is used in the following SQL statement:

```
SELECT *
    FROM Department
    WHERE Dept_ID IN (#form.SelectDepts#)
```

The following statement is sent to the database:

```
SELECT *
    FROM Department
    WHERE Dept_ID IN (2,4)
```
<option value="Sales">Sales</option>

If the user selects the Marketing and Sales items, the SelectDepts form field value is Marketing,Sales.

Just as you did when using check boxes to search database fields containing string values, use the ColdFusion ListQualify function with multiple-selection list boxes:

```
SELECT * 
FROM Departmt 
WHERE Dept_Name IN (#ListQualify(Form.SelectDepts,"")#)
```

The following statement is sent to the database:

```
SELECT * 
FROM Departmt 
WHERE Dept_Name IN ('Marketing','Sales')
```
Chapter 30: Building Dynamic Forms with cfform Tags

You can use the cfform tag to create rich, dynamic forms with sophisticated graphical controls, including several Java applet or Flash controls. You can use these controls without writing a line of Java or Flash code.

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Creating custom forms with the cfform tag ................................................................. 530
Building tree controls with the cftree tag ................................................................. 532
Building drop-down list boxes ............................................................................. 539
Building slider bar controls ................................................................................. 540
Creating data grids with the cfgrid tag ................................................................. 541
Embedding Java applets ......................................................................................... 551

Creating custom forms with the cfform tag

The cfform tag and its CFML subtags let you create dynamic forms in three formats:

HTML: Generates standard HTML tags wherever possible, and uses applets or Flash for more complex controls, such as grids, trees, and calendars. HTML format lets you present a familiar appearance, but does not let you easily separate data and presentation, or provide some of the more complex structures, such as Flash tabbed navigators or accordions, or customized XML controls.

Flash: Presents a modern, visually pleasing appearance. Flash format supports several controls, such as tabbed navigators and accordions, that are not available in HTML format. Flash forms are also browser-independent. In Flash format, Flash Player works in all commonly used browsers on Windows and Macintosh systems, and in Netscape and Mozilla on Linux.

XML: Lets you specify an Extensible Stylesheet Language Transformation (XSLT) skin that converts the XML into styled HTML output. ColdFusion provides several skins that you can use, and you can write your own custom skins and support custom controls.

The cfform tag and its subtags also provide you with several methods for validating input data. For example, you can perform the validation on the browser or on the server. You can check the data type, or you can mask data input. Individual cfform tags have additional dynamic features. Several of the tags do not have HTML counterparts, and others directly support dynamically populating the control from data sources. Also, the cfform tag preservedata attribute retains user input in a form after the user submits the form, so the data reappears if the form gets re-displayed.

This chapter describes features of the cfform tag and focuses on using several of the cfform child tags that do not have HTML counterparts. The following chapters describe other features of ColdFusion forms that you create using the cfform tag:

• “Validating Data” on page 553
• “Creating Forms in Flash” on page 576
• “Creating Skinnable XML Forms” on page 594

The cfform controls

The following table describes the ColdFusion controls that you use in forms created using the cfform tag. You can use these tags only inside a cfform tag. Unless otherwise stated, these controls are supported in HTML, Flash, and XML skinable forms.

<table>
<thead>
<tr>
<th>Control</th>
<th>Description</th>
<th>For more information</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfapplet</td>
<td>Embeds a custom Java applet in the form. Not supported in Flash format forms.</td>
<td>“Embedding Java applets” on page 551.</td>
</tr>
<tr>
<td>cfformitem</td>
<td>Inserts a horizontal line, a vertical line, or formatted or unformatted text in a Flash form. Used in the cfform or cfformgroup tag body for Flash and XML forms. Ignored in HTML forms.</td>
<td>“Creating Forms in Flash” on page 576, “Creating Skinnable XML Forms” on page 594.</td>
</tr>
<tr>
<td>cfcalendar</td>
<td>Displays an interactive Flash calendar that can be included in an HTML or Flash format form. Ignored in XML skinable forms. The calendar lets a user select a date for submission as a form variable.</td>
<td>The cfcalendar tag in the CFML Reference.</td>
</tr>
<tr>
<td>cfgrid</td>
<td>Creates a Java applet or Flash data grid that you can populate from a query or by defining the contents of individual cells. You can also use grids to insert, update, and delete records from a data source.</td>
<td>“Creating data grids with the cfgrid tag” on page 541.</td>
</tr>
<tr>
<td>cfinput</td>
<td>Equivalent to the HTML input tag, with the addition of input validation.</td>
<td>“Creating a basic form” on page 512.</td>
</tr>
<tr>
<td>cfselect</td>
<td>Displays a selection box. Equivalent to the HTML select tag, with the addition of input validation.</td>
<td>“Building drop-down list boxes” on page 540.</td>
</tr>
<tr>
<td>cfslider</td>
<td>Creates a Java applet-based control that lets users enter data by moving a slider. Not supported in Flash format forms.</td>
<td>“Building slider bar controls” on page 540.</td>
</tr>
<tr>
<td>cftextarea</td>
<td>Displays a text input area. Equivalent to the HTML textarea tag, with the addition of input validation.</td>
<td>The cftree tag in the CFML Reference.</td>
</tr>
<tr>
<td>cftree</td>
<td>Creates a Java applet or Flash hierarchical tree-format control that can include graphical images for the different elements. Can also generate a ColdFusion structure that represents the tree data and attributes.</td>
<td>“Building tree controls with the cftree tag” on page 532.</td>
</tr>
</tbody>
</table>

Preserving input data with the preservedata attribute

The cfform preservedata attribute tells ColdFusion to continue displaying the user data in a form after the user submits the form. Data is preserved in the cfinput, cfslider, cftextinput, and cftree controls and in cfselect controls populated by queries. If you specify a default value for a control, and a user overrides that default in the form, the user input is preserved.

You can retain data on the form when the same page contains the form and the form’s action code; that is, the form submits to itself. You can also retain the data if the action page has a copy of the form, and the control names are the same in the forms on both pages. (The action page form does not need to be identical to the initial form. It can have more or fewer elements than the initial page form; only the form elements with identical names on both pages keep their data.)

Note: The preservedata setting on the action page controls the preservation of the data.
For example, if you save this form as preserve.cfm, it continues to display any text that you enter after you submit it, as follows:

```html
<cfform action="preserve.cfm" preservedata="Yes">
  <p>Please enter your name:
  <cfinput type="Text" name="UserName" required="Yes"><p>
  <input type="Submit" name="" > <input type="RESET">
</cfform>
```

Usage notes for the preservedata attribute

When you use the preservedata attribute, follow these guidelines:

- In the cftree tag, the preservedata attribute causes the tree to expand to the previously selected element. For this to work correctly, you must also set the completePath attribute to True.
- The preservedata attribute has no effect on a cfgrid tag. If you populate the control from a query, you must update the data source with the new data (typically by using a cfgridupdate tag) before redisplaying the grid. The grid then displays the updated database information.

Browser considerations

The applet-based versions of the cfgrid, cfslider, and cftree forms use JavaScript and Java to display their content. To allow them to display consistently across a variety of browsers, these applets use the Java plug-in. As a result, they are independent of the level of Java support provided by the browser.

ColdFusion downloads and installs the browser plug-in if necessary. Some browsers display a single permission dialog box asking you to confirm the plug-in installation. Other browsers, particularly older versions of Netscape, require you to navigate some simple option windows.

Because the controls use JavaScript to return data to ColdFusion, if you disable JavaScript in your browser, it cannot properly run forms that contain these controls. In that case, the controls still display, but data return and validation does not work and you can receive a JavaScript error.

Because Java is handled by the plug-in and not directly by the browser, disabling Java execution in the browser does not affect the operation of the controls. If for some other reason, however, the browser is unable to render the controls as requested, a "not supported" message appears in place of the control.

You can use the cfform tag's notsupported attribute to specify an alternative error message.

You can avoid browser Java and JavaScript issues with the cfgrid and cftree controls by using the Flash format versions of these controls. These controls work on Windows, Mac OS X, and Linux, and do not rely on Java support. There is no Flash format version of the cfslider control, and there is no applet format version of the cfcalendar control.

Building tree controls with the cftree tag

The cftree tag lets you display hierarchical information within a form in a space-saving collapsible tree populated from data source queries. To build a tree control with the cftree tag, you use individual cftreeitem tags to populate the control.

You can create trees in three formats:
Applet: Creates a Java applet that the client must download. Downloading an applet takes time; therefore, using the cftree tag can be slightly slower than using an HTML form element to retrieve the same information. In addition, browsers must be Java-enabled for the cftree tag to work properly.

Flash: Generates a Flash control that you can include in an HTML or Flash format form. For more information on Flash Format see "Creating Forms in Flash" on page 576.

Object: Creates a hierarchical ColdFusion structure that represents the tree data and many of the cftree and cftreeitem attributes.

The different formats support different sets of features and attributes. This section discusses general techniques that apply to all three formats, and indicates any techniques that do not apply to a specific format. It uses applet format for all examples, which use applet-specific attributes. For details on the features and attributes supported in each format, see the cftree entry in the CFML Reference.

Create and populate a tree control from a query

1. Create a ColdFusion page with the following content:

```cfml
<cfquery name="engquery" datasource="cfdocexamples">
    SELECT FirstName || ' ' || LastName AS FullName
    FROM Employee
</cfquery>
<cfform name="form1" action="submit.cfm">
    <cftree name="tree1" required="Yes" hscroll="No">
        <cftreeitem value="FullName" query="engquery" queryasroot="Yes" img="folder,document">
        </cftreeitem>
    </cftree>
</cfform>
```

2. Save the page as tree1.cfm and view it in your browser.

   The following image shows the output of this CFML page:

   ![Image of a tree control with multiple entries]

Reviewing the code

The following table describes the highlighted code and its function:
Grouping output from a query

In a query that you display using a cftree control, you might want to organize your employees by department. In this case, you separate column names with commas in the cftreeitem value attribute.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cftree name=&quot;tree1&quot;</code></td>
<td>Creates a tree and names it tree1.</td>
</tr>
<tr>
<td><code>required=&quot;Yes&quot;</code></td>
<td>Specifies that a user must select an item in the tree.</td>
</tr>
<tr>
<td><code>hscroll=&quot;No&quot;</code></td>
<td>Does not allow horizontal scrolling.</td>
</tr>
<tr>
<td><code>&lt;cftreeitem value=&quot;FullName&quot; query=&quot;deptquery&quot;</code></td>
<td>Creates an item in the tree and puts the results of the query named deptquery in it. Because this tag uses a query, it puts one item on the tree per query entry.</td>
</tr>
<tr>
<td><code>queryasroot=&quot;Yes&quot;</code></td>
<td>Specifies the query name as the root level of the tree control.</td>
</tr>
<tr>
<td><code>img=&quot;folder,document&quot;</code></td>
<td>Uses the folder and document images that ship with ColdFusion in the tree structure.</td>
</tr>
</tbody>
</table>

When populating a cftree tag with data from a cfquery tag, you can specify images or filenames for each level of the tree as a comma-separated list.

Organize the tree based on ordered results of a query

1. Create a ColdFusion page named tree2.cfm with the following content:

   ```coldfusion
   <!---- CFQUERY with an ORDER BY clause. ---->
   <cfquery name="deptquery" datasource="cfdocexamples">
     SELECT Dept_ID, FirstName || ' ' || LastName
     AS FullName
     FROM Employee
     ORDER BY Dept_ID
   </cfquery>

   <!---- Build the tree control. ---->
   <cfform name="form1" action="submit.cfm">

     <cftree name="tree1" hscroll="No" border="Yes" height="350" required="Yes">

     <cftreeitem value="Dept_ID, FullName" query="deptquery" queryasroot="Dept_ID"
     img="computer,folder,document" imgopen="computer,folder"
     expand="yes">

     </cftree>

   </cfform>

   <br>
   <input type="Submit" value="Submit">
   </cfform>

2. Save the page and view it in your browser. It should look as follows
Reviewing the code

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORDER BY Dept_ID</td>
<td>Orders the query results by department.</td>
</tr>
<tr>
<td><code>&lt;cftreeitem value=&quot;Dept_ID,FullName&quot;</code></td>
<td>Populates the tree with the department ID, and under each department, the full name for each employee in the department.</td>
</tr>
<tr>
<td>queryasroot=&quot;Dept_ID&quot;</td>
<td>Labels the root &quot;Dept_ID&quot;.</td>
</tr>
<tr>
<td>img=&quot;computer,folder,document&quot;</td>
<td>Uses the ColdFusion supplied computer image for the root level, folder image for the department IDs, and document image for the names, independent of whether any level is expanded (open) or collapsed. The imgopen attribute has only two items, because the employee names can never be open.</td>
</tr>
</tbody>
</table>

The cftreeitem comma-separated value, img, and imgopen attributes correspond to the tree level structure. In applet format, if you omit the img attribute, ColdFusion uses the folder image for all levels in the tree; if you omit the imgopen attribute, ColdFusion uses the folder image for all expanded levels in the tree. Flash format ignores the img and imgopen attributes and always uses folders for levels with children and documents for nodes without children.

The cftree form variables

The cftree tag lets you force a user to select an item from the tree control by setting the required attribute to Yes. With or without the required attribute, ColdFusion passes two form variables to the application page specified in the cfform action attribute:

- Form.treename.path Returns the complete path of the user selection, in the form: `[root]\node1\node2\node_n\value`  
- Form.treename.node Returns the node of the user selection.

To return the root part of the path, set the completepath attribute of the cftree tag to Yes; otherwise, the path value starts with the first node. If you specify a root name for a tree item using the queryasroot tag, that value is returned as the root. If you do not specify a root name, ColdFusion returns the query name as the root. If there is no query name, ColdFusion returns the tree name as the root.

In the previous example, if the user selects the name "John Allen" in the tree, ColdFusion returns the following form variables:
Form.tree1.path = John Allen
Form.tree1.node = John Allen

The deptquery root does not appear in the path, because the cftree tag does not specify completePath="Yes". You can specify the character used to delimit each element of the path form variable in the cftree delimiter attribute. The default is a backslash character (\).

**Input validation**

Although the cftree tag does not include a validate attribute, you can use the required attribute to force a user to select an item from the tree control. In addition, you can use the onValidate attribute to specify your own JavaScript code to perform validation.

**Structuring tree controls**

Tree controls built with the cftree tag can be very complex. Knowing how to specify the relationship between multiple cftreeitem entries helps you handle the most complex cftree constructs.

**Creating a one-level tree control**

The following example consists of a single root and a number of individual items:

```cfcquery name="deptquery" datasource="cfdocexamples">
    SELECT Dept_ID, FirstName || ' ' || LastName
    AS FullName
    FROM Employee
    ORDER BY Dept_ID
</cfcquery>

<cfform name="form1" action="submit.cfm">
    <cftree name="tree1">
        <cftreeitem value="FullName" query="deptquery" queryasroot="Department">
            img="folder,document">
    </cftree>
    <br>
    <cfinput type="submit" value="Submit">
</cfform>
```

**Creating a multilevel tree control**

The following image shows an example of a multilevel tree control:
When populating a `cftree` control, you create the multilevel structure of the tree by specifying a parent for each item in the tree. The `parent` attribute of the `cftreeitem` tag allows your `cftree` tag to show relationships between elements in the tree.

In this example, every `cftreeitem` tag, except the top level Divisions, specifies a parent. For example, the `cftreeitem value="Development"` tag specifies Divisions as its parent.

The following code populates the tree directly, not from a query:

```cfc
<cfform name="form2" action="cfform_submit.cfm">
  <cftree name="tree1" hscroll="No" vscroll="No" border="No">
    <cftreeitem value="Divisions">
      <cftreeitem value="Development" parent="Divisions" img="folder">
        <cftreeitem value="Product One" parent="Development" img="document">
          <cftreeitem value="GUI" parent="Product One" img="document">
            <cftreeitem value="Kernel" parent="Product One" img="document">
              <cftreeitem value="Product Three" parent="Kernel" img="document">
                <cftreeitem value="Support" parent="Divisions" img="fixed">...
              </cftreeitem>
            </cftreeitem>
          </cftreeitem>
        </cftreeitem>
      </cftreeitem>
    </cftreeitem>
    <cftreeitem value="QA">
      <cftreeitem value="Product One" parent="QA" img="document">
        <cftreeitem value="Product Two" parent="QA" img="document">
          <cftreeitem value="Product Three" parent="Product Two" img="document">
            <cftreeitem value="Sales" parent="Product Three" img="computer">
              <cftreeitem value="Marketing" parent="Sales" img="remote">
                <cftreeitem value="Finance" parent="Marketing" img="element">
                  <cftreeitem value="Divisions" parent="Finance" img="element">
                    <cftreeitem value="Support" parent="Divisions" img="fixed">...
                  </cftreeitem>
                </cftreeitem>
              </cftreeitem>
            </cftreeitem>
          </cftreeitem>
        </cftreeitem>
      </cftreeitem>
    </cftreeitem>
    <cftreeitem value="Finance">
      <cftreeitem value="Product Two" parent="Finance" img="computer">
        <cftreeitem value="Marketing" parent="Product Two" img="remote">
          <cftreeitem value="Sales" parent="Marketing" img="element">
            <cftreeitem value="Divisions" parent="Sales" img="element">
              <cftreeitem value="Support" parent="Divisions" img="fixed">...
            </cftreeitem>
          </cftreeitem>
        </cftreeitem>
      </cftreeitem>
    </cftreeitem>
  </cftreeitem>
</cfform>
```

**Image names in a cftree tag**

*Note: This section applies to applet format trees. In Flash format, you cannot control the tree icons. Flash format uses open and closed folders and documents as the icons. In object format, the image information is preserved in fields in the object structure.*

The default image displayed in a tree is a folder. However, you can use the `img` attribute of the `cftreeitem` tag to specify a different image.
When you use the `img` attribute, ColdFusion displays the specified image beside the tree items when they are not open. When you use the `imgopen` attribute, ColdFusion displays the specified image beside the tree items when they are open (expanded). You can specify a built-in ColdFusion image name, the file path to an image file, or the URL of an image of your choice, such as `http://localhost/Myapp/Images/Level3.gif`. You cannot use a custom image in Flash format. As a general rule, make the height of your custom images less than 20 pixels.

When populating a `cftree` control with data from a `cfquery` tag, you can use the `img` attribute of `cftreeitem` tag to specify images or filenames for each level of the tree as a comma-separated list.

The following are the ColdFusion built-in image names:

- computer
- document
- element
- folder
- floppy
- fixed
- remote

**Note:** In applet format, you can also control the tree appearance by using the `cftree` tag `lookAndFeel` attribute to specify a Windows, Motif, or Metal look.

**Embedding URLs in a ctree tag**

The `href` attribute in the `cftreeitem` tag lets you designate tree items as links. To use this feature in a `cftree` control, you define the destination of the link in the `href` attribute of the `cftreeitem` tag. The URL for the link can be a relative URL or an absolute URL, as in the following examples.

**Embed links in a ctree control**

1. Create a ColdFusion page named `tree3.cfm` with the following contents:

   ```coldfusion
   <cfform action="submit.cfm">
   <cftree name="oak"
     highlightref="Yes"
     height="100"
     width="200"
     hspace="100"
     vspace="6"
     hscroll="No"
     vscroll="No"
     border="No">
     <cftreeitem value="Important Links">
       <cftreeitem value="Adobe Home"
         parent="Important Links"
         img="document"
         href="http://www.adobe.com">
       </cftreeitem>
       <cftreeitem value="ColdFusion Developer Center"
         parent="Important Links"
         img="document"
         href="http://www.adobe.com/devnet/coldfusion/">
     </cftreeitem>
   </cftree>
   </cfform>
   ```

2. Save the page and view it in your browser.
The following image shows the output of this code:

Reviewing the code
The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>href=&quot;<a href="http://www.adobe.com">http://www.adobe.com</a>&quot;</td>
<td>Makes the node of the tree a link.</td>
</tr>
<tr>
<td>href=&quot;<a href="http://www.adobe.com/devnet/mx/coldfusion/">http://www.adobe.com/devnet/mx/coldfusion/</a>&quot;</td>
<td>Makes the node of the tree a link. Although this example does not show it, the href attribute can refer to the name of a column in a query if that query populates the tree item.</td>
</tr>
</tbody>
</table>

Specifying the tree item in the URL
When a user clicks on a tree item to link to a URL, the cftreeItemKey variable, which identifies the selected value, is appended to the URL in the following form:

http://myserver.com?CFTREEITEMKEY=selected_item_value_attribute

If the value attribute includes spaces, ColdFusion replaces the spaces with plus characters (+).

Automatically passing the name of the selected tree item as part of the URL makes it easy to implement a basic "drill down" application that displays additional information based on the selection. For example, if the specified URL is another ColdFusion page, it can access the selected value as the variable URL.CFTREEITEMKEY.

To disable this behavior, set the appendkey attribute in the cftree tag to no.

Building drop-down list boxes
The drop-down list box that you can create in a cfiform tag with a cfselect tag is similar to the HTML select tag. However, the cfselect tag gives you more control over user inputs, provides error handling, and, most importantly, lets you automatically populate the selection list from a query.

You can populate the drop-down list box from a query, or using lists of option elements created by the option tag. The syntax for the option tag with the cfselect tag is the same as for the HTML option tag.

When you populate a cfselect tag with data from a query, you only need to specify the name of the query that is supplying data for the cfselect tag and the query column name for each list element to display.

Populate a drop-down list box with query data using the cfselect tag
1. Create a ColdFusion page with the following content:

```coldfusion
<cfquery name="getNames"
    datasource="cfdocexamples">
    SELECT * FROM Employee
</cfquery>

<cfform name="Form1" action="submit.cfm">
```
<cfselect name="employees"
   query="getNames"
   value="Emp_ID"
   display="FirstName"
   required="Yes"
   multiple="Yes"
   size="8">
</cfselect>

<br><input type="Submit" value="Submit">
</cfform>

2. Save the file as selectbox.cfm and view it in your browser.

The following image shows the output of this code:

Because the tag includes the `multiple` attribute, the user can select multiple entries in the list box. Also, because the `value` tag specifies `Emp_ID`, the primary key for the Employee table, Employee IDs (not first names) get passed in the Form.Employee variable to the application page specified in the `cfform` action attribute.

You can use a query to create a two-level hierarchical list grouped by one of the query columns. For an example of this use, see the example for the `cfselect` entry in the CFML Reference.

### Building slider bar controls

You can use the `cfslider` control in a `cfform` tag to create a slider control and define a variety of characteristics, including label text, label font name, size, boldface, italics, and color, and slider range, positioning, and behavior.

Slider bars are useful because they are highly visual and users can only enter valid values. The `cfslider` tag is not supported in Flash format forms.

#### Create a slider control

1. Create a ColdFusion page with the following content:

   ```coldfusion
   <cfform name="Form1" action="submit.cfm">
   <cfslider name="myslider"
      bgcolor="cyan"
      bold="Yes"
      range="0,1000"
      scale="100"
      value="600"
      fontsize="14"
      label="Slider %value%"
      height="60"
      width="400">
    </cfform>
   ```

2. Save the file as slider.cfm and view it in your browser.
The following image shows the output of this code:

![Slider 600](image)

To get the value of the slider in the action page, use the variable `Form.slider_name`; in this case, `Form.myslider`.

---

## Creating data grids with the `cfgrid` tag

The `cfgrid` tag creates a `cfgrid` grid control that resembles a spreadsheet table and can contain data populated from a `cfquery` tag or from other sources of data. As with other `cfgrid` tags, the `cfgrid` tag offers a wide range of data formatting options, as well as the option of validating user selections with a JavaScript validation script.

You can also perform the following tasks with a `cfgrid` tag:

- Sort data in the grid alphanumerically.
- Update, insert, and delete data.
- Display images in the grid.

**Note:** Flash format grids support a subset of the features available in applet format grids. For details on features supported in each format, see the `cfgrid` tag in the CFML Reference.

Users can sort the grid entries in ascending order by double-clicking any column header. Double-clicking again sorts the grid in descending order. In applet format, you can also add sort buttons to the grid control.

When users select grid data and submit the form, ColdFusion passes the selection information as form variables to the application page specified in the `cfgrid` action attribute.

Just as the `cftree` tag uses the `cftreeitem` tag, the `cfgrid` tag uses the `cfgridcolumn` and `cfgridrow` tags. You can define a wide range of row and column formatting options, as well as a column name, data type, selection options, and so on. You use the `cfgridcolumn` tag to define individual columns in the grid or associate a query column with a grid column.

Use the `cfgridrow` tag to define a grid that does not use a query as the source for row data. If a query attribute is specified in the `cfgrid` tag, the `cfgridrow` tags are ignored.

The `cfgrid` tag provides many attributes that control grid behavior and appearance. This chapter describes only the most important of these attributes. For detailed information on these attributes, see the `cfgrid` tag in the CFML Reference.

---

## Working with a data grid and entering data

The following image shows an example applet format grid created using a `cfgrid` tag:
The following table describes some navigating tips:

<table>
<thead>
<tr>
<th>Action</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorting grid rows</td>
<td>Double-click the column header to sort a column in ascending order. Double-click again to sort the rows in descending order.</td>
</tr>
<tr>
<td>Rearranging columns</td>
<td>Click any column heading and drag the column to a new position.</td>
</tr>
<tr>
<td>Determining editable grid areas</td>
<td>When you click an editable cell, it is surrounded by a yellow box.</td>
</tr>
<tr>
<td>Determining noneditable grid areas</td>
<td>When you click a cell (or row or column) that you cannot edit, its background color changes. The default color is salmon pink.</td>
</tr>
<tr>
<td>Editing a grid cell</td>
<td>Double-click the cell. You must press Return when you finish entering the data.</td>
</tr>
<tr>
<td>Deleting a row</td>
<td>Click any cell in the row and click the Delete button. (Not available in Flash format grids.)</td>
</tr>
<tr>
<td>Inserting a row</td>
<td>Click the Insert button. An empty row appears at the bottom of the grid. To enter a value in each cell, double-click the cell, enter the value, and click Return. (Not available in Flash format grids.)</td>
</tr>
</tbody>
</table>

**Populate a grid from a query**

1. Create a new ColdFusion page named grid1.cfm with the following contents:

   ```cfc query```
   ```
   <cfquery name="empdata" datasource="cfdocexamples">
       SELECT * FROM Employee
   </cfquery>
   ```

   ```cform```
   ```
   <cform name="Form1" action="submit.cfm">
       <cfgrid name="employee_grid" query="empdata" selectmode="single">
           <cfgridcolumn name="Emp_ID">
               <cfgridcolumn name="LastName">
                   <cfgridcolumn name="Dept_ID">
                       </cfgrid>
                       <br>
                       <cfinput name="submitit" type="Submit" value="Submit"/>
       </cform>
   ```

**Note:** Use the `cfgridcolumn display="No"` attribute to hide columns that you want to include in the grid but not expose to an end user. You typically use this attribute to include columns such as the table's primary key column in the results returned by the `cfgrid` tag.
2 Save the file and view it in your browser. The following image shows the output of this code:

![Grid Output Image]

Reviewing the code
The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfgrid name=&quot;employee_grid&quot; query=&quot;empdata&quot; selectmode=&quot;single&quot;&gt;</code></td>
<td>Creates a grid named employee_grid and populate it with the results of the query empdata. If you specify a <code>cfgrid</code> tag with a <code>query</code> attribute defined and no corresponding <code>cfgridcolumn</code> attributes, the grid contains all the columns in the query. Allows the user to select only one cell; does not allow editing. Other modes are row, column, and edit.</td>
</tr>
<tr>
<td><code>selectmode=&quot;single&quot;&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfgridcolumn name=&quot;Emp_ID&quot;&gt;</code></td>
<td>Puts the contents of the Emp_ID column in the query results in the first column of the grid.</td>
</tr>
<tr>
<td><code>&lt;cfgridcolumn name=&quot;LastName&quot;&gt;</code></td>
<td>Puts the contents of the LastName column in the query results in the second column of the grid.</td>
</tr>
<tr>
<td><code>&lt;cfgridcolumn name=&quot;Dept_ID&quot;&gt;</code></td>
<td>Puts the contents of the Dept_ID column in the query results in the third column of the grid.</td>
</tr>
</tbody>
</table>

Creating an editable grid
You can build grids to allow users to edit data within them. Users can edit individual cell data, as well as insert, update, or delete rows. To enable grid editing, you specify `selectmode="edit"` in the `cfgrid` tag.

You can let users add or delete grid rows by setting the `insert` or `delete` attributes in the `cfgrid` tag to Yes. Setting the `insert` and `delete` attribute to Yes causes the `cfgrid` tag to display Insert and Delete buttons as part of the grid, as the following image shows:
You can use a grid in two ways to make changes to your ColdFusion data sources:

- Create a page to which you pass the `cfgrid` form variables. In that page, perform `cfquery` operations to update data source records based on the form values returned by the `cfgrid` tag.
- Pass grid edits to a page that includes the `cfgridupdate` tag, which automatically extracts the form variable values and passes that data directly to the data source.

Using the `cfquery` tag gives you complete control over interactions with your data source. The `cfgridupdate` tag provides a much simpler interface for operations that do not require the same level of control.

**Controlling cell contents**

You can control the data that a user can enter into a `cfgrid` cell in the following ways:

- By default, a cell is not editable. Use the `cfgrid` attribute `selectmode="edit"` to edit cell contents.
- Use the `cfgridcolumn type` attribute to control sorting order, to make the fields check boxes, or to display an image.
- Use the `cfgridcolumn values` attribute to specify a drop-down list of values from which the user can choose. You can use the `valuesDisplay` attribute to provide a list of items to display that differs from the actual values that you enter in the database. You can use the `valuesDelimiter` attribute to specify the separator between values in the `values` and `valuesDisplay` lists.
- Although the `cfgrid` tag does not have a `validate` attribute, it does have an `onValidate` attribute that lets you specify a JavaScript function to perform validation.

For more information on controlling the cell contents, see the attribute descriptions for the `cfgridcolumn` tag in the CFML Reference.

**How user edits are returned**

When a user inserts or deletes a row in a grid or changes any cells in a row and submits the grid, ColdFusion creates the following arrays as Form variables:

<table>
<thead>
<tr>
<th>Array name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>gridname.colname</td>
<td>Stores the new values of inserted, deleted, or updated cells. (Entries for deleted cells contain empty strings.)</td>
</tr>
<tr>
<td>gridname.Original.colname</td>
<td>Stores the original values of inserted, deleted, or updated cells.</td>
</tr>
<tr>
<td>gridname.RowStatus.Action</td>
<td>Stores the type of change made to the grid rows: D for delete, I for insert, or U for update.</td>
</tr>
</tbody>
</table>

*Note: The periods in these names are not structure separators; they are part of the text of the array name.*
ColdFusion creates a `gridname.colname` array and a `gridname.Original.colname` array for each column in the grid. For each inserted, deleted, or changed row in the grid, ColdFusion creates a row in each of these arrays.

For example, the following arrays are created if you update a `cfgrid` tag called `mygrid` that consists of two displayable columns (col1, col2) and one hidden column (col3):

```
Form.mygrid.col1
Form.mygrid.col2
Form.mygrid.col3
Form.mygrid.original.col1
Form.mygrid.original.col2
Form.mygrid.original.col3
Form.mygrid.RowStatus.Action
```

The value of the array index increments for each row that is added, deleted, or changed, and does not indicate a grid row number. All rows for a particular change have the same index in all arrays. Unchanged rows do not have entries in the arrays.

If the user makes a change to a single cell in col2, the following array elements contain the edit operation, the edited cell value, and the original cell value:

```
Form.mygrid.col2[1]
Form.mygrid.original.col2[1]
```

If the user changes the values of the cells in col1 and col3 in one row and the cell in col2 in another row, the information about the original and changed values is in the following array entries:

```
Form.mygrid.col1[1]
Form.mygrid.original.col1[1]
Form.mygrid.col3[1]
Form.mygrid.original.col3[1]
Form.mygrid.col2[2]
Form.mygrid.original.col2[2]
```

The remaining cells in the arrays (for example, Form.mygrid.col2[1] and Form.mygrid.original.col2[1]) have the original, unchanged values.

**Example: editing data in a grid**

The following example creates an editable grid. For code brevity, the example handles only three of the fields in the Employee table. A more realistic example would include, at a minimum, all seven table fields. It might also hide the contents of the Emp_ID column or display the Department name (from the Departmt table), instead of the Department ID.

**Create the editable grid**

1. Create a ColdFusion page with the following content:

   ```coldfusion
   <cfquery name="empdata" datasource="cfdocexamples">
       SELECT * FROM Employee
   </cfquery>

   <cfform name="GridForm" action="handle_grid.cfm">
       <cfgrid name="employee_grid" height=425 width=300
   ```
2  Save the file as grid2.cfm.

3  View the results in your browser.

The following image shows the output of this code:

The following sections describe how to write the handle_grid.cfm page to process user edits to the grid.
Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfgrid name=&quot;employee_grid&quot;</td>
<td>Populates a cfgrid control with data from the empdata query. Selecting a grid cell enables you to edit it. You can insert and delete rows. The grid is 425 X 300 pixels and has 10 pixels of space above and below it.</td>
</tr>
<tr>
<td>height=425 width=300 vspace=10 selectmode=&quot;edit&quot; query=&quot;empdata&quot; insert=&quot;Yes&quot; delete=&quot;Yes&quot;&gt;</td>
<td>Creates a 50-pixel wide column for the data in the Emp_ID column of the data source. Centers a header named Emp ID and makes it bold. Does not allow users to select fields in this column for editing. Since this field is the table’s primary key, users should not be able to change it for existing records, and the DBMS should generate this field as an autoincrement value.</td>
</tr>
<tr>
<td>&lt;cfgridcolumn name=&quot;Emp_ID&quot; height=50</td>
<td>Creates a 100-pixel wide column for the data in the LastName column of the data source. Centers a header named Last Name and makes it bold.</td>
</tr>
<tr>
<td>header=&quot;Emp ID&quot; width=50 headeralign=&quot;center&quot; headerbold=&quot;Yes&quot; select=&quot;No&quot;&gt;</td>
<td>Creates a 35-pixel wide column for the data in the Dept_ID column of the data source. Centers a header named Dept and makes it bold.</td>
</tr>
</tbody>
</table>

Updating the database with the cfgridupdate tag

The cfgridupdate tag provides a simple mechanism for updating the database, including inserting and deleting records. It can add, update, and delete records simultaneously. It is convenient because it automatically handles collecting the cfgrid changes from the various form variables, and generates appropriate SQL statements to update your data source.

In most cases, use the cfgridupdate tag to update your database. However, this tag does not provide the complete SQL control that the cfquery tag provides. In particular, the cfgridupdate tag has the following characteristics:

- You can update only a single table.
- Rows are deleted first, then rows are inserted, then any changes are made to existing rows. You cannot modify the order of changes.
- Updating stops when an error occurs. It is possible that some database changes are made, but the tag does not provide any information on them.

Update the data source with the cfgridupdate tag

1. Create a ColdFusion page with the following contents:

```html
<html>
<head>
    <title>Update grid values</title>
</head>
<body>

<h3>Updating grid using cfgridupdate tag.</h3>

<cfgridupdate grid="employee_grid"/>
```
Click <a href="grid2.cfm">here</a> to display updated grid.

2 Save the file as handle_grid.cfm.

3 View the grid2.cfm page in your browser, make changes to the grid, and then submit them.

**Note:** To update a grid cell, modify the cell contents, and then press Return.

### Reviewing the code

The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfgridupdate_grid=&quot;employee_grid&quot;</code></td>
<td>Updates the database from the Employee_grid grid.</td>
</tr>
<tr>
<td><code>datasource=&quot;cfdocexamples&quot;</code></td>
<td>Updates the cfdocexamples data source.</td>
</tr>
<tr>
<td><code>tablename=&quot;Employee&quot;</code></td>
<td>Updates the Employee table.</td>
</tr>
</tbody>
</table>

### Updating the database with the cfquery tag

You can use the `cfquery` tag to update your database from the `cfgrid` changes. This provides you with full control over how the updates are made and lets you handle any errors that arise.

### Update the data source with the cfquery tag

1 Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
     <title>Catch submitted grid values</title>
   </head>
   <body>
   <h3>Grid values for Form.employee_grid row updates</h3>
   <cfif isdefined("Form.employee_grid.rowstatus.action")>
   <cfloop index = "counter" from = "1" to =
   #arraylen(Form.employee_grid.rowstatus.action)#>  
   <cfoutput>
   The row action for #counter# is:
   #Form.employee_grid.rowstatus.action[counter]#
   <br>
   </cfoutput>
   <cfif Form.employee_grid.rowstatus.action[counter] is "D">
   <cfquery name="DeleteExistingEmployee"
   datasource="cfdocexamples">
   DELETE FROM Employee
   WHERE Emp_ID=<cfqueryparam
   value="#Form.employee_grid.original.Emp_ID[counter]#"
   CFSQLType="CF_SQL_INTEGER" >
   </cfquery>
   </cfif>
   </cfloop>
   </cfif>
   </body>
   </html>
```
Click <a href="grid2.cfm">here</a> to display updated grid.

2  Rename your existing handle_grid.cfm file as handle_grid2.cfm to save it, and then save this file as handle_grid.cfm.

3  View the grid2.cfm page in your browser, make changes to the grid, and then submit them.

**Reviewing the code**

The following table describes the code and its function:
## Code

```cfc
<cfif isdefined("Form.employee_grid.rowstatus.action")>
<cfloop index = "counter" from = "1" to = #arraylen(Form.employee_grid.rowstatus.action)#>

If there is an array of edit types, changes the table. Otherwise, does nothing. Loops through the remaining code once for each row to be changed. The counter variable is the common index into the arrays of change information for the row being changed.

Displays the action code for this row: U for update, I for insert, or D for delete.

If the action is to delete a row, generates a SQL DELETE query specifying the Emp_ID (the primary key) of the row to be deleted.

Otherwise, if the action is to update a row, generates a SQL UPDATE query to update the LastName and Dept_ID fields for the row specified by the Emp_ID primary table key.

Otherwise, if the action is to insert a row, generates a SQL INSERT query to insert the employee's last name and department ID from the grid row into the database. The INSERT statement assumes that the DBMS automatically increments the Emp_ID primary key. If you use the version of the cfdocexamples database that is provided for UNIX installations, the record is inserted without an Emp_ID number.

Closes the cfif tag used to select among deleting, updating, and inserting.

Closes the loop used for each row to be changed.

Closes the cfif tag that surrounds all the active code.
```

## Description

- If there is an array of edit types, changes the table. Otherwise, does nothing. Loops through the remaining code once for each row to be changed. The counter variable is the common index into the arrays of change information for the row being changed.

- Displays the action code for this row: U for update, I for insert, or D for delete.

- If the action is to delete a row, generates a SQL DELETE query specifying the Emp_ID (the primary key) of the row to be deleted.

- Otherwise, if the action is to update a row, generates a SQL UPDATE query to update the LastName and Dept_ID fields for the row specified by the Emp_ID primary table key.

- Otherwise, if the action is to insert a row, generates a SQL INSERT query to insert the employee's last name and department ID from the grid row into the database. The INSERT statement assumes that the DBMS automatically increments the Emp_ID primary key. If you use the version of the cfdocexamples database that is provided for UNIX installations, the record is inserted without an Emp_ID number.

Closes the cfif tag used to select among deleting, updating, and inserting.

Closes the loop used for each row to be changed.

Closes the cfif tag that surrounds all the active code.
Embedding Java applets

The `cfapplet` tag lets you embed Java applets either on a ColdFusion page or in a `cfiform` tag. To use the `cfapplet` tag, you must first register your Java applet using the ColdFusion Administrator Java Applets page (under Extensions). In the ColdFusion Administrator, you define the interface to the applet, encapsulating it so that each invocation of the `cfapplet` tag is very simple.

The `cfapplet` tag within a form offers several advantages over using the HTML `applet` tag:

- **Return values**: The `cfapplet` tag requires a form field `name` attribute, so you can avoid coding additional JavaScript to capture the applet's return values. You can reference return values like any other ColdFusion form variable: `Form.variablename`.

- **Ease of use**: The applet's interface is defined in the ColdFusion Administrator, so each instance of the `cfapplet` tag in your pages only needs to reference the applet name and specify a form variable name.

- **Parameter defaults**: ColdFusion uses the parameter value pairs that you defined in the ColdFusion Administrator. You can override these values by specifying parameter value pairs in the `cfapplet` tag.

When an applet is registered, you enter just the applet source and the form variable name:

```<cfapplet appletSource="Calculator" name="calc_value">```

By contrast, with the HTML `applet` tag, you must declare all the applet's parameters every time you want to use it in a ColdFusion page.

Registering a Java applet

Before you can use a Java applet in your ColdFusion pages, you must register the applet in the ColdFusion Administrator.

**Register a Java applet**

1. Open the ColdFusion Administrator by clicking the Administrator icon in the ColdFusion Program group and entering the Administrator password.
2. Under Extensions, click Java Applets.
   
   The Java Applets page appears.
3. Click the Register New Applet button.
   
   The Add/Edit Applet page appears.
4. Enter options in the applet registration fields, as described in the ColdFusion Administrator online help. Use the Add button to add parameters.
5. Click Submit.

Using the `cfapplet` tag to embed an applet

After you register an applet, you can use the `cfapplet` tag to place the applet in a ColdFusion page. The `cfapplet` tag has two required attributes: `appletSource` and `name`. Because you registered the applet and you defined each applet parameter with a default value, you can invoke the applet with a very simple form of the `cfapplet` tag:

```<cfapplet appletSource="appletname" name="form_variable">```
Overriding alignment and positioning values
To override any of the values defined in the ColdFusion Administrator for the applet, you can use the optional cfapplet parameters to specify custom values. For example, the following cfapplet tag specifies custom spacing and alignment values:

```xml
<cfapplet appletSource="myapplet"
    name="applet1_var"
    height=400
    width=200
    vspace=125
    hspace=125
    align="left">
```

Overriding parameter values
You can override the values that you assigned to applet parameters in the ColdFusion Administrator by providing new values for any parameter. To override a parameter, you must have already defined the parameter and its default value in the ColdFusion Administrator Applets page. The following example overrides the default values of two parameters, Param1 and Param2:

```xml
<cfapplet appletSource="myapplet"
    name="applet1_var"
    Param1="registered parameter1"
    Param2="registered parameter2">
```

Handling form variables from an applet
The cfapplet tag name attribute corresponds to a variable in the action page, Form.appletname, which holds any value that the applet method returns when it is executed in the cfform tag.

Not all Java applets return values. For instance, graphical widgets might not return a specific value. For this type of applet, the method field in the ColdFusion Administrator remains empty, but you must still provide a cfapplet name attribute.

You can only use one method for each applet that you register. If an applet includes more than one method that you want to access, you can register the applet with a unique name for each additional method you want to use.

Reference a Java applet return value in your application page
1. Specify the name of the method in the Add/Registered Java Applet page of the ColdFusion Administrator.
2. Specify the method name in the name attribute of the cfapplet tag.

When your page executes the applet, ColdFusion creates a form variable with the name that you specified. If you do not specify a method, ColdFusion does not create a form variable.
Chapter 31: Validating Data

You can validate data in ColdFusion, including form data, variable data and function parameters.

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About ColdFusion validation

Data validation lets you control data that is entered into an application by ensuring that the data conforms to specific type or formatting rules. Validation techniques have the following features:

- They let you provide feedback to users so that they can immediately correct information they provide. For example, a form can provide immediate feedback when a user enters a name in a telephone number field, or the form could force the user to enter the number in the correct format.

- They help prevent application errors that might arise when processing invalid data. For example, a validation test can prevent a variable that is used in a calculation from having nonnumeric data.

- They can help enhance security by preventing malicious users from providing data that takes advantage of system security weaknesses, such as buffer overrun attacks.

ColdFusion provides several techniques to ensure that data is valid. These include techniques for validating form data and for validating ColdFusion variables. They also include techniques for validating form data before the user submits it to ColdFusion, or on the ColdFusion server.

When you design data validation you consider the following factors:

The validation technique: Whether to validate on the client's browser or on the server, and the specific server- or client-side validation technique, such as whether to validate when a field loses focus or when the user submits the form.

The validation type: The specific method that you use to validate the data, including the rules that you apply to test the data validity, such as testing for a valid telephone number.

The following sections describe the ColdFusion validation techniques and provide information on selecting a technique that is appropriate for your application. They also describe the validation types that ColdFusion supports. Later sections describe particular techniques in detail.
Validation techniques

Different validation techniques apply to different ColdFusion tags or coding environments; for example, you can use masking only in HTML and Flash format `cfinput` tags. Validation techniques also vary in where and when they execute; for example, on the client browser when the user submits form data, or on the server when processing data.

The following table describes the ColdFusion validation techniques:

<table>
<thead>
<tr>
<th>Validation technique</th>
<th>Applies to</th>
<th>Where and when performed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mask (mask attribute)</td>
<td>HTML and Flash format <code>cfinput</code> tags</td>
<td>On the client as the user enters data</td>
<td>ColdFusion generates JavaScript or ActionScript to directly control the data a user enters by specifying a pattern. For example, 999-999-9999 requires a user to enter ten digits, and automatically fills in the dash (-) separators to create a formatted telephone number. For detailed information on using masks, see “Handling invalid data” on page 560.</td>
</tr>
<tr>
<td>onBlur (validateat=&quot;onBlur&quot; attribute)</td>
<td><code>cfinput</code> and <code>cftextarea</code> tags</td>
<td>On the client when the data field loses focus</td>
<td>In HTML and XML format, ColdFusion generates JavaScript that runs on the browser to check whether entered data is valid and provide immediate feedback, if the entry is invalid. In Flash format, uses Flash built-in validation routines.</td>
</tr>
<tr>
<td>onSubmit (validateat=&quot;onSubmit&quot; attribute)</td>
<td><code>cfinput</code> and <code>cftextarea</code> tags</td>
<td>On the client when the user clicks Submit</td>
<td>In HTML or XML format, the validation logic is identical to onBlur validation, but the test is not done until the user submits the form. In Flash format, this validation type is identical to onBlur Validation. Flash checks do not differentiate between the two events for validation.</td>
</tr>
<tr>
<td>onServer (validateat=&quot;onServer&quot; attribute)</td>
<td><code>cfinput</code> and <code>cftextarea</code> tags</td>
<td>On the server when ColdFusion gets the submitted form</td>
<td>ColdFusion checks submitted data for validity and runs a validation error page if the data is not valid. You can use the <code>cferror</code> tag to specify the validation error page.</td>
</tr>
<tr>
<td>hidden field</td>
<td>All Forms, including HTML-only forms</td>
<td>On the server when ColdFusion gets the submitted form</td>
<td>ColdFusion uses the same validation logic as with onServer validation, but you must create additional, hidden, fields and you can use this technique with HTML tags or CFML tags. For detailed information on using hidden fields, see “Validating form data using hidden fields” on page 565.</td>
</tr>
<tr>
<td>JavaScript (onValidate =&quot;function&quot; attribute)</td>
<td><code>cfgrid</code>, <code>cfinput</code>, <code>cfslider</code>, <code>cftextarea</code>, and <code>cftree</code> tags in HTML and XML format forms</td>
<td>On the client, when the user clicks Submit, before field-specific onSubmit validation</td>
<td>ColdFusion includes the specified JavaScript function in the HTML page it sends to the browser, and the browser calls it. For detailed information on using JavaScript for validation, see “Validating form input and handling errors with JavaScript” on page 569.</td>
</tr>
</tbody>
</table>
Note: For more information on ColdFusion error handling, see “Handling Errors” on page 246.

Selecting a validation technique

The following considerations affect the validation technique that you select:

- If you are validating form data, the techniques you use can vary depending on whether you are using HTML, Flash, or XML forms; for example, different form types have different validation limitations.
- Different validation techniques are appropriate for different form controls and data types.
- Available techniques vary depending on when and where you want the data validated; on the client or the server, when the user enters data or submits a form, or when ColdFusion processes a variable or function argument.
- Each technique has specific features and considerations, such as the form of user feedback, feature limitations, and so on.
- Security issues or concerns that apply to your environment or application can affect the technique you select.

The table in the preceding section described some of the considerations (see “Validation techniques” on page 554). The following table describes additional considerations for selecting a validation technique. For additional considerations that are specific to form fields, see “Validation type considerations” on page 559.

<table>
<thead>
<tr>
<th>Validation technique</th>
<th>Applies to</th>
<th>Where and when performed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsValid function</td>
<td>ColdFusion variables</td>
<td>On the server, when the function executes</td>
<td>ColdFusion tests the variable to determine whether it follows a specified validation rule and the function returns true or false. For more information on using the IsValid function for validation, see “Validating data with the IsValid function and the cfparam tag” on page 572.</td>
</tr>
<tr>
<td>cfparam tag</td>
<td>ColdFusion variables</td>
<td>On the server, when the tag executes</td>
<td>ColdFusion checks the specified variable. If the value does not meet the validation criteria, ColdFusion generates an expression exception. For more information on using the cfparam tag for validation, see, “Validating data with the IsValid function and the cfparam tag” on page 572.</td>
</tr>
<tr>
<td>cfargument tag</td>
<td>UDF and CFC function arguments</td>
<td>On the server, when a function is called or invoked</td>
<td>ColdFusion checks the argument value when it is passed to the function. If the value does not meet the validation criteria, ColdFusion generates an application exception. For more information on using the cfargument tag, see “Writing and Calling User-Defined Functions” on page 134.</td>
</tr>
</tbody>
</table>
Security considerations

Although form-specific validation techniques provide good methods for preventing users from submitting invalid or badly formatted data, they cannot prevent users from submitting maliciously formatted data from HTML forms. Malicious users can circumvent validation techniques that require validation on the browser using JavaScript or submission of validation rules in hidden fields. If you must use a technique for preventing malicious data submissions, consider using the following techniques:

- The onSubmit or OnBlur validation in Flash forms, which use Flash built-in validation.
- The IsValid function and the cfparam, and cfargument tags, which let you test variables and arguments in your CFML code.

- The cfqueryparam tag in cfquery tags, which can help protect databases from malicious query input (see “Enhancing security with cfqueryparam” on page 398).

- The script protection option, which helps prevent cross-site scripting attacks. You can set this option on the ColdFusion Administrator Server Settings > Settings page or by using the Application.cfc This.scriptProtect variable or the cfapplication tag scriptprotect attribute. For more information on cross-site scripting attacks and this option, see the cfapplication tag page in the CFML Reference.

Data validation types

The following table lists the types of data you can validate when you use most ColdFusion validation techniques. It does not include mask validation. Some validation types are not available for all techniques; in these cases the table indicates the limitations. The onBlur and onSubmit validation algorithms for Flash format forms might vary from those described in the following table, and most commonly have less functionality. For more detailed descriptions of the onServer validation algorithms, see the table in “Validating form data using hidden fields” on page 565.

<table>
<thead>
<tr>
<th>Type field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>date</td>
<td>When validating on the server, allows any date/time format that returns true in the IsDate function, including a time value. When validating on the client, same as USdate.</td>
</tr>
<tr>
<td>USdate *</td>
<td>A U.S. date of the format mm/dd/yy, with 1- or 2-digit days and months, and 1-through 4-digit years. The separators can be slash (/), hyphen (-), or period (.) characters</td>
</tr>
<tr>
<td>eurodate *</td>
<td>A date of the format dd/mm/yy, with 1- or 2-digit days and months, and 1- through 4-digit years. The separators can be slash (/), hyphen (-), or period (.) characters.</td>
</tr>
<tr>
<td>time *</td>
<td>When validating on the server, allows any date/time format that returns True in the IsDate function, including a date value. When validating on the client, allows a time of format hh:mm[:ss] [A/PM].</td>
</tr>
<tr>
<td>float *</td>
<td>A number; allows integers. When validating form fields on the server, integer values are converted to real numbers.</td>
</tr>
<tr>
<td>numeric</td>
<td>A number; allows integers. When validating form fields on the server, integer values are unchanged.</td>
</tr>
<tr>
<td>integer *</td>
<td>An integer.</td>
</tr>
<tr>
<td>range *</td>
<td>A numeric range specified by a range attribute or max and min attributes.</td>
</tr>
<tr>
<td>boolean</td>
<td>A value that can be converted to a Boolean value: Yes, No, True, or False, (all case-independent), or a number.</td>
</tr>
<tr>
<td>telephone *</td>
<td>Standard U.S. telephone formats. Allows an initial 1 long-distance designator and up to 5-digit extensions, optionally starting with x.</td>
</tr>
<tr>
<td>zipcode *</td>
<td>U.S. 5- or 9-digit ZIP code format ####-####. The separator can be a hyphen (-) or a space.</td>
</tr>
<tr>
<td>creditcard *</td>
<td>Strips blanks and dashes; verifies number using mod10 algorithm. The number must have 13–16 digits.</td>
</tr>
<tr>
<td>ssn or social_security_number *</td>
<td>US. Social Security number format, ###-##-####. The separator can be a dash (-) or a space.</td>
</tr>
<tr>
<td>email *</td>
<td>A valid e-mail address of the form <a href="mailto:name@server.domain">name@server.domain</a>. ColdFusion validates the format only; it does not check that entry is a valid active e-mail address.</td>
</tr>
<tr>
<td>URL *</td>
<td>A valid URL pattern; supports http, https, ftp file, mailto, and news URLs.</td>
</tr>
<tr>
<td>guid *</td>
<td>A unique identifier that follows the Microsoft/DCE format, xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx, where x is a hexadecimal number.</td>
</tr>
<tr>
<td>uuid *</td>
<td>A universally unique identifier (UUID) that follows the ColdFusion format, xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxxxxxx, where x is a hexadecimal number.</td>
</tr>
<tr>
<td>regex or regular_expression *</td>
<td>Matches the value against a regular expression specified in a pattern attribute. Valid in HTML and XML format only; ignored in Flash format.</td>
</tr>
</tbody>
</table>
Note: For more details on how ColdFusion handles data when it does onServer and hidden field validation, see “Validating form data using hidden fields” on page 565.

The following validation types can only be used in `cfinput` tags:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>maxlength</code></td>
<td>Limits the input to a maximum number of characters specified by a <code>maxlength</code> attribute.</td>
</tr>
<tr>
<td><code>noblanks</code></td>
<td>Does not allow fields that consist only of blanks. ColdFusion uses this validation only if the <code>required</code> attribute is <code>true</code>.</td>
</tr>
<tr>
<td><code>SubmitOnce</code></td>
<td>Used only with <code>cfform submit</code> and <code>image</code> types; prevents the user from submitting the same form multiple times before until the next page loads. Use this attribute, for example, to prevent a user from submitting an order form a second time before getting the confirmation for the initial order, and thereby making a duplicate order. Valid in HTML and XML format only; ignored in Flash format.</td>
</tr>
</tbody>
</table>

You can use the following validation types in `cfparam` and `cfargument` tags and the `isValid` function only:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>any</code></td>
<td>Any type of value</td>
</tr>
<tr>
<td><code>array</code></td>
<td>An array of values</td>
</tr>
<tr>
<td><code>binary</code></td>
<td>A binary value</td>
</tr>
<tr>
<td><code>query</code></td>
<td>A query object</td>
</tr>
<tr>
<td><code>string</code></td>
<td>A string value or single character</td>
</tr>
<tr>
<td><code>struct</code></td>
<td>A structure</td>
</tr>
<tr>
<td><code>variableName</code> *</td>
<td>A string formatted according to ColdFusion variable naming conventions.</td>
</tr>
</tbody>
</table>

**Validating form fields**

This section describes basic validation of form fields. Later sections in this chapter describe other validation types and techniques that you can use, including regular expression validation, masking, hidden field validation, JavaScript validation, and validation using CFML tags and functions.

In basic form field validation, you do the following:

- Use a `cfinput` or `cftextarea` tag.
- Specify a validation type, such as numeric, or multiple types.
- Optionally, specify an error message.
- Optionally, specify a validation technique. (By default, ColdFusion uses onSubmit validation.)

The following example specifies onBlur validation of a telephone number:

```
Phone: <cfinput type="text" name="HPhone"
    validateat="onBlur"
    validate="required,telephone"
    message="Please enter a standard U.S. telephone number with an optional extension, such as x12345">  
```
The following sections describe considerations for validation in `cfinput` and `cftextarea` tags, and show a more complete example.

**Validation type considerations**

**General considerations:** Consider the following issues when you determine how to validate form data:

- When you validate form data using onBlur, onSubmit, onServer, or hidden form field validation, you can specify one or more validation types for each field that you validate. For example, you can specify that a field entry is required and that it must be numeric. To specify multiple validation types for onSubmit, onBlur, or onServer validation, specify the type values in a comma-delimited list.

- If you use onBlur, onSubmit, or onServer type validation, you can specify only one error message for each field that you validate. If you use hidden field validation, you can create a custom message for each validation rule (with the exception of range checking).

- In the `cfinput` tag, most validation type attributes apply only to text or password fields.

**Validation algorithm differences:** The underlying validation code used when validating form data can differ depending on the validation technique and the form type. As a result, the algorithms used vary in some instances, including the following:

- The validation algorithms used for date/time values in onSubmit and OnBlur validation are different from those used for all server-side validation techniques.

- The algorithms used for onSubmit and OnBlur validation in Flash might vary from those used for HTML or XML format, and generally follow simpler rules.

For detailed information on the validation algorithms used for validation techniques used on the server, see "Validating form data using hidden fields" on page 565.

**Validating data in XML skinnable forms**

If you create an XML skinnable form and use any skin provided by Adobe, such as the basic.xsl or silver.xsl skin, you can use all form validation techniques that are available for HTML forms.

If you use a custom skin (XSL file), the available validation techniques depend on the skin. The `cf_webroot\CFIDE\scripts\xsl` directory contains a `_cfformvalidation.xsl` file that implements all ColdFusion HTML form validation techniques and supports onBlur, onSubmit, onServer, and hidden form field validation. XML skin writers can include this file in their skin XSLT to implement ColdFusion validation for their skin.

**Example: basic form validation**

The following form asks for information that might be used when registering a new user. It checks to make sure that the user enters required information. (Only the telephone number is optional.) It also checks to make sure that the telephone number and e-mail address are properly formatted and that the number to be used in a challenge question is in the proper range. This example performs onSubmit validation. It posts back to itself, and dumps the submitted results.

```cfc
<cfif IsDefined("form.fieldnames")>
  <cfdump var="#form#"><br>
</cfif>

<cfif name="myform" preservedata="Yes" >
  First Name: <cfinput type="text" size="15" name="firstname"
                    required="yes" message="You must enter a first name."><br>
```

```cfc
```
Handling invalid data

How you handle invalid data depends on the validation type. This section describes validation error-handling rules and considerations. For detailed information on error handling in ColdFusion, including invalid data handling, see “Handling Errors” on page 246.

1  For onBlur, onSubmit, or onServer validation, you can use the cfinput or cftextarea tag’s message attribute to specify a text-only error message to display. Otherwise, ColdFusion uses a default message that includes the name of the form field that was invalid. (For OnServer validation, you can customize this message, as described in “Handling form field validation errors” on page 252.) The following example displays an error message when the user enters an invalid e-mail address:

   E-mail: <cfinput type="text" size="25" name="email"
       validate="email" message="You must enter a valid e-mail address.">

2  For hidden form validation, you can specify a text-only error message in the hidden field’s value attribute. Otherwise, ColdFusion uses a default message that includes the name of the form field that was invalid. (You can customize this message, as described in “Handling form field validation errors” on page 252.) The following cfinput tag, for example, uses a hidden field validation to display an error message if the user enters an invalid address. (It uses onServer validation to display a different error message if the user fails to enter a number.)

   Telephone: <cfinput type="text" size="20" name="telephone"
       validateat="onServer" required="Yes"
       message="You must enter a telephone number">
      <cfinput type="hidden" name="telephone_cfformtelephone"
       value="The number you entered is not in the correct format.
       Use a number such as (617) 555-1212, 617-555-1212, or 617-555-1212 x12345">

   • For HTML and XML format forms (using ColdFusion skins), most ColdFusion form tags have an onError attribute that lets you specify a Javascript function to run if an onSubmit error occurs.

   • For the IsValid function, you write separate code paths to handle valid and invalid data. The following example shows a simplified case that displays an error message if the user entered an invalid e-mail address, or a different message if the address is valid:
<cfif IsValid("email", custEmail)>
    Thank you for entering a valid address.
    <!--- More processing would go here. --->
</cfif>
<cfelse>
    You must enter a valid e-mail address.<br>
    Click the Back button and try again.
</cfif>

3 For cfparam and cfargument tags, you use standard ColdFusion error-handling techniques. You can include the tag in a try block and use a catch block to handle the error, or you can use a custom error-handling page. The following example form action page code uses a custom error page, expresserr.cfm, to handle the error that the cfparam tag generates if a user submits a form with an invalid e-mail address:

```cferror type="EXCEPTION" exception="expression" template="expresserr.cfm">
<cfif IsDefined("form.fieldnames")>
    <cfparam name="form.custEmail" type="email">
    <!--- Normal form processing code goes here. --->
</cfif>
</cferror>

Masking form input values

The cfinput tag mask attribute controls the format of data that can be entered into a text or datefield input field. You can also use a mask attribute in the cfcalendar tag. You can combine masking and validation on a field.

- In HTML and Flash form format, a mask can control the format of data entered into a text field.
- In the cfcalendar tag, and, for Flash format forms, the datefield type cfinput field, a mask can control the format of the date that ColdFusion uses for the date a user chooses in the displayed calendar.

Note: The standard ColdFusion XML skins do not support masking.

Masking text input

In text fields, ColdFusion automatically inserts literal mask characters, such as - characters in telephone numbers. Users type only the variable part of the field. You can use the following characters to mask data:

<table>
<thead>
<tr>
<th>Mask character</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Allows an uppercase or lowercase character: A–Z and a–z.</td>
</tr>
<tr>
<td>X</td>
<td>Allows an uppercase or lowercase character or number: A–Z, a–z, and 0–9.</td>
</tr>
<tr>
<td>9</td>
<td>Allows a number: 0–9.</td>
</tr>
<tr>
<td>?</td>
<td>Allows any character.</td>
</tr>
<tr>
<td></td>
<td>All other characters Automatically inserts the literal character.</td>
</tr>
</tbody>
</table>

The following pattern enforces entry of a part number of the format EB-1234-c1-098765, where the user starts the entry by typing the first numeric character, such as 1. ColdFusion fills in the preceding EB prefix and all hyphen (-) characters. The user must enter four numbers, followed by two alphanumeric characters, followed by six numbers.

```cfinput type="text" name="newPart" mask="EB-9999-XX-999999" /

Note: You cannot force a user to type an A, X, 9, or question mark (?) character. To ensure that a pattern is all-uppercase or all-lowercase, use the ColdFusion UCase or LCase functions in the action page.
Masking cfcalendar and datefield input

In the cfcalendar tag and the Flash format datefield input control, you use the following masks to determine the format of the output. You can use uppercase or lowercase characters in the mask:

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Single- or double-digit day of month, such as 1 or 28</td>
</tr>
<tr>
<td>DD</td>
<td>Double-digit day of month, such as 01 or 28</td>
</tr>
<tr>
<td>M</td>
<td>Single- or double-digit month, such as 1 or 12</td>
</tr>
<tr>
<td>MM</td>
<td>Double-digit month, such as 01 or 12</td>
</tr>
<tr>
<td>MMM</td>
<td>Abbreviated month name, such as Jan or Dec</td>
</tr>
<tr>
<td>MMMM</td>
<td>Full month name, such as January or December</td>
</tr>
<tr>
<td>YY</td>
<td>Two-character year, such as 05</td>
</tr>
<tr>
<td>YYYY</td>
<td>Four-character year, such as 2005</td>
</tr>
<tr>
<td>E</td>
<td>Single-digit day of week, in the range 0 (Sunday)–6 (Saturday)</td>
</tr>
<tr>
<td>EEE</td>
<td>Abbreviated day of week name, such as Mon or Sun</td>
</tr>
<tr>
<td>EEEE</td>
<td>Full month day of week name, such as Monday or Sunday</td>
</tr>
</tbody>
</table>

The following pattern specifies that the Flash forms sends the date selected using a datefield input control to ColdFusion as text in the format 04/29/2004:

```html
<cfinput name="startDate" type="datefield" label="date:" mask="mm/dd/yyyy"/>
```

Validating form data with regular expressions

You can use regular expressions to match and validate the text that users enter in cfinput and cftextinput tags. Ordinary characters are combined with special characters to define the match pattern. The validation succeeds only if the user input matches the pattern.

Regular expressions let you check input text for a wide variety of custom conditions for which the input must follow a specific pattern. You can concatenate simple regular expressions into complex search criteria to validate against complex patterns, such as any of several words with different endings.

You can use ColdFusion variables and functions in regular expressions. The ColdFusion server evaluates the variables and functions before the regular expression is evaluated. For example, you can validate against a value that you generate dynamically from other input data or database values.

**Note:** The rules listed in this section are for JavaScript regular expressions, and apply to the regular expressions used in cfinput and cftextinput tags only. These rules differ from those used by the ColdFusion functions REFind, Replace, RFIndNoCase, and RFerplaceNoCase. For information on regular expressions used in ColdFusion functions, see "Using Regular Expressions in Functions" on page 107.

Special characters

Because special characters are the operators in regular expressions, in order to represent a special character as an ordinary one, you must escape it by preceding it with a backslash. For example, use two backslash characters (\) to represent a backslash character.
Single-character regular expressions

The following rules govern regular expressions that match a single character:

- Special characters are: + * ? . [ ^ $ ( ) { | \
- Any character that is not a special character or escaped by being preceded by a backslash (\) matches itself.
- A backslash (\) followed by any special character matches the literal character itself; that is, the backslash escapes the special character.
- A period (.) matches any character except newline.
- A set of characters enclosed in brackets ([]) is a one-character regular expression that matches any of the characters in that set. For example, “[akm]” matches an a, k, or m. If you include ] (closing square bracket) in square brackets, it must be the first character. Otherwise, it does not work, even if you use \].
- A dash can indicate a range of characters. For example, [a-z] matches any lowercase letter.
- If the first character of a set of characters in brackets is the caret (^), the expression matches any character except those in the set. It does not match the empty string. For example: “[^akm]” matches any character except a, k, or m.
- The caret loses its special meaning if it is not the first character of the set.
- You can make regular expressions case insensitive by substituting individual characters with character sets; for example, “[Nn][Ii][Cc][Kk]” is a case-insensitive pattern for the name Nick (or NICK, or nick, or even nIcK).
- You can use the following escape sequences to match specific characters or character classes:

<table>
<thead>
<tr>
<th>Escape seq</th>
<th>Matches</th>
<th>Escape seq</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>\b</td>
<td>Backspace.</td>
<td>\s</td>
<td>Any of the following white space characters: space, tab, form feed, and line feed.</td>
</tr>
<tr>
<td>\b</td>
<td>A word boundary, such as a space.</td>
<td>\S</td>
<td>Any character except the white space characters matched by \s.</td>
</tr>
<tr>
<td>\B</td>
<td>A nonword boundary.</td>
<td>\t</td>
<td>Tab.</td>
</tr>
<tr>
<td>\cX</td>
<td>The control character Ctrl-x. For example, \cv matches Ctrl-v, the usual control character for pasting text.</td>
<td>\v</td>
<td>Vertical tab.</td>
</tr>
<tr>
<td>\d</td>
<td>A digit character [0-9].</td>
<td>\w</td>
<td>An alphanumeric character or underscore. The equivalent of [A-Za-z0-9_].</td>
</tr>
<tr>
<td>\D</td>
<td>Any character except a digit.</td>
<td>\W</td>
<td>Any character not matched by \w. The equivalent of [^A-Za-z0-9_].</td>
</tr>
<tr>
<td>\f</td>
<td>Form feed.</td>
<td>\n</td>
<td>Backreference to the nth expression in parentheses. See “Backreferences” on page 564.</td>
</tr>
<tr>
<td>\n</td>
<td>Line feed.</td>
<td>\octal</td>
<td>The character represented in the ASCII character table by the specified octal number.</td>
</tr>
<tr>
<td>\r</td>
<td>Carriage return.</td>
<td>\xhex</td>
<td>The character represented in the ASCII character table by the specified hexadecimal number.</td>
</tr>
</tbody>
</table>

Multicharacter regular expressions

Use the following rules to build a multicharacter regular expression:
• Parentheses group parts of regular expressions together into a subexpression that can be treated as a single unit. For example, "(ha)+" matches one or more instances of ha.

• A one-character regular expression or grouped subexpression followed by an asterisk (*) matches zero or more occurrences of the regular expression. For example, "[a-z]x*" matches zero or more lowercase characters.

• A one-character regular expression or grouped subexpression followed by a plus sign (+) matches one or more occurrences of the regular expression. For example, "[a-z]+" matches one or more lowercase characters.

• A one-character regular expression or grouped subexpression followed by a question mark (?) matches zero or one occurrences of the regular expression. For example, "xy?z" matches either xyz or xz.

• The carat (^) at the beginning of a regular expression matches the beginning of the field.

• The dollar sign ($) at the end of a regular expression matches the end of the field.

• The concatenation of regular expressions creates a regular expression that matches the corresponding concatenation of strings. For example, "[A-Z][a-z]*" matches any capitalized word.

• The OR character (\|) allows a choice between two regular expressions. For example, "jell(y|ies)" matches either jelly or jellies.

• Braces ({}) indicate a range of occurrences of a regular expression. You use them in the form "\{m, n\}" where m is a positive integer equal to or greater than zero indicating the start of the range and n is equal to or greater than m, indicating the end of the range. For example, "\{ba\}{0,3}" matches up to three pairs of the expression ba. The form "\{m,\}" requires at least m occurrences of the preceding regular expression. The form "\{m\}" requires exactly m occurrences of the preceding regular expression. The form "\{,n\}" is not allowed.

Backreferencing
Backreferencing lets you match text in previously matched sets of parentheses. A slash followed by a digit n (\n) refers to the nth parenthesized subexpression.

One example of how you can use backreferencing is searching for doubled words; for example, to find instances of "the the" or "is is" in text. The following example shows backreferencing in a regular expression:

```
(\b[A-Za-z]+)\s+\1
```

This code matches text that contains a word that is repeated twice; that is, it matches a word, (specified by the \b word boundary special character and the "[A-Za-z]+") followed by one or more spaces (specified by "\s+"), followed by the first matched subexpression, the first word, in parentheses. For example, it would match "is is", but not "This is".

Exact and partial matches
ColdFusion validation normally considers a value to be valid if any of it matches the regular expression pattern. Often you might want to ensure that the entire entry matches the pattern. If so, you must “anchor” it to the beginning and end of the field, as follows:

• If a caret (^) is at the beginning of a pattern, the field must begin with a string that matches the pattern.

• If a dollar sign ($) is at the end of a pattern, the field must end with a string that matches the pattern.

• If the expression starts with a caret and ends with a dollar sign, the field must exactly match the pattern.

Expression examples
The following examples show some regular expressions and describe what they match:
Validating form data using hidden fields

ColdFusion lets you specify form field validation on the server by using hidden form fields whose names consist of the name of the field to validate and the validation type. Hidden field validation uses the same underlying techniques and algorithms as onServer validation of ColdFusion form fields.

Hidden field validation has the following features:

- You can use it with standard HTML tags. For example, you can validate data in an HTML input tag. This feature was particularly useful in releases prior to ColdFusion MX 7, because the cfinput tag did not support all HTML type attributes.
- It is backward-compatible with validation prior to ColdFusion MX 7, when hidden field validation was the only way to do validation on the server.
- Because you use a separate tag for each validation type, if you specify multiple validation rules for a field, you can specify a different error message for each rule.
- You can use hidden field validation with any form field type that submits a data value, not just input, cfinput, textarea, or cftextarea.

### Specifying hidden form field validation

To specify hidden field validation, you do the following:

- Create one HTML input element or CFML cfinput tag of type="hidden" for each validation rule.
- Specify the name of the field to validate as the first part of the hidden field name.
- Specify the type of validation, starting with an underscore character (_), as the second part of the hidden field name.
- You can specify multiple rules for each form data field. For example, to specify range and required validation for a field named myValue, create hidden myValue_cfformrange and myValue_cfformrequired fields.
- For most types of validation, specify the error message as the field value attribute.

### Table of Regular Expressions

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>?&amp;value=</td>
<td>Any string containing a URL parameter value.</td>
</tr>
<tr>
<td>^[A-Z]{1-9}[0-9]+$</td>
<td>An uppercase Windows directory path that is not the root of a drive and has only letters, numbers, and underscores in its text.</td>
</tr>
<tr>
<td>^(+)[-1-9]{0-9}+$</td>
<td>An integer that does not begin with a zero and has an optional sign.</td>
</tr>
<tr>
<td>^(+)[-1-9]{0-9}E(+)[-]+{0-9}+$</td>
<td>A real number.</td>
</tr>
<tr>
<td>a{2,4}</td>
<td>A string containing two to four occurrences of a: aa, aaa, aaaa; for example, aardvark, but not automatic.</td>
</tr>
<tr>
<td>{ba}{2,}</td>
<td>A string containing least two ba pairs; for example, Ali baba, but not Ali Baba.</td>
</tr>
</tbody>
</table>

**Note:** An excellent reference on regular expressions is *Mastering Regular Expressions* by Jeffrey E.F. Friedl, published by O'Reilly & Associates, Inc.
For range, maximum length, or regular expression validation, specify the rule, such as the maximum length, in the `value` attribute. For these validation types, you cannot specify a custom error message.

The following example uses hidden fields to require data in a date field and ensure that the field contains a date. It consists only of HTML tags.

```html
<input type="text" name="StartDate" size="16" maxlenght="16"><br>
<input type="hidden" name="StartDate_required" value="You must enter a start date.">
<input type="hidden" name="StartDate_date" value="Please enter a valid date as the start date.">
```

Use the following suffixes at the end of hidden form field names to specify the validation type. The type identifier always starts with an underscore. Several validation rules have two names you can use. The names that do not start with "cf" were used in earlier releases and are retained for backward compatibility. For consistency and clarity, Adobe recommends using the names that start with "cf" in new forms.

<table>
<thead>
<tr>
<th>Field name suffix</th>
<th>Verifies</th>
</tr>
</thead>
<tbody>
<tr>
<td>_integer, _cfforminteger</td>
<td>An integer of the range -2,147,483,648 — 2,147,483,647. Treats the initial characters &quot;$ ¥ £ +&quot; as valid input, but removes them from the number.</td>
</tr>
<tr>
<td>_cfformnumeric</td>
<td>Any numeric value. Treats the initial characters &quot;$ ¥ £ +&quot; as valid input, but does NOT remove them from the number.</td>
</tr>
<tr>
<td>_float, _cfformfloat</td>
<td>Any value (including an integer) that can be represented as a floating point number with up to 12 significant digits. Treats the initial characters &quot;$ ¥ £ +&quot; as valid input, but removes them from the number. Converts input data to a real number; for example a dump of an integer value on the action page includes a decimal point followed by a 0.</td>
</tr>
<tr>
<td>_range, _cfformrange</td>
<td>A numeric value within boundaries specified by the <code>value</code> attribute. Specify the range in the <code>value</code> attribute using the format &quot;min=minvalue max=maxvalue.&quot; You cannot specify a custom error message for this validation.</td>
</tr>
<tr>
<td>_date, _cfformdate</td>
<td>A date in any format that ColdFusion can understand; converts the input to ODBC date format. Allows entry of a time part, but removes it from the ODBC value.</td>
</tr>
<tr>
<td>_cfformusdate</td>
<td>A date in the form m/d/y, m-d-y, or m.d.y. The m and d format can be 1 or 2 digits; y can be 2 or 4 digits. Does not convert the string to an ODBC value and does not allow a time part.</td>
</tr>
<tr>
<td>_eurodate, _cfformeurodate</td>
<td>A date in the form d/m/y, d-m-y, or d.m.y. The m and d format can be 1 or 2 digits; y can be 2 or 4 digits. Converts the input to ODBC date format. Allows entry of a time part, but removes it from the ODBC value.</td>
</tr>
<tr>
<td>_time, _cfformtime</td>
<td>A time. Can be in 12-hour or 24-hour clock format, and can include seconds in the form hhmmscss or a case-independent am or pm indicator. Converts the input to ODBC time format. Allows entry of a date part, but removes it from the ODBC value.</td>
</tr>
<tr>
<td>_cfformcreditcard</td>
<td>After stripping blanks and dashes, a number that conforms to the mod10 algorithm. Number must have 13-16 digits.</td>
</tr>
<tr>
<td>_cfformSSN, _cfformsocial_security_number</td>
<td>A nine-digit Social Security number. Can be of the form xxx-xx-xxxx or xxx xx xxxx.</td>
</tr>
<tr>
<td>_cfformtelephone</td>
<td>Standard U.S. telephone formats. Does not support international telephone numbers. Allows area codes with or without parentheses, and hyphens (-), spaces, periods, or no separators between standard number groups. Can be preceded by a 1 long-distance designator, and can end with an up-to-5 digit extension, optionally starting with x. The area code and exchange must begin with a digit in the range 1 - 9.</td>
</tr>
<tr>
<td>_cfformzipcode</td>
<td>A 5-digit or 9-digit U.S. ZIP code. In 9-digit codes, the final four digits must be preceded by a hyphen (-) or space.</td>
</tr>
<tr>
<td>_cfformemail</td>
<td>A valid e-mail address. Valid address characters are a-zA-Z0-9-_ and the period and separator. There must be a single at sign (@) and the text after the @ character must include a period, as in <a href="mailto:my_address@MyCo.com">my_address@MyCo.com</a> or <a href="mailto:b-b.jones27@hisco.co.uk">b-b.jones27@hisco.co.uk</a>.</td>
</tr>
</tbody>
</table>
### Hidden form field considerations
Consider the following rules and recommendations when determining whether and how to use hidden form field validation:

- Use hidden field validation if you want to validate data from standard HTML input tags. The `cfinput` and `cftextarea` tags include a `validateAt` attribute that provides a simpler method for specifying server-side validation.
- Consider using hidden field validation with the `cfinput` and `cftextarea` tags if you specify multiple validation rules for a single field and want to provide a separate error message for each validation.
- Do not use the suffixes listed in the table as field names.
- Adding a validation rule to a field does not make it a required field. You must add a separate `_required` hidden field to ensure user entry.

#### Hidden form field example
The following procedure creates a simple form for entering a start date and a salary. It uses hidden fields to ensure that you enter data and that the data is in the right format.

This example uses a self-submitting form; the same ColdFusion page is both the form page and its action page. The page uses an `IsDefined` function to check that form data has been submitted. This way, the pages does not show any results until you submit the input. The form uses HTML tags only; you can substitute these tags with the CFML equivalents.

```html
<html>
<head>
    <title>Simple Data Form</title>
</head>
<body>
<h2>Simple Data Form</h2>

<!-- Form part. -->
<form action="datatest.cfm" method="Post">
    <input type="hidden" name="StartDate_cfformrequired"
```
When the user submits this form, ColdFusion scans the form fields to find any validation rules. It then uses the rules to analyze the user's input. If any of the input rules are violated, ColdFusion displays an error page with the error message that you specified in the hidden field's `value` attribute. The user must go back to the form, correct the problem, and resubmit the form. ColdFusion does not accept form submission until the user enters the entire form correctly.

Because numeric values often contain commas and currency symbols, ColdFusion automatically deletes these characters from fields with _cfforminteger and _cfformfloat rules before it validates the form field and passes the data to the form's action page. ColdFusion does not delete these characters from fields with _cfformnumeric rules.

**Reviewing the code**

The following table describes the code and its function:
Validating form input and handling errors with JavaScript

ColdFusion lets you write your own validation routines in JavaScript, and lets you create JavaScript error handlers.

Validating input with JavaScript

In addition to native ColdFusion input validation using the `validate` attribute of the `cfinput` and `cftextarea` tags, the following tags support the `onValidate` attribute, which lets you specify a JavaScript function to handle your `cform` input validation:

- `cfgrid`
- `cfinput`
- `cfslider`
- `cftextarea`
- `cftree`

ColdFusion passes the following arguments to the JavaScript function that you specify in the `onValidate` attribute:

- The form JavaScript DOM object
• The name attribute of the form element
• The value of the control to validate

For example, if you write the cfinput tag as the following:

```
<cfinput type="text"
  ...>
<!--- Do not include () in JavaScript function name. --->
onvalidate="handleValidation"
  ...>
```

You define the JavaScript function as the following:

```
<script>
<!--
function handleValidation(form_object, input_object, object_value) {
  ...
}
//-->
</script>
```

**Example: validating a password**

The following example validates a password. The password must have at least one of each of the following: an uppercase letter, a lowercase letter, and a number. It must be between 8 and 12 characters long. If the password is invalid, the browser displays a message box. If the password is valid, it redisplay the page with a brief success message.

**Use JavaScript to validate form data**

1. Create a ColdFusion page with the following content:

```
<html>
<head>
<title>JavaScript Validation</title>
<!--- JavaScript used for validation. --->
<script>
<!--
var anUpperCase = /[A-Z]/;
var aLowerCase = /[a-z]/;
var aNumber = /[0-9]/;
/* The function specified by the onValidate attribute.
Tests for existence of at least one uppercase, lowercase, and numeric
character, and checks the length for a minimum.
A maximum length test is not needed because of the cfinput maxlength
attribute. */
function testpasswd(form, ctrl, value) {
  if (value.length < 8 || value.search(anUpperCase) == -1 ||
      value.search(aLowerCase) == -1 || value.search(aNumber) == -1)
  {
    return (false);
  }
  else
  {
    return (true);
  }
</script>
<br />
```

Example: validating a password

The following example validates a password. The password must have at least one of each of the following: an uppercase letter, a lowercase letter, and a number. It must be between 8 and 12 characters long. If the password is invalid, the browser displays a message box. If the password is valid, it redisplay the page with a brief success message.

**Use JavaScript to validate form data**

1. Create a ColdFusion page with the following content:

```
<html>
<head>
<title>JavaScript Validation</title>
<!--- JavaScript used for validation. --->
<script>
<!--
var anUpperCase = /[A-Z]/;
var aLowerCase = /[a-z]/;
var aNumber = /[0-9]/;
/* The function specified by the onValidate attribute.
Tests for existence of at least one uppercase, lowercase, and numeric
character, and checks the length for a minimum.
A maximum length test is not needed because of the cfinput maxlength
attribute. */
function testpasswd(form, ctrl, value) {
  if (value.length < 8 || value.search(anUpperCase) == -1 ||
      value.search(aLowerCase) == -1 || value.search(aNumber) == -1)
  {
    return (false);
  }
  else
  {
    return (true);
  }
</script>
<br />
```
//-->
</script>
</head>

<body>
<h2>JavaScript validation test</h2>
<!--- Form is submitted only if the password is valid. --->
<cfif IsDefined("Form.passwd1")>
<p>Your Password is valid.</p>
</cfif>
<p>Please enter your new password:</p>
<cfform name="UpdateForm" preservedata="Yes">
<!--- The onValidate attribute specifies the JavaScript validation function. The message attribute is the message that appears if the validation attribute returns False. --->
<cfinput type="password" name="passwd1" required="YES" onValidate="testpasswd"
message="Your password must have 8-12 characters and include uppercase and lowercase letters and at least one number."
size="13" maxlength="12">
<input type="Submit" value="Update...">
</cfform>
</body>
</html>

2 Save the page as validjs.cfm.
3 View the validjs.cfm page in your browser.

Handling failed validation
The onError attribute lets you specify a JavaScript function to execute if an onValidate, onBlur or onSubmit validation fails. For example, if you use the onValidate attribute to specify a JavaScript function to handle input validation, you can also use the onError attribute to specify a JavaScript function to handle a failed validation (that is, when onValidate returns a False value). If you use the onValidate attribute, you can also use the onError attribute to specify a JavaScript function that handles the validation errors. The following cfform tags support the onError attribute:
  • cfgrid
  • cfinput
  • cfselect
  • cfslider
  • cftextinput
  • cftree
ColdFusion passes the following JavaScript objects to the function in the onError attribute:
  • The JavaScript form object
  • The name attribute of the form element
  • The value that failed validation
  • The error message text specified by the CFML tag's message attribute
The following example shows a form that uses an `onError` attribute to tell ColdFusion to call a `showErrorMessage` JavaScript function that uses the `alert` method to display an error message. The function assembles the message from the invalid value and the contents of the `cfinput` tag’s `message` attribute.

```html
<!--- The JavaScript function to handle errors.--->
<script>
  <!---
  function showErrorMessage(form, ctrl, value, message) {
    alert("The value " + value +" of the " + ctrl + " field " + message);
  }
  //-->
</script>

<!--- The form.--->
<form>
  <!--- A minimum quantity is required and must be a number.--->
  Minimum Quantity: <input type="Text" name="MinQuantity"
onError="showErrorMessage" validate="numeric" required="Yes"
message="is not a number." />

  <!--- A maximum quantity is optional, but must be a number if supplied.--->
  Maximum Quantity: <input type="Text" name="MaxQuantity"
onError="showErrorMessage" validate="numeric"
message="is not a number." />
</form>

Validating data with the `IsValid` function and the `cfparam` tag

The `IsValid` function and `cfparam` tag validate any ColdFusion variable value, not just forms variables. Because they reside entirely on the ColdFusion server, they can provide a secure mechanism for ensuring that the required validation steps get performed. Users cannot evade any of the checks by modifying the form data that gets submitted. These techniques also provide greater flexibility in how you respond to user errors, because you can use full CFML syntax in your error-handling code.

These two validation techniques operate as follows:

- The `IsValid` function tests the value of a ColdFusion variable. If the value is valid, it returns True; if the value is invalid, it returns False.
- The `cfparam` tag with a `type` attribute tests the value of a ColdFusion value for validity. If the value is valid, it does nothing; if the value is invalid, it throws a ColdFusion expression exception.

You can use either technique interchangeably. The one you choose should depend on your coding style and programming practices. It can also depend on the specific information that you want to display if an error occurs.

**Example: IsValid function validation**

The following example checks whether a user has submitted a numeric ID and a valid e-mail address and phone number. If any of the submitted values does not meet the validation test, the page displays an error message.

```html
<!--- Action code. First make sure the form was submitted.--->
```
<cfif isDefined("form.saveSubmit")>
    <cfif isInteger(form.UserID) and isEq(form.emailAddr) and isTelephone(form.phoneNo)>
        <cfoutput>
            <!--- Application code to update the database goes here --->
            <h3>The e-mail address and phone number for user #Form.UserID# have been added</h3>
        </cfoutput>
    </cfifelse>
    <h3>Please enter a valid user ID, phone number, and e-mail address.</h3>
</cfifelse>
</cfif>

<!--- The form. --->
<cfform action="#CGI.SCRIPT_NAME#">
    User ID: <cfinput type="Text" name="UserID"><br>
    Phone: <cfinput type="Text" name="phoneNo"><br>
    E-mail: <cfinput type="Text" name="emailAddr"><br>
    <cfinput type="submit" name="saveSubmit" value="Save Data"><br>
</cfform>

Examples: cfparam tag validation
The following two examples use cfparam tags to do the same tests as in the "Example: IsValid function validation" on page 572. They check whether a user has submitted a numeric ID and a valid e-mail address and phone number. If any of the submitted values does not meet the validation test, ColdFusion throws an expression exception.

In the first example, the error is handled by the exprerr.cfm page specified in the cferror tag. In this case, if the user made multiple errors, ColdFusion lists only one.

In the second example, each invalid field is handled in a separate try/catch block. In this case, the user gets information about each error.

Using an error-handling page
The self-posting form and action page looks as follows:

<!--- Action part of the page. --->
<!--- If an expression exception occurs, run the exprerr.cfm page. --->
<cferror type="EXCEPTION" exception="expression" template="exprerr.cfm">
    <!--- Make sure the form was submitted. --->
    <cfif isDefined("form.saveSubmit")>
        <!--- Use cfparam tags to check the form field data types. --->
        <cfparam name="form.UserID" type="integer">
        <cfparam name="form.emailAddr" type="email">
        <cfparam name="form.phoneNo" type="telephone">
        <!--- Application code to update the database goes here. --->
        <cfoutput>
            <h3>The e-mail address and phone number for user #Form.UserID# have been added</h3>
        </cfoutput>
    </cfifelse>
</cfif>

<!--- The form. --->
<cfform action="#CGI.SCRIPT_NAME#">
    User ID: <cfinput type="Text" name="UserID"><br>
    Phone: <cfinput type="Text" name="phoneNo"><br>
    E-mail: <cfinput type="Text" name="emailAddr"><br>
    <cfinput type="submit" name="saveSubmit" value="Save Data"><br>
The expresserr.cfm page looks as follows:

```cfoutput>
You entered invalid data.<br>
Please click the browser Back button and try again<br>
#cferror.RootCause.detailMessage#
</cfoutput>
```

**Using cftry and cfcatch tags**

The self-posting form and action page looks as follows:

```cftag lang="cfm">
<!--- Use a Boolean variable to indicate whether all fields are good. --->
<cfset goodData="Yes">
<!--- Make sure the form was submitted. --->
<cfif isDefined("form.saveSubmit")>
<!--- The cftry block for testing the User ID value. --->
<cftry>
<!--- The cfparam tag checks the field data types. --->
<cfparam name="form.UserID" type="integer">
<!--- If the data is invalid, ColdFusion throws an expression exception. --->
<!--- Catch and handle the exception. --->
<cfcatch type="expression">
<!--- Set the data validity indicator to False. --->
<cfset goodData="No">
<cfoutput>
Invalid user ID.<br>
#cfcatch.detail#<br>
</cfoutput>
</cfcatch>
</cftry>
<!--- The cftry block for testing the e-mail address value. --->
<cftry>
<cfparam name="form.emailAddr" type="email">
<cfcatch type="expression">
<cfset goodData="No">
<cfoutput>
Invalid e-mail address.<br>
#cfcatch.detail#<br>
</cfoutput>
</cfcatch>
</cftry>
<!--- The cftry block for testing the telephone number value. --->
<cftry>
<cfparam name="form.phoneNo" type="telephone">
<cfcatch type="expression">
<cfset goodData="No">
<cfoutput>
Invalid telephone number.<br>
#cfcatch.detail#<br>
</cfoutput>
</cfcatch>
</cftry>
<!--- Do this only if the validity indicator was not set to False in a validation catch block. --->
<cfif goodData>
<!--- Application code to update the database goes here. --->
<cfoutput>
<h3>The e-mail address and phone number for user #Form.UserID# have been added</h3>
</cfoutput>
```
<cfoutput>
</cfif> <!-- goodData is True--->
</cfif> <!-- Form was submitted. --->

<cfform action="#CGI.SCRIPT_NAME#" preservedata="Yes">
    User ID: <cfinput type="Text" name="UserID"><br>
    Phone: <cfinput type="Text" name="phoneNo"><br>
    E-mail: <cfinput type="Text" name="emailAddr"><br>
    <cfinput type="submit" name="saveSubmit" value="Save Data"><br>
</cfform>
Chapter 32: Creating Forms in Flash

You can create effective forms in Adobe Flash format, in which ColdFusion displays forms using Flash, not HTML. This chapter describes Flash forms and how they differ from HTML forms, and discusses how to create Flash forms.

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About Flash forms

ColdFusion can deliver forms to the client in Flash (SWF) file format. ColdFusion automatically generates the Flash binary from your CFML code and displays it on the client. Flash forms have the following advantages over HTML forms:

- They are browser-independent. Flash Player works in all commonly used browsers on Windows and Macintosh systems, and in Netscape and Mozilla on Linux.
- By default, they present a modern, visually pleasing appearance, and you can apply predefined color skins or customize the appearance with specifications similar to those in a Cascading Style Sheet (CSS).
- They let you develop complex, multipart forms that do not require multiple pages, by using tabbed or accordion-style dialog boxes.
- They automatically do much of the layout work for you.

Note: Flash form configuration requirements differ from ColdFusion requirements. For example, Flash forms might not work with all J2EE servers supported by ColdFusion. For more information, see Installing and Using ColdFusion.

In addition to creating Flash forms, ColdFusion lets you specify Flash format for cfcalendar, cftree, and cfgrid tags. Use these tags to embed Flash calendar choosers, trees, and grids in HTML forms, to eliminate the need to use Java applets. This chapter does not specifically discuss using Flash grids and trees in HTML forms; however, the information in this chapter about grids and trees also applies to these elements.

A Flash form example

Flash forms provide many features that help you quickly create easy-to-use, professional-looking, complex forms. The following image contains a two-tab form that shows many of these features:
This form includes the following features:

- Each tab contains a different section of the overall form, and users can enter data on both tabs before submitting the form. This technique can eliminate the need for multiple forms on multiple HTML pages.
- The first and last names are required fields, indicated by the red asterisks.
- The Flash form automatically fills the e-mail field with data from the name fields, but the user can override this information.
- When the user selects the date field, a calendar automatically opens for picking the date.

**Flash form CFML differences from HTML forms**

Because ColdFusion sends a Flash form to the client in SWF format, everything inside a Flash form is rendered by Flash. Rendering the form in Flash has several effects:

- Plain text and HTML tags in the body of a Flash Form have no effect.
- You must specify all form content inside CFML tags that support Flash forms.
- ColdFusion provides two tags that let you take advantage of Flash features and perform tasks that you would otherwise do in HTML: you use the \texttt{cfformitem} tag to add text blocks and horizontal and vertical rules to your form, and you use the \texttt{cfformgroup} tag to structure your form.
- Standard ColdFusion forms tags, such as \texttt{cfinput} and \texttt{cftree}, include attributes that work only with Flash forms, and attribute values that let you specify form style and behavior. These include the \texttt{skin} attribute with many Flash-specific \texttt{style} attribute values for appearance, and the \texttt{bind} attribute for filling a field value with data from other fields.

The reference pages for the individual tags in the *CFML Reference* describe the form tags and their features, indicating which attributes and values work with Flash forms. This chapter describes how you can use CFML tags to build effective Flash forms.
Building Flash forms

You build Flash forms using standard ColdFusion form tags, plus the cfformgroup and cfformitem tags. These tags create the elements of the form, as follows:

- The cfform, cfformgroup, cfformitem, cfformgroup, and cfformitem tags create controls for data display and user input.
- The cfformitem tag lets you add formatted or unformatted text, spacers, and horizontal and vertical rules without using HTML.
- The cfformgroup tag creates containers, such as horizontally aligned boxes or tabbed navigators, that let you group, organize, and structure the form contents.

Flash forms follow a hierarchical structure of containers and children.

1. The cfform tag is the master container, and its contents are child containers and controls.
2. The cfformgroup tag defines a container that organizes its child elements.
3. All other tags create individual controls, including display elements such as rules.

For example, the image in the About Flash forms section has the following hierarchical structure of containers and children. (This outline only shows the structure of the page that is visible in the image. It omits the structure of the Preferences tab.)

```
1 cfform
 2 cfformgroup type="tabnavigator" -- Tab navigator container
 3 cfformgroup type="page" -- Tabbed page container, child of tabnavigator
 4 cfformgroup type="horizontal" -- Aligns its two children horizontally
 5 cfinput type="text" -- First name input control
 5 cfinput type="spacer" -- Space between the name input controls
 5 cfinput type="text" -- Last name input control
 4 cfformitem type="hrule" -- Displays a rule
 4 cfformitem type="html" -- Displays formatted text
 4 cfinput type="text" -- E-mail input control
 4 cfformitem type="hrule" -- Displays a rule
 4 cfinput type="text" -- Phone number input control
 4 cfinput type="spacer" -- Space between the phone and date controls
 4 cfinput type="datefield" -- Date input control
 3 cfinput type="page" -- Second tabbed page container for preferences

1 cfformgroup type="horizontal" -- Follows the tabnavigator in the form
2 cfinput type="submit" -- Submit button control
3 cfinput type="reset" -- Reset button control
```

The following sections describe how you use the various Flash form elements to build a Flash form.

Adding text, images, rules, and space with the cfformitem tag

Because Flash forms do not support inline HTML, you use the cfformitem tag to add text blocks and horizontal and vertical rules to your form. (Flash form controls, such as cfinput, use the label or value attribute to specify text labels.) You can also use the cfformitem tag to add spacers between visual form elements.

The cfformitem type="hrule" and cfformitem type="vrule" tags put horizontal and vertical rules in the form. You can specify the rule thickness, color, and shadow characteristics by using style specifications. For more information on specifying rule styles, see "Styles for cfformitem with hrule or vrule type attributes" on page 1296 in "ColdFusion Flash Form Style Reference" on page 1287 in the CFML Reference.
The `cfformitem type="spacer"` tag puts a blank space of the specified height and width on the form. This tag type does not use styles; it can be useful in improving the form appearance by helping you control the form layout.

The `cfformitem type="text"` tag lets you insert plain text in the form. You can use the `style` attribute to apply a consistent format to the text.

The `cfformitem type="html"` tag lets you insert formatted text and images in the form. You can include basic HTML-style formatting tags in the body of this tag to add images and to format and style the text.

You can use the following formatting tags and attributes in the body of a `cfformitem type="html"` tag:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Valid attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td><code>href</code> URL to link to.</td>
</tr>
<tr>
<td></td>
<td><code>target</code> window name; can be a standard HTML window name such as <code>_blank</code>.</td>
</tr>
<tr>
<td>b</td>
<td>None.</td>
</tr>
<tr>
<td>br</td>
<td>None.</td>
</tr>
<tr>
<td>font</td>
<td><code>color</code> Must be in hexadecimal format, such as <code>#FF00AA</code>. Use a single number sign (<code>#</code>) character.</td>
</tr>
<tr>
<td></td>
<td><code>face</code> Can be a comma-delimited list of font face names; Flash uses the first font that is available on the client system.</td>
</tr>
<tr>
<td></td>
<td><code>size</code> In pixels; + and -relative values are allowed.</td>
</tr>
<tr>
<td>i</td>
<td>None.</td>
</tr>
<tr>
<td>img</td>
<td>See the attribute table for the <code>img</code> tag.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> You must close this tag with <code>/&gt;</code> or an <code>&lt;/img&gt;</code> tag.</td>
</tr>
<tr>
<td>li</td>
<td>None.</td>
</tr>
<tr>
<td>p</td>
<td><code>align</code> Must be one of the following: <code>left</code>, <code>right</code>, <code>center</code>.</td>
</tr>
<tr>
<td>textformat</td>
<td>See the attribute table for the <code>textformat</code> tag.</td>
</tr>
<tr>
<td>u</td>
<td>None.</td>
</tr>
</tbody>
</table>

The `img` tag supports the following attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>src</td>
<td>(Required) URL or pathname to a JPEG or SWF file. Images are not displayed until they have downloaded completely. Flash Player does not support progressive JPEG files.</td>
</tr>
<tr>
<td>width</td>
<td>Width of the image, in pixels.</td>
</tr>
<tr>
<td>height</td>
<td>Height of the image in pixels.</td>
</tr>
<tr>
<td>align</td>
<td>Horizontal alignment of the embedded image within the text field. Valid values are <code>left</code> and <code>right</code>. The default value is <code>left</code>.</td>
</tr>
<tr>
<td>hspace</td>
<td>Number of pixels of horizontal space that surround the image where no text appears. The default value is 8.</td>
</tr>
<tr>
<td>vspace</td>
<td>Number of pixels of vertical space that surround the image where no text appears. The default value is 8.</td>
</tr>
</tbody>
</table>

**Note:** Because of the Flash dynamic sizing rules, to ensure that the image displays properly, you might have to specify the `formitem tag height` attribute and the `width` and `height` attributes for the form or the containing `cformgroup` tag. Also, the image always displays on a new line, not inline with text, and text that follows the image in your code occupies any available space to the right of the image.

The `textformat` tag is specific to Flash, and has the following attributes:
For detailed descriptions of these tags, see the Flash documentation.

The following code creates a simple Flash form that consists of a formatted text area surrounded by horizontal rules:

```html
<cfform name="myform" height="220" width="400" format="Flash">
  <!--- Use text formitem tag with style specifications for the heading. --->
  <cfformitem type="text" style="fontWeight:bold; fontSize:14;">
    Flash form with formatted text and rules
  </cfformitem>
  <!--- The spacer adds space between the text and the rule --->
  <cfformitem type="spacer" height="2" />
  <cfformitem type="hrule" />
  <cfformitem type="html">
    <b><font color="#FF0000" size="+4" face="serif">
      This form has formatted text, including:
    </font></b><br>
    <textformat blockindent="20" leading="2">
      <li>colored text</li>
      <li><i>italic and bold text</i></li>
      <li>a bulleted list in an indented block</li>
    </textformat>
    <p><b>The text is preceded and followed by horizontal rules</b></p>
    It also has a link to a web page.
    <a href="http://www.adobe.com/" target="_blank">
      This link displays the Adobe home page in a new browser window
    </a>
  </cfformitem>
  <cfformitem type="spacer" height="2" />
  <cfformitem type="hrule" />
</cfform>
```

This form appears as follows:

---

**Flash form with formatted text and rules**

**This form has formatted text, including:**
- colored text
- italic and bold text
- a bulleted list in an indented block

**The text is preceded and followed by horizontal rules**
It also has a link to a web page.
**This link displays the Macromedia home page in a new browser window**
Using the cfformgroup tag to structure forms

ColdFusion provides form group container types that provide basic structure to a Flash form. You specify these types in the type attribute of the cfformgroup tag. Use the following container types to control the layout of controls and groups of controls:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>horizontal</td>
<td>Arranges individual controls horizontally, and optionally applies a label to the left of the controls. Use only for arranging ColdFusion form controls, including cfformitem controls. As a general rule, do not use to organize cfformgroup containers; use the hbox attribute instead. If you put other cfformgroup tags inside a horizontal form group, the controls inside the included cfformgroup do not align with other controls in the horizontal group.</td>
</tr>
<tr>
<td>vertical</td>
<td>Arranges individual controls vertically, and optionally applies a label to the left (not top) of the controls. Use only for groups of ColdFusion form controls, including cfformitem controls. As a general rule, do not use to organize cfformgroup containers; use the vbox attribute instead. If you put other cfformgroup tags inside a vertical form group, the controls inside the included cfformgroup tag do not align with other controls in the vertical group.</td>
</tr>
<tr>
<td>hbox</td>
<td>Arranges groups of controls horizontally. Does not apply a label. Use this attribute value to arrange other cfformgroup containers. This tag does not enforce alignment of child controls that have labels, so you should not use it to align individual controls.</td>
</tr>
<tr>
<td>vbox</td>
<td>Arranges groups of controls vertically. Does not apply a label. Use this attribute value to arrange other cfformgroup containers. This tag does not enforce alignment of child controls that have labels, so you should not use it to align individual controls.</td>
</tr>
<tr>
<td>hdividedbox</td>
<td>Arranges two or more children horizontally, and puts divider handles between the children that users can drag to change the relative sizes of the children. Does not apply a label. The direct children of an hdividedbox container must be cfformgroup tags with type attributes other than horizontal or vertical.</td>
</tr>
<tr>
<td>vdividedbox</td>
<td>Arranges two or more children vertically, and puts divider handles between the children that users can drag to change the relative sizes of the children. Does not apply a label. The direct children of a vdividedbox container must be cfformgroup tags with type attributes other than horizontal or vertical.</td>
</tr>
<tr>
<td>tile</td>
<td>Arranges its children in a rectangular grid in row-first order. Does not apply a label.</td>
</tr>
<tr>
<td>panel</td>
<td>Consists of a title bar containing the label attribute text, a border, and a content area with vertically arranged children.</td>
</tr>
<tr>
<td>accordion</td>
<td>Puts each of its child pages in an accordion pleat with a label bar. Displays the contents of one pleat at a time. Users click the labels to expand or contract the pleat pages. Does not apply a label.</td>
</tr>
<tr>
<td>tabnavigator</td>
<td>Puts each of its children on a tabbed page. Users click the tabs to display a selected page. Does not apply a label.</td>
</tr>
<tr>
<td>page</td>
<td>The immediate child of an accordion or tab navigator container. Specifies the label on the pleat bar or tab, and arranges its child containers and controls vertically.</td>
</tr>
</tbody>
</table>

For more information on using the accordion, tabnavigator, and page cfformgroup types, see “Creating complex forms with accordion and tab navigator containers” on page 584.

Example: structuring with the cfformgroup tag

The following example shows a form with an hdividedbox container with two vbox containers. The left box uses a horizontal container to arrange two radio buttons. The right box uses a tile container to lay out its check boxes. You can drag the divider handle to resize the two boxes. When you submit the form, the ColdFusion page dumps the Form scope to show the submitted data.

```cfc
<cfif Isdefined("Form.fieldnames")>
<cfdump var="#form#" label="form scope">
<br><br>
</cfif>

<cfform name="myform" height="200" width="460" format="Flash" skin="HaloBlue">
```
Controlling sizes in Flash forms

Sizing elements in a Flash form is something of an art, rather than a science. As a general rule, if you don't specify the height and width attributes, Flash tends to do a good job of laying out the form. However, keep in mind the following considerations:

- If you do not specify the height and width attributes in the cfform tag, Flash reserves the full dimensions of the visible browser window, if the form is not in a table, or the table cell, if the form is in a table, even if they are not required for the form contents. Any HTML output that precedes or follows the form causes the output page to exceed the size of the browser window.

- If you do not specify the height or width of a control, including a form group, Flash adjusts the dimensions, trying to fit the controls in the available space. For example, Flash often extends input boxes to the width of the containing control, if not otherwise specified.
In general, it is best to use the following process when you design your Flash form.

**Determine the sizes of a Flash form and its controls**

1. When you first create the form, don't specify any `height` and `width` attributes on the form or its child tags. Run the form and examine the results to determine height and width values to use.

2. Specify `height` and `width` attributes in the `cfform` tag for the desired dimensions of the form. You can specify absolute pixel values, or percentage values relative to the size of the containing window.

3. Specify any `height` or `width` attributes on individual tags. These values must be in pixels.

4. Repeat step 3 for various tags, and possibly step 2, until your form has a pleasing appearance.

**Repeating Flash form elements based on query data**

The `repeater` `cfformgroup` type tells Flash Player to iterate over a query and create a set of the `cfformgroup` tag's child controls for each row in the query. For each set of child controls, `bind` attributes in the child tags can access fields in the current query row. This `cfformgroup` type lets you create Flash forms where the number of controls can change based on a query, without requiring ColdFusion to recompile the Flash SWF file for the form. This significantly enhances server performance.

*Note:* For more information on binding data, see "Binding data in Flash forms" on page 586.

 Optionally, you can specify a start row and a maximum number of rows to use in the `repeater`. Unlike most ColdFusion tags, `repeater` index values start at 0, not 1. To specify a repeater that starts on the first line of the query object and uses no more than 15 rows, use a tag such as the following:

```
<cfformgroup type="repeater" query="q1" startrow="0" maxrows="15">
```

One example that might use a repeater is a form that lets a teacher select a specific class and update the student grades. Each class can have a different number of students, so the form must have a varying number of input lines. Another example is a shopping cart application that displays the product name and quantity ordered and lets users change the quantity.

The following example uses the `cfformgroup` tag with a `repeater` type attribute value to populate a form. It creates a query, and uses the repeater to iterate over a query and create a firstname and lastname input box for each row in the query.

```cfc
<cfif IsDefined("Form.fieldnames")>
  <cfdump var="#form#" label="form scope">
  <br><br>
</cfif>
<cfform>
  <cfscript>
    q1 = queryNew("id,firstname,lastname");
    queryAddRow(q1);
    querySetCell(q1, "id", "1");
    querySetCell(q1, "firstname", "Rob");
    querySetCell(q1, "lastname", "Smith");
    queryAddRow(q1);
    querySetCell(q1, "id", "2");
    querySetCell(q1, "firstname", "John");
    querySetCell(q1, "lastname", "Doe");
    queryAddRow(q1);
    querySetCell(q1, "id", "3");
    querySetCell(q1, "firstname", "Jane");
    querySetCell(q1, "lastname", "Doe");
    queryAddRow(q1);
    querySetCell(q1, "id", "4");
```
Creating complex forms with accordion and tab navigator containers

The accordion and tabnavigator attributes of the cfformgroup tag let you construct complex forms that would otherwise require multiple HTML pages. With accordions and tab navigator containers, users can switch among multiple entry areas without submitting intermediate forms. All data that they enter is available until they submit the form, and all form elements load at one time.

An accordion container puts each logical form page on an accordion pleat. Each pleat has a label bar; when the user clicks a bar, the current page collapses and the selected page expands to fill the available form space. The following image shows a three-pleat accordion, open to the middle pleat, Preferences:

A tab navigator container puts each logical form page on a tabbed frame. When the user clicks a tab, the selected page replaces the previous page. The image in About Flash forms shows a tab navigator container.

The following example generates a two-tab tab navigator container that gets contact information and preferences. You can change it to an accordion container by changing the type attribute of the first cfformgroup tag from accordion to tabnavigator. To prevent the accordion from having scroll bars, you must also increase the cfform tag height attribute to 310 and the tabnavigator tag height attribute to 260.

```cfc
<cfform name="myform" height="285" width="480" format="Flash" skin="HaloBlue">
  <cfformgroup type="tabnavigator" height="240" style="marginTop: 0">
    <cfformgroup type="page" label="Contact Information">
    ...
    </cfformgroup>
  </cfformgroup>
</cfform>
```
<!--- Align the first and last name fields horizontally. --->
<cfformgroup type="horizontal" label="Your Name">
  <cfinput type="text" required="Yes" name="firstName" label="First"
      value="" width="100"/>
  <cfinput type="text" required="Yes" name="lastName" label="Last"
      value="" width="100"/>
</cfformgroup>
<cfformitem type="hrule" />
<cfformitem type="HTML"><textformat indent="95"><font size="-2">
Flash fills this field in automatically.
You can replace the text.
</font></textformat>
</cfformitem>

<!--- The bind attribute gets the field contents from the firstName
and lastName fields as they get filled in. --->
<cfinput type="text" name="email" label="email"
      bind="{firstName.text}.{lastName.text}@mm.com">
<cfformitem type="spacer" height="3" />
<cfformitem type="hrule" />
<cfformitem type="spacer" height="3" />
<cfinput type="text" name="phone" validate="telephone" required="no"
      label="Phone Number">
<cfinput type="datefield" name="mydate1" label="Requested date">
</cfformgroup>
</cfformgroup type="page" label="Preferences" style="marginTop: 0">
<cfformitem type="html" height="20">
  b>Tell us your preferences</b>
</cfformitem>

<!--- Put the pet selectors to the left of the fruit selectors. --->
<cfformgroup type="hdividedbox" >

<!--- Group the pet selector box contents, aligned vertically. --->
<cfformgroup type="VBox"height="130">
  <cfformitem type="text" height="20">
    Pets:
  </cfformitem>
  <cfformgroup type="vertical" height="80">
    <cfinput type="Radio" name="pets" label="Dogs" value="Dogs" checked>
    <cfinput type="Radio" name="pets" label="Cats" value="Cats">
  </cfformgroup>
</cfformgroup>
</cfformgroup>

<!--- Group the fruit selector box contents, aligned vertically. --->
<cfformgroup type="VBox" height="130">
  <cfformitem type="text" height="20">
    Fruits:
  </cfformitem>
  <cfformgroup type="tile" height="80" width="190" label="Tile box">
    Flsh requires unique names for all controls. --->
    <cfinput type = "Checkbox" name="chk1" Label="Apples" value="Apples">
    <cfinput type="Checkbox" name="chk2" Label="Bananas" value="Bananas">
    <cfinput type="Checkbox" name="chk3" Label="Pears" value="Pears">
    <cfinput type="Checkbox" name="chk4" Label="Oranges" value="Oranges">
    <cfinput type="Checkbox" name="chk5" Label="Grapes" value="Grapes">
</cfformgroup>
Binding data in Flash forms

The bind attribute lets you set the value of the fields using the contents of other form fields. You can use the bind attribute with the cftextarea tag and any cfinput type that takes a value, including hidden. This data binding occurs dynamically as the user enters data within Flash on the client system. Flash does not send any information to ColdFusion until the user submits the form. To use the bind attribute to specify the field value, use the following formats:

<table>
<thead>
<tr>
<th>Data source</th>
<th>bind attribute format</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfinput type = &quot;text&quot; or cftextarea</td>
<td>bind=&quot;{sourceName.text}&quot;</td>
</tr>
<tr>
<td>selected radio button</td>
<td>bind=&quot;{sourceName.selectedData}&quot;</td>
</tr>
<tr>
<td>cftree selected item</td>
<td>bind=&quot;{sourceName.selectedNode.getProperty('data').value}&quot;</td>
</tr>
<tr>
<td>cfgrid selected item</td>
<td>bind=&quot;{sourceName.selectedItem.COLUMNAME}&quot;</td>
</tr>
<tr>
<td>cfselect selected item</td>
<td>bind=&quot;{sourceName.selectedItem.data}&quot;</td>
</tr>
</tbody>
</table>

**Note:** If you use the bind attribute, you cannot use the value attribute.

The following rules and techniques apply to the binding formats:

- The sourceName value in these formats is the name attribute of the tag that contains the element that you are binding to.
- You can bind to additional information about a selected item in a tree. Replace value with display to get the displayed value, or with path to get the path to the node in the tree.
- You can bind to the displayed value of a cfselect item by replacing data with label.
- If the user selects multiple items in a cfselect control, the selectedItem object contains the most recent selection, and a selectedItems array contains all selected items. You can access the individual values in the array, as in myTree.selectedItems[1].data. The selectedItems array exists only if the user selects multiple items; otherwise, it is undefined.
- You can use ActionScript expressions in Flash bind statements.

The following example shows how to use the values from the firstName and lastName fields to construct an e-mail address. The user can change or replace this value with a typed entry.

```xml
<cfformgroup type="horizontal" label="Your Name">
  <cfinput type="text" required="Yes" name="firstName" label="First" value="" />
  <cfinput type="text" required="Yes" name="lastName" label="Last" value="" />
</cfformgroup>
```
Setting styles and skins in Flash forms

ColdFusion provides the following methods for controlling the style and appearance of Flash forms and their elements:

**Skins:** provide a simple method for controlling the overall appearance of your form. A single skin controls the entire form.

**Styles:** provide a finer-grained level of control than skins. Each style specifies a particular characteristic for a single control. Many styles are also inherited by a control's children.

You can use both techniques in combination: you can specify a skin for your form and use styles to specify the appearance (such as input text font) of individual controls.

The following sections describe these methods and how you can use them. For detailed information on the style names and values that you can use, see “ColdFusion Flash Form Style Reference” on page 1287 in the CFML Reference.

**Controlling form appearance with Flash skins**

The `cfform` tag takes a `skin` attribute, which lets you select an overall appearance for your form. The skin determines the color used for highlighted and selected elements.

You can select the following Flash skins:

- haloBlue
- haloGreen (the default)
- haloOrange
- haloSilver

**About Flash form styles**

The ColdFusion Flash form tags have a `style` attribute that lets you specify control characteristics using CSS syntax. You can specify a `style` attribute in the following tags:

- `cfform`
- `cfformgroup`
- `cfcalendar`
- `cfformitem`, types `hrule` and `vrule`
- `cfgrid`
- `cfinput`
- `cfselect`
- `cftextarea`
- `cftree`
The attributes for the `cfform` and `cfformgroup` generally apply to all the form or form group’s children.

Flash supports many, but not all, standard CSS styles. ColdFusion Flash forms only support applying specific CSS style specifications to individual CFML tags and their corresponding Flash controls and groups. You cannot use an external style sheet or define a document-level style sheet, as you can for HTML format forms.

**Flash form style specification syntax**

To specify a Flash style, use the following format:

```html
style="stylename1: value; stylename2: value; ..."
```

For example, the following code specifies three style values for a text input control:

```html
<cfinput type="text" name="text2" label="Last"
  style="borderStyle:inset; fontSize:12; backgroundColor:##FFEEFF">
```

**About Flash form style value formats**

Style properties can be Boolean values, strings, numbers, or arrays of these values. The following sections describe the formats for length, time, and color values.

**Length format**

You specify styles that take length or dimension values, including font sizes, in pixels.

The `fontSize` style property lets you use a set of keywords in addition to numbered units. You can use the following keywords when you set the `fontSize` style property. The exact sizes are defined by the client browser.

- `xx-small`
- `x-small`
- `small`
- `medium`
- `large`
- `x-large`
- `xx-large`

The following `cfinput` tag uses the `style` attribute with a `fontSize` keyword to specify the size of the text in the input box:

```html
<cfinput type="text" name="text1" style="fontSize:X-large" label="Name">
```

**Time format**

You specify styles that take time values, such as the `openDuration` style that specifies how fast an accordion pleat opens, in milliseconds. The following example shows an `accordion` tag that takes one-half second to change between accordion pleats:

```html
<cfformgroup type="accordion" height="260" style="openDuration: 500">
```

**Color format**

You define color values, such as those for the `backgroundColor` style, in the following formats:
Some styles support only the hexadecimal color format.

Some controls accept multiple colors. For example, the tree control’s `depthColors` style property can use a different background color for each level in the tree. To assign multiple colors, use a comma-delimited list, as the following example shows:

```
style="depthColors: ##EAEAEA, ##FF22CC, ##FFFFFF"
```

### About Flash form style applicability and inheritance

Because of the way Flash control styles are implemented, some common styles are valid, but have no effect, in some tags. Therefore, in the table in “Styles valid for all controls” on page 1288 in “ColdFusion Flash Form Style Reference” on page 1287 in the CFML Reference, the listed styles do not cause errors when used in controls, but might not have any effect.

Styles can be inheritable or noninheritable. If a style is noninheritable, it only affects the tag, and does not affect any of its children. For example, to maintain a consistent background color in an `hbox` form group and its children tags, you must specify the color in all tags. If a style is inheritable, it applies to the tag and its children.

### Example: applying styles to a Flash form

The following form uses a skin and styles to control its appearance:

The code for the form is as follows. Comments in the code explain how formatting controls and styles determine the appearance.

```cfc
<!--- Specify the form height and width, use the HaloBlue skin.
Note: Flash ignores a backgroundColor style set in cfform. --->
<cfform name="myform" height="390" width="440" format="Flash" skin="HaloBlue">
```
Using ActionScript in Flash forms

ActionScript 2 is a powerful scripting language that is used in Flash and other related products and is similar to JavaScript. You can use a subset of ActionScript 2 code in your Flash forms.
The following sections tells you how to include ActionScript in your Flash forms, and describes restrictions and additions to ActionScript that apply to ColdFusion Flash forms. It does not provide information on writing ActionScript. For details on ActionScript and how you can use it, see the Flash ActionScript 2 documentation, including the documents available in the Flash and Flex sections of LiveDocs at http://www.adobe.com/support/documentation/.

**Using ActionScript code in CFML**

You can use ActionScript in the following attribute of tags in CFML Flash format forms:

- Form and control events, such as the `onSubmit` attribute of the `cfform` tag, or the `onChange` and `onClick` attributes of the `cfinput` tag. The attribute description on the tag reference pages in the CFML Reference list the event attributes.

- Bind expressions, which you can use to set field values. For more information on binding data, see “Binding data in Flash forms” on page 586.

Your ActionScript code can be inline in the form attribute specification, you can make a call to a custom function that you define, or you can use the ActionScript `include` command in the attribute specification to get the ActionScript from a .as file.

The following example shows a simple Fahrenheit to Celsius converter that does the conversion directly on the client, without requiring the user to submit a form to the ColdFusion server.

```cfml
<cfform format="flash" width="200" height="150">
  <cfinput type="text" name="fahrenheit" label="Fahrenheit" width="100" value="68">
  <cfinput type="text" name="celsius" label="Celsius" width="100">
  <cfinput type="button" name="convert" value="Convert" width="100"
    onClick="celsius.text = Math.round((fahrenheit.text-32)/1.8*10)/10">
</cfform>
```

*Note:* You do not use the `text` property (for example, `fieldname.text`) to access hidden fields. To access a hidden field, use the format `formname.fieldname = 'value'`.

**Custom ActionScript functions**

Custom ActionScript functions are the equivalent of CFML UDFs. You can define your own functions in ColdFusion by using the `cfformitem` tag with a `type` attribute value of `script`, or you can define the functions in an ActionScript (.as) file. Also, ColdFusion includes a small number of predefined custom ActionScript functions that you can use in your Flash form controls.

You can use the following custom functions in the ActionScript for all form controls to reset or submit the form:

- `resetForm()`
- `submitForm()`

You can use the following custom functions in `cfgrid` tags only to insert and delete rows in the grid:

- `GridData.insertRow(gridName)`
- `GridData.deleteRow(gridName)`

The following example shows how you can use the two GridData functions to add custom buttons that add and delete rows from a Flash form. These buttons are equivalent to the buttons that ColdFusion creates if you specify `insert="yes"` and `delete="yes"` in the `cfgrid` tag, but they allow you to specify your own button text and placement. This example puts the buttons on the side of the grid, instead of below it and uses longer than standard button labels.
You can edit this grid as follows:
<ul>
<li>To change an item, click the field and type.</li>
<li>To add a row, click the Insert Row button and type in the fields in the highlighted row.</li>
<li>To delete a row, click anywhere in the row and click the Delete Row button.</li>
</ul>
When you are done, click the submit button.

---

Best practices for Flash forms

The following sections describe best practices that can help you increase the performance of Flash forms.
Minimizing form recompilation

Flash forms are sent to the client as SWF files, which ColdFusion must compile from your CFML code. The following techniques can help limit how frequently ColdFusion must recompile a Flash form.

- Only data should be dynamic. Whenever a variable name changes, or a form characteristic, such as an element width or a label changes, the Flash output must be recompiled. If a data value changes, the output does not need to be recompiled.

- Use `<cfformgroup type="repeater">` if you must loop no more than ten times over no more than ten elements. This tag does not require recompiling when the number of elements changes. It does have a processing overhead that increases with the number of loops and elements, however, so for large data sets or many elements, it is often more efficient not to use the repeater.

Caching data in Flash forms

The `<cfform>` tag `timeout` attribute specifies how many seconds ColdFusion retains Flash form data on the server. When a Flash form is generated, the values for the form are stored in memory on the server. When the Flash form is loaded on the client, it requests these form values from the server. If this attribute is 0, the default, the data on the server is immediately deleted after the data has been requested from the Flash form.

A Flash form can be reloaded multiple times if a user displays a page with a Flash form, goes to another page, and uses the browser Back button to return to the page with the form. This kind of behavior is common with search forms, login forms, and the like. When the user returns to the original page:

- If the `timeout` value is 0, or the time-out period has expired, the data is no longer available, and ColdFusion returns a data-expired exception to the browser; in this case, the browser typically tells the user to reload the page.

- If the time-out has not expired, the browser displays the original data.

If your form data contains sensitive information, such as credit card numbers or social security numbers, you should leave the time-out set to 0. Otherwise, consider setting a time-out value that corresponds to a small number of minutes.

Using Flash forms in a clustered environment

Flash forms require sticky sessions when used in a cluster.
Chapter 33: Creating Skinnable XML Forms

You can create XML skinnable forms, which are forms that generate XForms-compliant XML and are normally formatted using an XSLT (extensible stylesheet language transformations) skin.

You can use XML skinnable forms with the skins that ColdFusion provides without having any knowledge of either XML or XSLT. For information on using XML with ColdFusion, see "Using XML and WDDX" on page 865.

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About XML skinnable forms

A ColdFusion form with a format="XML" attribute is an XML skinnable form. When ColdFusion processes an XML skinnable form, it generates the form as XML. By default, it applies an XML Stylesheet Language Transform (XSLT) skin to the XML and generates a formatted HTML page for display on the user's browser. Optionally, you can specify an XSLT file, or you can process the raw XML in your ColdFusion page.

By using XML skinnable forms, you can control the type and appearance of the forms that ColdFusion generates and displays. ColdFusion provides a set of standard skins, including a default skin that it uses if you do not specify another skin (or tell it not to apply a skin). You can also create your own XSLT skin and have ColdFusion use it to give your forms a specific style or appearance.

ColdFusion forms and XForms

ColdFusion skinnable forms conform to and extend the W3C XForms specification. This specification provides an XML syntax for defining interactive forms using a syntax that is independent of form appearance. ColdFusion forms tags include attributes that provide information that does not correspond directly to the XForms model, such as appearance information, validation rules, and standard HTML attributes. ColdFusion skinnable forms retain this information in XForms extensions so that an XSL transformation can use the values to determine appearance or do other processing.

For more information on XML structure of ColdFusion skinnable forms, see “ColdFusion XML format” on page 599.

The role of the XSLT skin

An XSLT skin and associated cascading style sheet (CSS) determine how an XML skinnable form is processed and displayed, as follows:

- The XSLT skin tells ColdFusion how to process the XML, and typically converts it to HTML for display. The skin specifies the CSS style sheet to use to format the output.
- The CSS style sheet specifies style definitions that determine the appearance of the generated output.
XSLT skins give you extensive freedom in the generated output. They let you create a custom appearance for your forms, or even different appearances for different purposes. For example, you could use the same form in an intranet and on the Internet, and change only the skin to give a different appearance (or even select different subsets of the form for display). You can also create skins that process your form for devices, such as wireless mobile devices.

**How ColdFusion processes XML skinnable forms**

When ColdFusion processes a `cfform` tag that specifies XML format and an XSLT skin, it does the following to the form:

1. Converts the CFML form tags into an XForms-compliant XML text format and makes it available in a variable with the same name as the form. ColdFusion ignores in-line text or HTML tags in the form, and does not pass them to the XML. (It does process HTML `option` tags that are children of a `cfselect` tag.)
2. Applies an XSLT skin to the XML; for example, to convert the form into HTML. The XSLT file specifies the CSS style sheet.
3. Returns the resulting, styled, form to the client, such as a user's browser.

If you omit the `cfform` tag `skin` attribute, ColdFusion uses a default skin.

If you specify `skin="none"`, ColdFusion performs the first step, but omits the remaining steps. Your application must handle the XML version of the form as needed. This technique lets you specify your own XSL engine, or incorporate the form as part of a larger form.

**ColdFusion XSL skins**

ColdFusion provides the following XSL skins:

- basic
- basiccss
- basiccss_top
- beige
- blue
- default
- lightgray
- red
- silver

The XSLT skin files are located in the `cf_webroot\CFIDE\scripts\xsl` directory, and the CSS files that they use for style definitions are located in the `cf_webroot\CFIDE\scripts\css` directory.

The default skin and the basic skin format forms identically. ColdFusion uses the default skin if you do not specify a `skin` attribute in the `cfform` tag. The default and basic skins are simple skins that use tables for arranging the form contents. The basic skin uses `div` and `span` tags to arrange the elements. The skins with names of colors are similar to the basic skin, but make more use of color.

**Example: a simple skinnable form**

The following image shows a simple XML skinnable form that uses the default skin to format the output:
Building XML skinnable forms

You build ColdFusion XML skinnable forms using standard ColdFusion forms tags, including cfformgroup and cfformitem tags. These tags create the elements of the form, the building blocks of the form.

ColdFusion converts the following tags to XML for processing by the XSLT:

- Standard ColdFusion form data control tags: The cfgrid, cfinput, cfselect, cfslider, cftextarea, and tree tags specify the controls that the form displays.
- cfformitem tags: Add individual items to your form, such as text or rules. The valid types depend on the skin.
- cfformgroup tags: Group, organize, and structure the form contents. The valid types depend on the skin.

These tags are designed so you can develop forms in a hierarchical structure of containers and children. Using this model, the cfform tag is the master container, and its contents are children containers and controls. Each cfformgroup tag defines a container that organizes its child elements.

The specific tags and attributes that you use in your form depend on the capabilities of the XSLT skin. You use only the tag and attribute combinations that the skin supports. If you are using a skin provided by a third party, make sure that the supplier provides information on the supported attributes.

Using standard ColdFusion form tags

You use standard ColdFusion form tags, such as cfinput or cftree, as you normally do in standard CFML forms to generate form input elements. ColdFusion maps most of these tags and their subtags (such as option tags in the cfselect tag) to equivalent XForms elements. ColdFusion maps applet and Flash format cfgrid and cftree tags to ColdFusion XML extensions that contain Java applet or Flash objects. It converts XML format cfgrid and cftree tags to ColdFusion XML extension.

The specific attributes you can use and their meanings can depend on the skins.

Using ColdFusion skins: The skins that are supplied with ColdFusion support the attributes that you can use with HTML forms. You can also use label attributes to provide labels for the following tags:

- cfinput with type attribute values of text, button, password, and file
Using other skins: If you use any other skin, some attributes might not be supported, or the skin might support custom attributes. Get the information about the supported attributes from the XSLT skin developer.

Using cfformitem tags
ColdFusion does not process inline text or standard HTML tags when it generates an XML form; therefore, you use the cfformitem tag to add formatted HTML or plain text blocks and any other display elements, such as horizontal and vertical rules, to your form.

ColdFusion converts all cfformitem type attribute values to all-lowercase. For example, if you specify type="MyType" ColdFusion converts the type name to "mytype".

ColdFusion makes no other limitations on the cfformitem type attributes that you can use in a form, but the XSLT skin must process the attributes to display the items.

Using ColdFusion skins: The skins provided in ColdFusion support the following cfformitem types:

- hrule
- text
- html

The hrule type inserts an HTML hr tag, and the text type displays unformatted plain text.

The html type displays HTML-formatted text. You can include standard HTML text markup tags, such as strong, p, ul, or li, and their attributes. For example, the following text from the Example: a simple skinnable form section shows how you could use a cfformitem tag to insert descriptive text in a form:

```xml
<cfformitem type="html">
  <b>We value your input</b>.<br>
  <em>Please tell us a little about yourself and your thoughts.</em>
</cfformitem>
```

Using other skins: If you use any other skin, the supported attributes and attribute values depend on the skin implementation. Get the information about the supported attributes and attribute values from the XSLT skin developer.

Using cfformgroup tags
The cfformgroup tag lets you structure forms by organizing its child tags, for example, to align them horizontally or vertically. Some skins might use cfformgroup tags for more complex formatting, such as tabbed navigator or accordion containers. ColdFusion makes no limitations on the type attributes that you can use in a form, but the XSLT must process the resulting XML to affect the display.

Using ColdFusion skins: The skins provided in ColdFusion support the following type attribute values:

- horizontal
- vertical
- fieldset

The horizontal and vertical types arrange their child tags in the specified direction and place a label to the left of the group of children. The following text from the Example: a simple skinnable form section shows how you could use a cfformgroup tag to apply a Name label and align first and last name fields horizontally:
The `fieldset` type corresponds to the HTML `fieldset` tag, and groups its children by drawing a box around them and replacing part of the top line with legend text. To specify the legend, use the `label` attribute. To specify the box dimensions, use the `style` attribute with `height` and `width` values.

The following code shows a simple form group with three text controls. The `cfformgroup type="vertical"` tag ensures that the contents of the form is consistently aligned. The `cfformgroup type="horizontal"` aligns the `firstname` and `lastname` fields horizontally.

```cfml
<cfform name="comments" format="xml" skin="basiccss" width="400" preservedata="Yes"
    cfformgroup type="fieldset" label="Contact Information">
    <cfformgroup type="vertical">
        <cfformgroup type="horizontal" label="Name">
            <cfinput type="text" size="20" name="firstname" required="yes">
            <cfinput type="text" size="25" name="lastname" required="yes">
        </cfformgroup>
        <cfinput type="text" name="email" label="E-mail" validation="email">
    </cfformgroup>
</cfformgroup>
</cfformgroup>
</cfform>
```

**Note:** Because XML is case-sensitive, but ColdFusion is not, ColdFusion converts `cfformgroup` and `cfformitem` attributes to all-lowercase letters. For example, if you specify `cfformgroup type="Random"`, ColdFusion converts the type to `random` in the XML.

**Using other skins:** If you use any other skin, the supported attributes and attribute values depend on the skin implementation. Get the information about the supported attributes and attribute values from the skin developer.

**Example: CFML for a skinnable XML form**

The following CFML code creates the form shown in the image in "About XML skinnable forms" on page 594. It shows how you can use CFML to structure your form.

```cfml
<cfform name="comments" format="xml" skin="basiccss" width="400" preservedata="Yes">
    <cfinput type="hidden" name="revision" value="12a">
    <cfformgroup type="fieldset" label="Basic Information">
        <cfformgroup type="vertical">
            <cfformgroup type="horizontal" label="Name">
                <cfinput type="text" size="20" name="firstname" required="yes">
                <cfinput type="text" size="25" name="lastname" required="yes">
            </cfformgroup>
            <cfinput type="text" name="email" label="E-mail" validate="email" maxlength="35">
            <cfselect name="satisfaction" style="width:120px" multiple="false" label="Satisfaction">
                <option selected>very satisfied</option>
                <option>somewhat satisfied</option>
                <option>somewhat dissatisfied</option>
                <option>very dissatisfied</option>
                <option>no opinion</option>
            </cfselect>
        </cfformgroup>
    </cfformgroup>
    <cfformitem name="html1" type="html">
    <p><b>We value your input</b>.<br>
    <em>Please tell us a little about yourself and your thoughts.</em></p>
</cfformitem>
</cfform>
```
ColdFusion XML format

This section describes the XML generated from a ColdFusion `cfform` tag and its children. It provides a building block toward creating your own XSL skins.

**XML namespace use**

The XML that ColdFusion generates for forms uses elements and attributes in several XML *namespaces*. Namespaces are named collections of names that help ensure that XML names are unique. They often correspond to a web standard, a specific document type definition (DTD), or a schema. In XML, the namespace name and a colon (:) precede the name of the tag that is defined in that namespace; for example `xf:model` for the XForms namespace `model` tag.

ColdFusion uses several standard XML namespaces defined by the World Wide Web Consortium (W3C). These namespaces correspond to specifications for standard XML dialects such as XHTML, XForms and XML Events. ColdFusion XML forms also use a custom namespace for skinnable forms XML extensions. The following table lists the namespaces in the XML that ColdFusion generates.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>URL</th>
<th>Used for</th>
</tr>
</thead>
<tbody>
<tr>
<td>html</td>
<td><a href="http://www.w3.org/1999/xhtml">http://www.w3.org/1999/xhtml</a></td>
<td>Form tag information, including action, height, width, and name. XHTML compliant.</td>
</tr>
<tr>
<td>xf</td>
<td><a href="http://www.w3.org/2002/xforms">http://www.w3.org/2002/xforms</a></td>
<td>XForms model (including initial field values) and XForms elements that correspond to <code>cfform</code> tags.</td>
</tr>
<tr>
<td>ev</td>
<td><a href="http://www.w3.org/2001/xml-events">http://www.w3.org/2001/xml-events</a></td>
<td>System events. Used for the <code>cfinput type=&quot;reset&quot;</code>.</td>
</tr>
<tr>
<td>cf</td>
<td>All ColdFusion extensions, including passthrough of attributes that do not correspond to XForms elements or attributes.</td>
<td></td>
</tr>
</tbody>
</table>

**XML structure**

For each CFML tag, ColdFusion converts attributes and element values to XML in the XForms `xf:model` element, or in individual control elements, such as the XForms `xf:input`, `xf:secret`, or `xf:group` elements.

ColdFusion generates XForms XML in the following format. The numbers on each line indicate the level of nesting of the tags.

```
1  form tag
2   XForms model element
3      XForms instance element
4         cf:data element
3      XForms submission element
3      XForms bind element
3      XForms bind element
3
```
The following sections describe the data model and the elements that make up the XForms document.

**Data model**

The XForms data model specifies the data that the form submits. It includes information on each displayed control that can submit data, including initial values and validation information. It does not contain information about `cfformgroup` or `cfformitem` tags. The data model consists of the following elements and their children:

- One `xf:instance` element
- One `xf:submission` element
- One `xf:bind` element for each form control that can submit data

**xf:instance element**

The XForms `xf:instance` element contains information about the form data controls. Any control that can submit data has a corresponding instance element. If the control has an initial value, the instance element contains that value.

The `xf:instance` element contains a single `cf:data` element that contains an element for each data control: `cfgrid`, most `cfinput` tag types, `cfselect`, `cfslider`, `cftextarea`, and `cftree`. Each element name is the corresponding CFML tag's `name` attribute. For applet and Flash format `cfgrid` and `cftree` tags, the element name is the value of the `cf_param_name` parameter of the tree or grid's Java applet object. Only `cfinput` tags of types `submit`, `image`, `reset`, and `button` do not have instance data, because they cannot submit data.

Each element's body contains the control data from the CFML tag's `value` attribute or its equivalent. For example, for a `cfselect` tag, the `xf:instance` element body is a comma-delimited list that contains the `name` attributes of all the `option` tags with a `selected` attribute. For `submit` and `image` buttons, the body contains the `name` attribute value.

The following example shows the `xf:instance` element for the form shown in the image in "About XML skinnable forms" on page 594:

```xml
<xf:instance>
  <cf:data>
    <firstname/>
    <lastname/>
    <email/>
    <revision>Comment Form revision 12a</revision>
    <satisfaction>very satisfied</satisfaction>
    <thoughts>We really want to hear from you!</thoughts>
  </cf:data>
</xf:instance>
```

**xf:submission element**

The `xf:submission` element specifies the action when the form is submitted, and contains the values of the `cf:form` `action` and `method` attributes.
The following example shows the XML for the form shown in the image in “About XML skinnable forms” on page 594:

```xml
<xf:submission action="/MyStuff/phase1/forms/XForms/FrameExamples/Figure1.cfm"
    method="post"/>
```

**xf:bind elements**

The `xf:bind` elements provide information about the input control behavior, including the control type and any data validation rules. The XML has one bind element for each instance element that can submit data. It does not have bind elements for controls such as `cfformitem` tags, or `cfinput` tags with submit, input, reset, or image types. Each element has the following attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>CFML tag attribute value</td>
</tr>
<tr>
<td>nodeset</td>
<td>XPath expression with the path in the XML to the instance element for the control</td>
</tr>
<tr>
<td>required</td>
<td>CFML tag attribute value</td>
</tr>
</tbody>
</table>

Each `xf:bind` element has an `xf:extension` element with ColdFusion specific information, including type and validation values. The following table lists the `cf` namespace elements that are used in this section:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cf:attribute name=&quot;type&quot;</code></td>
<td>Control type. One of the following:</td>
</tr>
<tr>
<td></td>
<td>CHECKBOX, FILE, IMAGE, PASSWORD, RADIO, SELECT, SUBMIT TEXT, CFSLIDER. The TEXT type is used for <code>cfinput</code> <code>type=&quot;text&quot;</code> and <code>cftextinput</code>.</td>
</tr>
<tr>
<td><code>cf:attribute name=&quot;onerror&quot;</code></td>
<td>JavaScript function specified by the control's <code>onError</code> attribute, if any.</td>
</tr>
<tr>
<td><code>cfargument name=&quot;maxlength&quot;</code></td>
<td>Value of the control's <code>maxlength</code> attribute, if any.</td>
</tr>
<tr>
<td><code>cf:validate type=&quot;validatationtype&quot;</code></td>
<td>Data validation information.</td>
</tr>
<tr>
<td></td>
<td>Has one attribute, <code>type</code>, the validation type, and one or more <code>cf:argument</code> and <code>cf:trigger</code> children. ColdFusion generates a <code>cf:validate</code> element for each of the following:</td>
</tr>
<tr>
<td></td>
<td>• <code>cfinput</code> or <code>cftextarea</code> <code>validation attribute</code></td>
</tr>
<tr>
<td></td>
<td>• <code>cfinput</code> or <code>cftextarea</code> <code>range attribute</code></td>
</tr>
<tr>
<td></td>
<td>• <code>cfslider</code>: the <code>range</code> and <code>message</code> attributes are specified by a <code>cf:validate</code> <code>type=&quot;range&quot;</code> <code>element</code></td>
</tr>
</tbody>
</table>
The following example shows the `xf:bind` element of the form shown in the image in “About XML skinnable forms” on page 594:

```xml
<xf:bind id="firstname"
    nodeset="//xf:model/xf:instance/cf:data/firstname"
    required="true()">
    <xf:extension>
        <cf:attribute name="type">TEXT</cf:attribute>
        <cf:attribute name="onerror">_CF_onError</cf:attribute>
    </xf:extension>
</xf:bind>

<xf:bind id="lastname"
    nodeset="//xf:model/xf:instance/cf:data/lastname"
    required="true()">
    <xf:extension>
        <cf:attribute name="type">TEXT</cf:attribute>
        <cf:attribute name="onerror">_CF_onError</cf:attribute>
    </xf:extension>
</xf:bind>

<xf:bind id="email"
    nodeset="//xf:model/xf:instance/cf:data/email" required="false()">
    <xf:extension>
        <cf:attribute name="type">TEXT</cf:attribute>
        <cf:attribute name="onerror">_CF_onError</cf:attribute>
    </xf:extension>
</xf:bind>

<xf:bind id="satisfaction"
    nodeset="//xf:model/xf:instance/cf:data/satisfaction"
    required="false()">
    <xf:extension>
        <cf:attribute name="type">SELECT</cf:attribute>
        <cf:attribute name="onerror">_CF_onError</cf:attribute>
    </xf:extension>
</xf:bind>
```
<xf:bind id="thoughts"
   nodeset="//xf:model/xf:instance/cf:data/thoughts" required="false()">
<xf:extension>
   <cf:attribute name="type">TEXT</cf:attribute>
   <cf:attribute name="onerror">_CF_onError</cf:attribute>
</xf:extension>
</xf:bind>

Control elements
The XML tags that follow the xf:bind element specify the form controls and their layout. The XML includes one element for each form control and cfformitem or cfformgroup tag.

CFML to XML tag mapping
ColdFusion maps CFML tags to XForms elements and ColdFusion extensions as the following table shows:

<table>
<thead>
<tr>
<th>CFML tag</th>
<th>XML tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfinput type=&quot;text&quot;</td>
<td>xfinput</td>
</tr>
<tr>
<td>cfinput type=&quot;password&quot;</td>
<td>xf:secret</td>
</tr>
<tr>
<td>cfinput type=&quot;hidden&quot;</td>
<td>None: instance data only</td>
</tr>
<tr>
<td>cfinput type=&quot;file&quot;</td>
<td>xf:upload</td>
</tr>
<tr>
<td>cfinput type=&quot;radio&quot;</td>
<td>xf:select1</td>
</tr>
<tr>
<td>cfinput type=&quot;checkbox&quot;</td>
<td>xf:select</td>
</tr>
<tr>
<td>cfinput type=&quot;button&quot;</td>
<td>xf:trigger</td>
</tr>
<tr>
<td>cfinput type=&quot;image&quot;</td>
<td>xf:submit</td>
</tr>
<tr>
<td>cfinput type=&quot;reset&quot;</td>
<td>xf:submit</td>
</tr>
<tr>
<td>cfinput type=&quot;submit&quot;</td>
<td>None: instance data only</td>
</tr>
<tr>
<td>cfselect multiple=&quot;false&quot;</td>
<td>xf:select1</td>
</tr>
<tr>
<td>cfselect multiple=&quot;true&quot;</td>
<td>xf:select</td>
</tr>
<tr>
<td>cftextarea</td>
<td>xf:textarea</td>
</tr>
<tr>
<td>cslider</td>
<td>xf:range</td>
</tr>
<tr>
<td>cfgrid</td>
<td>cf:grid</td>
</tr>
<tr>
<td>ctree</td>
<td>cf:tree</td>
</tr>
<tr>
<td>cfformitem type=&quot;text&quot;</td>
<td>xf:output</td>
</tr>
<tr>
<td>cfformitem type=&quot;html&quot;</td>
<td>xf:output</td>
</tr>
<tr>
<td>cfformitem type=&quot;*&quot;</td>
<td>xf:output appearance=&quot;*&quot;</td>
</tr>
<tr>
<td>cfformitem type=&quot;*&quot;</td>
<td>xf:output appearance=&quot;*&quot;</td>
</tr>
</tbody>
</table>

ColdFusion converts cfformitem tags with text and html type attributes to XForms output elements with the tag body in a <![CDATA[ section. It converts all other cfformitem tags to XForms group elements, and sets each element's appearance attribute to the cfformitem tag's type attribute. The XSLT must process these elements to produce meaningful output. For example, the ColdFusion default skin transform displays the xf:output text blocks and processes the xf:group appearance="hrule" element, but it ignores all other xf:group elements.
General control element structure
Each control element that can be represented by a standard XForms control element has the following general structure. (For information on XML element structure for cfformitem, cfformgroup, cfgrid, and cftree tags, see the following sections.)

```xml
<xf:tagname bind="bindid" id="bindid">
  <xf:label>label</xf:label>
  <xf:extension>
    <cf:attribute name="type">controltype</cf:attribute>
    <cf:attribute name="attribname">attribvalue</cf:attribute>
    .
  </xf:extension>
</xf:tagname>
```

The following table describes the variable parts of this structure:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>tagname</td>
<td>The xf or cf namespace element name, as identified in the table in &quot;CFML to XML tag mapping&quot; on page 603.</td>
</tr>
<tr>
<td>bindid</td>
<td>ID attribute of the model xf:bind element for this control. Specified by the control's CFML tag name attribute.</td>
</tr>
<tr>
<td>label</td>
<td>Control label text. Specified by one of the following:</td>
</tr>
<tr>
<td></td>
<td>• The CFML tag label attribute</td>
</tr>
<tr>
<td></td>
<td>• The value attribute of the radiobutton, submit, and reset cfinput tags</td>
</tr>
<tr>
<td></td>
<td>• The tag body content of cfselect option subtags,</td>
</tr>
<tr>
<td></td>
<td>• Not used for cfgrid and cftree tags.</td>
</tr>
<tr>
<td>controltype</td>
<td>Type of control. One of the following:</td>
</tr>
<tr>
<td></td>
<td>• The cfinput type attribute</td>
</tr>
<tr>
<td></td>
<td>• Select, slider, or textarea, for the cfselect, cfslider, or cftextarea tags, respectively.</td>
</tr>
<tr>
<td></td>
<td>• Not used for cfgrid and cftree tags.</td>
</tr>
<tr>
<td>attribname</td>
<td>Name of a CFML tag attribute. There is a cf:attribute tag for each attribute specified in the CFML code that does not otherwise have an entry in the XML.</td>
</tr>
<tr>
<td>attribvalue</td>
<td>Value of a CFML tag attribute.</td>
</tr>
</tbody>
</table>

Tag-specific element structure
The following sections describe tag-specific features of the XML for several types of input tags. It is not all-inclusive. For the specific structure of any ColdFusion form tag, see the XML generated from the tag by ColdFusion.

Selection tags
Tags that are used for selection, cfselect, cfinput type="radio", and cfinput type="checkbox" are converted to XForms select and select1 elements. These elements include an xf:choices element, which in turn has an xf:item element for each item a user can choose. Each item normally has an xf:label element and an xf:value element. Check boxes have a single item; select and radio button controls have more than one.

The following example shows the CFML code for a group of two radio buttons, followed by the generated XML control elements. This example also shows the use of a cfformgroup tag to arrange and label the radio button group.

CFML
```xml
<cfformgroup type="horizontal" label="Accept?">
  <cfinput type = "Radio" name = "YesNo" value = "Yes" checked>
```
<cfformgroup>
<cfinput type="Radio" name="YesNo" value="No">
</cfformgroup>

XML
<xf:group appearance="horizontal">
<xf:label>Accept?</xf:label>
<xf:extension />
<xf:select1 appearance="full" bind="YesNo" id="YesNo">
<xf:extension>
<cf:attribute name="type">radio</cf:attribute>
</xf:extension>
<xf:choices>
<xf:item>
<xf:label>Yes</xf:label>
<xf:value>Yes</xf:value>
<xf:extension>
<cf:attribute name="checked">checked</cf:attribute>
</xf:extension>
</xf:item>
<xf:item>
<xf:label>No</xf:label>
<xf:value>No</xf:value>
<xf:extension/>
</xf:item>
</xf:choices>
</xf:select1>
</xf:group>

cfgrid tags
ColdFusion represents a cfgrid tag using the cf:grid XML tag. This tag has four attributes: format, which can be Flash, Applet, or XML; and the id, name, and bind attributes, which all have the value of the cfgrid tag name attribute.

For applet and Flash format grids, ColdFusion inserts cfgrid controls in the XML as HTML embed objects in <![CDATA[]] sections in the body of a cf:grid tag. The controls can be Java applets or in SWF file format.

For XML format grids, ColdFusion converts the CFML to XML in the following format:
<cf:grid bind="gridname" name="gridname" format="xml" id="gridname">
<metadata>
<cfgridAttribute1>attributeValue</cfgridAttribute1>
...
(There are an entry for attributes with a specified or default value.)
</metadata>
<columns>
<column cfgridcolumnAttribute1="value" ...
</columns>
<rows>
<row>
<column1Name>row1Column1Value</column1Name>
<column2Name>row1Column2Value</column2Name>
...
</row>
<row>
<column1Name>row2Column1Value</column1Name>
<column2Name>row2Column2Value</column2Name>
</row>
...
</rows>
The following example shows a minimal grid with two nodes.

**CFML**

```cfml
<cfgrid name="mygrid" Format="xml" selectmode="Edit" width="350">
   <cfgridcolumn name="CorName" header="Course Name"/>
   <cfgridcolumn name="Course_ID" header="ID">
   <cfgridrow data="one0,two0">
   <cfgridrow data="one1,two1">
</cfgrid>

**XML**

Most metadata lines are omitted for brevity:

```xml
<cf:grid bind="mygrid" format="XML" id="mygrid" name="mygrid">
   <metadata>
      <autowidth>false</autowidth>
      <insert>false</insert>
      <sort>false</sort>
      <italic>false</italic>
      <bold>false</bold>
      <appendkey>true</appendkey>
      <highlughthref>true</highlughthref>
      <griddatalines>Left</griddatalines>
      <gridlines>true</gridlines>
      <rowheaders>true</rowheaders>
      <rowheaderalign>Left</rowheaderalign>
      <rowheaderitalic>false</rowheaderitalic>
      <rowheaderbold>false</rowheaderbold>
      <colheaders>true</colheaders>
      <colheaderalign>Left</colheaderalign>
      <colheaderitalic>false</colheaderitalic>
      <colheaderbold>false</colheaderbold>
      <selectmode>Edit</selectmode>
      <notsupported>&lt;b&gt; Browser must support Java to view ColdFusion Java Applets&lt;/b&gt;</notsupported>
      <picturebar>false</picturebar>
      <insertbutton>insert</insertbutton>
      <deletebutton>delete</deletebutton>
      <sortAscendingButton>SortAsc</sortAscendingButton>
      <sortDescendingButton>SortDesc</sortDescendingButton>
   </metadata>
   <columns>
      <column bold="false" display="true" header="Course Name" headerBold="false" headerItalic="false" italic="false" name="CorName" select="true"/>
      <column bold="false" display="true" header="ID" headerBold="false" headerItalic="false" italic="false" name="Course_ID" select="true"/>
   </columns>
   <rows>
      <row>
         <CorName>one0</CorName>
         <Course_ID>two0</Course_ID>
      </row>
      <row>
         <CorName>one1</CorName>
         <Course_ID>two1</Course_ID>
      </row>
   </rows>
</cf:grid>
The cftree tags

For applet and Flash format trees, ColdFusion inserts cftree controls in the XML as HTML embed objects in <! [CDATA [ sections in the tag body. The controls can be Java applets or in Flash SWF format. The cftree XML tag has two attributes: format, which can be Flash or Applet, and id.

For XML format trees, ColdFusion converts the CFML to XML in the following format:

cf:tree format="XML" id="treename">
    <metadata>
        <cf:treeAttribute1>attributeValue</cf:treeAttribute1>
        ...
    </metadata>
    <node cfml tree item attributes>
        <node //nested node with no children
            cfml tree item attributes />
        ...
    </node>
    ...
</cf:tree>

The following example shows a minimal tree with two nodes:

CFML
<cfform name="form2" Format="XML">
<cf:tree name="tree1" hscroll="No" vscroll="No" format="xml" border="No">
    <cftreeitem value="Divisions">
        <cftreeitem value="Development" parent="Divisions" img="folder"/>
    </cftreeitem>
</cf:tree>
</cfform>

XML
The following code shows only the XML that is related to the tree appearance:

<cf:tree format="xml" id="tree1">
    <metadata>
        <fontWeight/>
        <align/>
        <lookAndFeel>windows</lookAndFeel>
        <delimiter>\</delimiter>
        <completePath>false</completePath>
        <border>false</border>
        <hScroll>false</hScroll>
        <vScroll>false</vScroll>
        <appendKey>true</appendKey>
        <highlightHref>true</highlightHref>
        <italic>false</italic>
        <bold>false</bold>
    </metadata>
    <node display="Divisions" expand="true" href="" img=""
        imgOpen="" parent="" path="Divisions" queryAsRoot="true"
        value="Divisions">
    <node display="Development" expand="true" href=""
        img="folder" imgOpen="" parent="Divisions"
        path="Divisions\Development" queryAsRoot="true"
        value="Development"/>
The `cfformgroup` and `cfformitem` tags

All `cfformgroup` tags and all `cfformitem` tags, except `type="html"` and `type="text"`, generate `xf:group` elements. The following rules determine the element structure:

- The CFML tag `type` attribute determines the `xf:group appearance` attribute.
- ColdFusion converts `type` attribute values to all-lowercase characters.
- For `cfformgroup` tags only, the CFML `label` attribute determines the `xf:group label` attribute.
- All other CFML attributes are put in `cf:attribute` elements in a `xf:extension` element.
- The `cfformitem` tags generate an `xf:output` element with the body text in a `<![CDATA[` section.

The following example shows two `cfformitem` tags, and the resulting XML:

```xml
<xf:output>![CDATA[Please tell us a little about yourself and your thoughts.]]>
  <xf:extension>
    <cf:attribute name="style">color:green</cf:attribute>
  </xf:extension>
</xf:output>
<xf:group appearance="hrule">
  <xf:extension>
    <cf:attribute name="width">200</cf:attribute>
    <cf:attribute name="height">3</cf:attribute>
    <cf:attribute name="testattribute">testvalue</cf:attribute>
  </xf:extension>
</xf:group>
```

Example: control element XML

The following code shows the XML for the input controls for the form shown in the image in “About XML skinnable forms” on page 594. This code immediately follows the end of the `xf:model` element.

```xml
<xf:group appearance="horizontal">
  <xf:label name="/name">
    <xf:extension/>
  </xf:label>
  <xf:input bind="firstname" id="firstname">
    <xf:label>First</xf:label>
    <xf:extension>
      <cf:attribute name="type">text</cf:attribute>
      <cf:attribute name="size">20</cf:attribute>
    </xf:extension>
  </xf:input>
  <xf:input bind="lastname" id="lastname">
    <xf:label>Last</xf:label>
    <xf:extension>
      <cf:attribute name="type">text</cf:attribute>
      <cf:attribute name="size">25</cf:attribute>
    </xf:extension>
  </xf:input>
</xf:group>
```
<xf:input bind="email" id="email">
    <xf:label>Email</xf:label>
    <xf:extension>
        <cf:attribute name="type">text</cf:attribute>
        <cf:attribute name="validation">email</cf:attribute>
    </xf:extension>
</xf:input>

<xf:output>
    <![CDATA[<b>We value your input</b>. Please tell us a little about yourself and your thoughts.]]>
</xf:output>

<xf:group appearance="vertical">
    <xf:extension/>
    <xf:select1 appearance="minimal" bind="satisfaction" id="satisfaction">
        <xf:label>Satisfaction</xf:label>
        <xf:extension>
            <cf:attribute name="type">select</cf:attribute>
            <cf:attribute name="style">width:200</cf:attribute>
        </xf:extension>
        <xf:choices>
            <xf:item>
                <xf:label>very satisfied</xf:label>
                <xf:value>very satisfied</xf:value>
            </xf:item>
            <xf:item>
                <xf:label>somewhat satisfied</xf:label>
                <xf:value>somewhat satisfied</xf:value>
            </xf:item>
            <xf:item>
                <xf:label>somewhat dissatisfied</xf:label>
                <xf:value>somewhat dissatisfied</xf:value>
            </xf:item>
            <xf:item>
                <xf:label>very dissatisfied</xf:label>
                <xf:value>very dissatisfied</xf:value>
            </xf:item>
            <xf:item>
                <xf:label>no opinion</xf:label>
                <xf:value>no opinion</xf:value>
            </xf:item>
        </xf:choices>
    </xf:select1>
    <xf:textarea bind="thoughts" id="thoughts">
        <xf:label>Additional Comments</xf:label>
        <xf:extension>
            <cf:attribute name="type">textarea</cf:attribute>
            <cf:attribute name="rows">5</cf:attribute>
            <cf:attribute name="cols">40</cf:attribute>
        </xf:extension>
    </xf:textarea>
</xf:group>

<xf:group appearance="horizontal">
    <xf:submit id="submit" submission="comments">
        <xf:label>Tell Us</xf:label>
        <xf:extension>
            <cf:attribute name="type">submit</cf:attribute>
            <cf:attribute name="name">submit</cf:attribute>
        </xf:extension>
    </xf:submit>
Creating XSLT skins

You can create your own XSLT skins to process the XML that ColdFusion generates. You should be familiar with XSLT and CSS programming. This document does not provide general information on writing XSLT transformations or CSS styles. It does provide information about the following areas:

- How ColdFusion passes form attribute values to the XML file
- How to extend XSLT skins that ColdFusion provides as templates
- Basic techniques for extending the basic.xsl file to support additional `cfformgroup` and `cfformitem` tag type attributes
- How to extend the ColdFusion CSS files to enhance form appearance.

XSLT skin file locations

If you specify an XSLT skin by name and omit the .xsl extension, ColdFusion looks for the file in the `cfform` script source directory and its subdirectories. You can specify the script source directory in your `cfform` tag `scriptsrc` attribute, and you can set a default location on the Settings page in the ColdFusion Administrator. When you install ColdFusion, the default location is set to `/CFIDE/scripts/` (relative to the web root).

You can also use a relative or absolute file path, or a URL, to specify the XSLT skin location. ColdFusion uses the CFML page's directory as the root of relative paths. The following formats are valid:

<table>
<thead>
<tr>
<th>Format</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfform format=&quot;xml&quot; skin=&quot;basic&quot;&gt;</code></td>
<td>Searches for XML/CSS in the default directory and its subdirectories.</td>
</tr>
<tr>
<td><code>&lt;cfform format=&quot;xml&quot; skin=&quot;c:\foo\bar\basic.xsl&quot;&gt;</code></td>
<td>Uses the absolute path.</td>
</tr>
<tr>
<td><code>&lt;cfform format=&quot;xml&quot; skin=&quot;basic.xsl&quot;&gt;</code></td>
<td>Searches in the current directory.</td>
</tr>
<tr>
<td><code>&lt;cfform format=&quot;xml&quot; skin=&quot;\.\basic.xsl&quot;&gt;</code></td>
<td>Searches the parent of the current directory.</td>
</tr>
<tr>
<td><code>&lt;cfform format=&quot;xml&quot; skin=&quot;http://anywhereOnTheWeb/basic.xsl&quot;&gt;</code></td>
<td>Uses the specified URL.</td>
</tr>
</tbody>
</table>

Note: Hosting companies might move the default skin location folder out of CFIDE; this lets them secure the CFIDE while giving site developers access to the files that you need for `cfform`.

Attribute and value passthrough

ColdFusion passes form tag attributes or attribute values that it does not specifically process directly to the XML, as follows:

- It converts `cfformitem` and `cfformgroup` type attributes to `xf:group` element `appearance` attributes.
- It passes the name and value of tag attributes that it does not recognize or process in `cf:attribute` elements.
This passthrough feature lets you create custom versions of any of the following items for your XSLT to process:

- The `cfitem` types, such as rules, spacers, or other display elements
- The `cfgroup` types, such as divided boxes or tabbed dialog boxes
- The custom `cfinput` types, such as a custom year chooser element
- ColdFusion tag attributes, such as those used to control validation

### Extending ColdFusion XSLT skins
ColdFusion provides basic XSLT transforms that you can use as templates and extend for making your own skin. Each skin has a base XSL file, which include several utility XSL files. Utility filenames start with an underscore (_), and the files are shared by multiple base skins. The following tables describes the XSL files, which are located in the `cf_webroot\CFIDE\scripts\xsl` directory:

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>default.xsl</code></td>
<td>The default transform that ColdFusion uses if you do not specify a <code>skin</code> attribute for an XML format form. Identical to the <code>basic.xsl</code> file.</td>
</tr>
<tr>
<td><code>basic.xsl</code></td>
<td>A basic form format that arranges form elements using a table.</td>
</tr>
<tr>
<td><code>basiccss.xsl</code></td>
<td>A basic form format that arranges form elements using HTML <code>div</code> and <code>span</code> tags.</td>
</tr>
<tr>
<td><code>colorname.xsl</code></td>
<td>A basic form format that arranges form elements using a table and applies a color scheme determined by the <code>colorname</code> to the form. Based on the <code>basic.xsl</code> file.</td>
</tr>
<tr>
<td><code>_cfformvalidation.xsl</code></td>
<td>Applies ColdFusion validation rules. Used by all skins.</td>
</tr>
<tr>
<td><code>_formelements.xsl</code></td>
<td>Transformation rules for form elements except for those defined using <code>cfitem</code> tags. Used by all skins.</td>
</tr>
<tr>
<td><code>_group_type.xsl</code></td>
<td>Transformation rules for <code>cfitem</code> tags. The <code>type</code> attribute is part of the filename. Files with <code>table</code> in the name are used by <code>basic.xsl</code> and its derivatives. Files with <code>css</code> in the name are used by <code>basiccss.xsl</code>.</td>
</tr>
<tr>
<td><code>_group_type_table.xsl</code></td>
<td></td>
</tr>
<tr>
<td><code>_group_type_css.xsl</code></td>
<td></td>
</tr>
</tbody>
</table>

All skins support the same set of CFML tags and tag types, and do a relatively simple transformation from XML to HTML. For example, they do not support horizontal or vertical rules.

The ColdFusion skin XSL files have several features that you can use when designing and developing your own transformation. They do the following:

- Provide an overall structure and initial templates for implementing custom transformations.
- Show how you can handle the various elements in the ColdFusion-generated XML.
- Use a structure of included files that can form a template for your XSLT code.
- The base XSL files include a separate file, `_cfformvalidation.xsl`, with complete code for generating the hidden fields required for ColdFusion onServer validation and the JavaScript for performing ColdFusion onSubmit and onBlur validation. You can include this file without modification to do ColdFusion validation in your XSLT template, or you can change it to add other forms of validation or to change the validation rules.
- The base XSL files include files, that implement several form groups, laying out the child tags and applying a label to the group. These files can serve as templates for implementing additional form group types or you can expand them to provide more sophisticated horizontal and vertical form groups.
- You can add custom `cfitem` and `cfitem` type attributes by including additional XSL files.
Extending basic.xsl cfformgroup and cfformitem support

The following procedure describes the steps for extending the basic.xsl file to support additional cfformgroup and cfformitem types. You can use similar procedures to extend other xsl files.

Add support for cfformgroup and cfformitem types to the basic.xsl

1. Create an XSL file.
2. For each type attribute that you want to support, create an xsl:template element to do the formatting. The element's match attribute must have the following format:
   
   ```xml
   match="xf:group[@appearance='type_attribute_name']"
   ```
   
   For example, to add a panel cfformgroup type, add an element with a start tag such as the following:
   
   ```xml
   <xsl:template match="xf:group[@appearance='panel']">
   ```
   
3. Deploy your XSL file or files to the cf_webroot\CFIDE\scripts\xsl directory.
4. Add an include statement to the basic.xsl file at the end of the Supported groups section; for example, if you create a my_group_panel.xsl file to handle a panel cfformgroup type, your basic.xsl file would include the following lines:
   
   ```xml
   <!-- include groups that will be supported for this skin-->
   <xsl:include href="_group_vertical_table.xsl" />
   <xsl:include href="_group_horizontal_table.xsl" />
   <xsl:include href="_group_fieldset.xsl" />
   <xsl:include href="my_group_panel.xsl" />
   ```

Styling forms by extending the ColdFusion CSS files

Each ColdFusion skinnable form XSL file uses a corresponding CSS style sheet to specify the form style and layout characteristics. The following CSS files are located in the cf_webroot\CFIDE\scripts\css directory:

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>basic_style.css</td>
<td>Provides a plain style for ColdFusion XSL files that use table-based formatting. These files are identical and are used by the basic.xsl and default.xsl transforms. ColdFusion uses the default_style.css if you do not specify a skin in your cfform tag.</td>
</tr>
<tr>
<td>default_style.css</td>
<td></td>
</tr>
<tr>
<td>basic2_style.css</td>
<td>The basic_style with limited positioning changes for use with XSL files that have div-based formatting. Used by the basiccss.xsl transform.</td>
</tr>
<tr>
<td>css_layout.css</td>
<td>Style specifications for laying out forms that use div-based formatting. Used by the basiccss.xsl transform.</td>
</tr>
<tr>
<td>colorname_style.css</td>
<td>Used by the color-formatted ColdFusion skins. Defines the same classes as basic_style.css, with additional property specifications.</td>
</tr>
</tbody>
</table>

The ColdFusion XSL files and their corresponding CSS style sheets use classes extensively to format the form. The basic.xsl file, for example, has only one element style; all other styles are class-based. Although the CSS files contain specifications for all classes used in the XSL files, they do not always contain formatting information. The horizontal class definition in basic_style.css, which is used for horizontal form groups, for example, is empty.

You can enhance the style of XML skinnable forms without changing the XSL transform by enhancing the style sheets that ColdFusion provides.
Chapter 34: Using Ajax UI Components and Features

You can use ColdFusion Ajax-based layout and form controls and other Ajax-based user interface capabilities to create a dynamic application.

For information about how ColdFusion uses the Ajax framework in general, or how to use ColdFusion Ajax data and programming capabilities, including binding to form data and managing JavaScript resources, see “Using Ajax Data and Development Features” on page 647.

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About Ajax and ColdFusion user interface features

Ajax (Asynchronous JavaScript and XML) is a set of web technologies for creating interactive web applications. Ajax applications typically combine:

• HTML and CSS for formatting and displaying information.
• JavaScript for client-side dynamic scripting
• Asynchronous communication with a server using the XMLHttpRequest function.
• XML or JSON (JavaScript Object Notation) as a technique for serializing and transferring data between the server and the client.

ColdFusion provides a number of tools that simplify using Ajax technologies for dynamic applications. By using ColdFusion tags and functions, you can easily create complex Ajax applications.

ColdFusion Ajax features

ColdFusion provides two types of Ajax features:

• Data and development features
• User interface (UI) features

Data and development features

ColdFusion data and development features help you develop effective Ajax applications that use ColdFusion to provide dynamic data. They include many features that you can use with other Ajax frameworks, including Spry.

The following data and development features are particularly important for use with form and layout tags:
ColdFusion supports data binding in many tags. Binding allows form and display tags to dynamically display information based on form input. In the simplest application, you display form data directly in other form fields, but usually you pass form field data as parameters to CFC or JavaScript functions or CFM pages and use the results to control the display.

The `cfajaximport` tag specifies the location of the JavaScript and CSS files that a ColdFusion page imports or to selectively import files required by specific tags. The ability to change the file location lets you support a wide range of configurations and use advanced techniques, such as application-specific styles.

For more information about the data and development features and how to use them, see "Using Ajax Data and Development Features" on page 647.

### User Interface tags and features

Several ColdFusion user interface elements incorporate Ajax features. The tags and tag-attribute combinations can be divided into the following categories:

- Container tags that lay out or display contents
- Forms tags that dynamically display data
- A menu tag that lets you create menu bars and pull-down menus
- User assistance features that provide tool tips and form completion

The following table lists the basic tags and attributes that display the Ajax-based features. For information on additional forms-specific features, see "Using Ajax form controls and features" on page 626.

<table>
<thead>
<tr>
<th>Tag/attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Container tags</strong></td>
<td></td>
</tr>
<tr>
<td><code>cfdiv</code></td>
<td>An HTML <code>div</code> region that can be dynamically populated by a bind expression. Forms in this region submit asynchronously.</td>
</tr>
<tr>
<td><code>cflayout</code></td>
<td>A horizontal or vertical box, a tabbed region, or a set of bordered regions that can include a top, bottom, left, right, and center regions.</td>
</tr>
<tr>
<td><code>cflayoutarea</code></td>
<td>An individual region within a <code>cflayout</code> area, such as the display that appears in a tabbed layout when the user selects a tab. Forms in this region submit asynchronously.</td>
</tr>
<tr>
<td><code>cfpod</code></td>
<td>An area of the browser window with an optional title bar and a body that contains display elements. Forms in this region submit asynchronously.</td>
</tr>
<tr>
<td><code>cfwindow</code></td>
<td>A pop-up window within the browser. You can also use the ColdFusion.Window.createWindow function to create a pop-up window. Forms in this region submit asynchronously.</td>
</tr>
<tr>
<td><strong>Forms tags</strong></td>
<td></td>
</tr>
<tr>
<td><code>cfgrid format=&quot;html&quot;</code></td>
<td>A dynamic, editable, sortable, data grid.</td>
</tr>
<tr>
<td><code>cfinput type=&quot;datefield&quot;</code></td>
<td>An input control that users can fill by selecting a date from a pop-up calendar.</td>
</tr>
<tr>
<td><code>cftextarea richtext=&quot;yes&quot;</code></td>
<td>A text area with a set of controls that let users format the displayed text.</td>
</tr>
<tr>
<td><code>cftree format=&quot;html&quot;</code></td>
<td>A dynamic, editable, tree-format representation of data.</td>
</tr>
<tr>
<td><strong>Menu tags</strong></td>
<td></td>
</tr>
<tr>
<td><code>cfmenu</code></td>
<td>A menu bar or the root of a drop-down menu.</td>
</tr>
<tr>
<td><code>cfmenuitem</code></td>
<td>An individual item in a menu, or the root of a submenu.</td>
</tr>
</tbody>
</table>
In addition to the tags and attributes, ColdFusion provides a number of JavaScript functions that let you control and manage the display. Many functions control the display of specific tags. For example, you can use JavaScript functions to dynamically display and hide the window. There are also several utility tags, such as the ColdFusion.getElementValue function that gets the value of a control attribute, or the ColdFusion.navigate function that displays the results of a URL in a container tag. For a complete list of all ColdFusion Ajax JavaScript functions, and detailed function descriptions, see “AJAX JavaScript Functions” on page 1246 in the CFML Reference.

Using ColdFusion Ajax UI features

ColdFusion Ajax UI features let you create data-driven pages that update dynamically without requiring multiple HTML pages or page refreshes or non-HTML display tools such as Flash forms. Many UI features use data binding to dynamically get data based on other data values: form field values, form control selections, and selections in Spry data sets.

ColdFusion Ajax UI controls and features can be divided into two major categories:

- Display layout
- Data interaction

Display layout controls include the cflayout, cfpod, and cfwindow controls. Some of the data interaction features include the HTML format cfgrid control, the cfmenu control, and dynamic autosuggest lists for text input controls. Most display layout and data interaction features can use data binding to dynamically interact with the user.

ColdFusion Ajax UI features are based on the Yahoo User Interface Library and the Ext JavaScript Library. Also, the cftextarea rich text editor is based on the FCKeditor text editor. In most situations, you require only ColdFusion tags and functions (including JavaScript functions) to create and manage the interface; however, advanced developers can modify the library code, particularly the CSS styles, to customize the controls in more complex ways.

Controlling Ajax UI layout

The following layout tags let you dynamically control the display:

- cfdiv
- cflayout
- cfpod
- cfwindow

For information about how you can use these tags to submit form contents asynchronously, see “Using Ajax containers for form submission” on page 626.
Using the cfdiv tag

The cfdiv tag is a general purpose container that lets you use a bind expression to specify its contents. It therefore lets you dynamically refresh any arbitrary region on the page based on bind events. By default, the tag creates an HTML div region, but it can create any HTML tag with body contents. Unlike other ColdFusion Ajax container tags, you can use any type of bind expression to populate contents: CFC or JavaScript function, URL, or a string with bind parameters. As a result, the cfdiv tag provides substantial flexibility in dynamically populating the page contents.

The cfdiv tag is also useful if you want a form to submit asynchronously, whether or not you use a bind expression to populate the tag. If you submit a form that is inside a cfdiv tag (including in HTML returned by a bind expression), the form submits asynchronously and the response from the form submission populates the cfdiv region. (The cflayoutarea, cfwindow, and cfpod tags have the same behavior.) For example, you could have a page with a form that includes a list of artists, and lets you add artists. If the form is in a cfdiv tag, when the user submits the form, the entire page is not refreshed, only the region inside the cfdiv tag. For an example of using container controls for asynchronous forms, see “Using Ajax containers for form submission” on page 626.

One use case for a cfdiv tag is an application where a cfgrid tag displays an employee list. Details of the selected row in the grid are displayed inside a cfdiv tag with a bind expression that specifies the cfgrid in a bind parameter. As users click through different employees on the grid, they get the employee details in the cfdiv region.

The following simple example shows how you can use the cfdiv tag to get data using a bind expression. It uses binding to display the contents of a text input field in an HTML div region. Whenever the user enters text in the input box and tabs out of it, or clicks on another region of the application, the div region displays the entered text.

The cfdiv tag.cfm file, the main application file, has the following contents.

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<title>cfdiv Example</title>
</head>

<body>
<cfform>
  <cfinput name="tinput1" type="text">
</cfform>

<h3> using a div</h3>
<cfdiv bind="url:divsource.cfm?InputText={tinput1}" ID="theDiv"
    style="background-color:##CCffFF; color:red; height:350"/>
</body>
</html>
```

The divsource.cfm file that defines the contents of the div region has the following code:

```coldfusion
<h3>Echoing main page input:</h3>
<cfoutput>
  <cfif isdefined("url.InputText")>
    #url.InputText#
  <cfelse>
    No input
  </cfif>
</cfoutput>
```

Using layouts

The cflayout tag controls the appearance and arrangement of one or more child cflayoutarea regions. The cflayoutarea regions contain display elements and can be arranged in one of the following ways:

- Horizontally or vertically.
In a free-form bordered grid (panel layout) with up to five regions: top, bottom, left, right, and center. You can optionally configure the layout so that users can resize or collapse any or all of the regions, except the center region. The center region grows or shrinks to take up any space that is not used by the other regions. You can also dynamically show or hide individual regions, or let users collapse, expand, or close regions.

As a tabbed display, where selecting a tab changes the display region to show the contents of the tab’s layout area. You can dynamically show and hide, and enable and disable tabs, and optionally let users close tabs.

You can configure a layout area to have scroll bars all the time, only when the area content exceeds the available screen size, or never, and you can let layout area contents extend beyond the layout area. You can also nest layouts inside layout areas to create complex displays.

You can define the layout area content in the `cflayoutarea` tag body, but you can also use a bind expression to dynamically get the content by calling a CFC function, requesting a CFML page, or calling a JavaScript function.

ColdFusion provides a number of JavaScript functions for managing layouts, including functions to collapse, expand, show, and hide border areas; and to create, enable, disable, select, show, and hide tabs. For a complete list of functions, see “AJAX JavaScript Functions” on page 1246 in the CFML Reference.

The following example shows the use of a tabbed layout, including the use of JavaScript functions to enable and disable a tab, and to show and hide a tab.

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
</head>
<body>

<!--- The tabheight attribute sets the height of all tab content areas and therefore the layout height. The width style controls the layout width. --->
<cflayout type="tab" name="mainTab" tabheight="300px" style="width:400px">
  <!--- Each layoutarea is one tab. --->
  <cflayoutarea title="First Tab" name="tab1">
    <h2>The First Tab</h2>
    <p>Here are the contents of the first tab.</p>
  </cflayoutarea>

  <cflayoutarea title="Second Tab" name="tab2">
    <h2>The Second Tab</h2>
    <p>This is the content of the second tab.</p>
  </cflayoutarea>
</cflayout>

<p>
Use these links to test selecting tabs via JavaScript:<br/>
<a href="" onclick="ColdFusion.Layout.selectTab('mainTab','tab1');return false;">Click here to select tab 1.</a><br/>
<a href="" onclick="ColdFusion.Layout.selectTab('mainTab','tab2');return false;">Click here to select tab 2.</a><br/>
</p>

<p>
Use these links to test disabling/enabling via JavaScript. Notice that you cannot disable the currently selected tab.<br/>
<a href="" onclick="ColdFusion.Layout.enableTab('mainTab','tab1');return false;">Click here to enable tab 1.</a><br/>
</p>
</body>
</html>
```
For an example that uses a bordered layout with `cfpod` children, see the next section. For another example of a tab layout, see the `cflayoutarea` tag in the CFML Reference. For an example of a bordered layout nested inside a layout area of a vertical layout, see `cflayout` in the CFML Reference.

Styling layouts
The `cflayout` and `cflayoutarea` tags have `style` attributes. The `cflayout` tag `style` attribute controls the style of the layout container, and sets default values for many, but not all, styles for the layout areas. For example, the color and background color styles of the `cflayout` tag set the default text and background colors in the layout areas, but the `cflayout` tag `border` style sets only the color of the border around the entire layout, not the layout area borders. The `cflayoutarea` tag `style` attribute controls the style of the individual layout area and overrides any corresponding settings in the `cflayout` tag.

As is often the case with complex controls, the effects of layout and layout area styles can vary. For example, you should often not specify the `height` style in the `cflayout` tag; instead, specify height styles on each of the `cflayoutarea` tags.

The following simple example shows a tab layout with two layout areas. The layout has a light pink background color, and the layout areas have 3 pixel-wide red borders:

```cflayout name="layout1" type="tab" style="background-color:##FFCCCC">
  <cflayoutarea title="area1" style="border:3px solid red">
    Layout area 1
  </cflayoutarea>
  <cflayoutarea title="area1" style="border:3px solid red">
    Layout area 2
  </cflayoutarea>
</cflayout>
```

Using pods
The `cfpod` control creates a content region with a title bar and surrounding border. You can define the pod content in the `cfpod` tag body, or you can use a bind expression to dynamically get the content from a URL. Pods are frequently used for portlets in a web portal interface and for similar displays that are divided into independent, possibly interactive, regions.

You control the pod header style and body style independently by specifying CSS style properties in the `headerStyle` and `bodyStyle` attributes.

The following example uses multiple pods inside `cflayoutarea` tags to create a simple portal. The time pod gets the current time from a CFML page. The contents of the other pods is defined in the `cfpod` bodies for simplicity. Each pod uses the `headerStyle` and `bodyStyle` attributes to control the appearance.

The `cfpodExample.cfm` application has the following code:

```html
<html>
<head>
</head>
<body>
  <cflayout name="theLayout" type="border" style="height:300;">  
    <cflayoutarea position="left" size="300" style="float:right;">  
```
In this example, the podweather.cfm page contains only the following line. A more complete example would dynamically get the weather from a feed and format it for display.

Partly Cloudy, 76 degrees

Using pop-up windows
ColdFusion HTML pop-up windows have the following characteristics:

- They have title bars
- They float over the browser window and can be placed at an arbitrary location over the window.
- They can be modal (users cannot interact with the main window when the pop-up window is displayed) or non-modal (users can interact with both windows).
- You can specify that the user can drag, close, or resize the window.
- You can create and show a window independently. After you create the window, you can use JavaScript functions to show and hide it multiple times without having to create it again.

Displaying and hiding windows
You display a window in the following ways:
• By using a ColdFusion cfwindow tag with an initShow attribute value of to create and show the window.

• By using a ColdFusion cfwindow tag with an initShow attribute value of false and calling the ColdFusion.Window.show JavaScript function to display it.

• By by using ColdFusion.Window.create and ColdFusion.Window.show JavaScript functions.

You can hide a window that is currently showing by calling the ColdFusion.Window.hide function. You can use the ColdFusion.Window.onShow and ColdFusion.Window.onhide functions to specify JavaScript functions to run when a window shows or hides.

The following example shows how you can create, display, and hide a window. It also shows several of the configuration options that you can set, including whether the user can close, drag, or resize the window. When you run the application, the cfwindow tag creates and shows Window 1. You can then hide it and reshow it. To show Window 2, you must click the Create Window 2 button, followed by the Show Window 2 button. You can then hide and show it.

The following examples shows the main application page:

```html
<html>
<head>
<script>
<!--
//Configuration parameters for window 2.
var config =
{x:250,y:300,height:300,width:300,modal:false,closable:false,
draggable:true,resizable:true,initshow:false,minheight:200,minwidth:200
}
-->
</script>
</head>
<body>
<p>This content was defined in the cfwindow tag body.</p>
</body>
</html>
```

```html
<form>
<!-- Use the API to show and hide Window 1. -->
<input type="button" value="Show Window1"
onClick="ColdFusion.Window.show('window1')">
<input type="button" value="Hide Window1"
onClick="ColdFusion.Window.hide('window1')"><br />
<!-- Use the API to create, show, and hide Window 2 -->
<input type="button" value="Create Window2"
onClick="ColdFusion.Window.create('window2', 'JavaScript Window',
'window2.cfm', config)"
<input type="button" value="Show Window2"
onClick="ColdFusion.Window.show('window2')"
<input type="button" value="Hide Window2"
onClick="ColdFusion.Window.hide('window2')">
</form>
</html>
```
The window2.cfm file with the contents of Window 2 has the following contents:

```cfoutput
<p>
This content was loaded into window 2 from a URL.<br />
</p>
</cfoutput>
```

**Using the window show and hide events**

You can use the `onShow` and `onHide` events that are triggered each time a window shows and hides to control your application. To do so, call the `ColdFusion.Window.onShow` and `ColdFusion.Window.onHide` functions to specify the event handlers. Both functions take the window name and the handler function as parameters. The event handler functions can take a single parameter, the window name.

The following example displays an alert dialog when a window hides or shows. The alert message includes the window name. The alert does not show when the window first appears, because the `cfwindow` tag uses the `initShow` attribute to initially display the window. An alert dialog does appear when the user hides the window by clicking the Toggle Window button or the close button on the window.

```html
<html>
<head>
<script language="javascript">

//Boolean value tracking the window state.
var shown=true;

//Functions to display an alert box when
function onshow(name) {
    alert("window shown = " + name);
}
function onhide(name) {
    alert("window hidden = " + name);
}

//Initialize the window show/hide behavior.
function initWindow() {
    ColdFusion.Window.onShow("testWindow", onshow);
    ColdFusion.Window.onHide("testWindow", onhide);
}

//Show or hide the window, depending on its current state.
function toggleWindow() {
    if (shown) {
        ColdFusion.Window.hide("testWindow");
        shown = false;
    }
    else {
        ColdFusion.Window.show("testWindow");
        shown = true;
    }
}

</script>
</head>
<!-- The body tag onLoad event calls the window show/hide initializer function. -->
<body onLoad="initWindow()">

<cfwindow name="testWindow" initshow=true title="test window" closable=true> Window contents
</cfwindow>

<cfform>
```
Controlling container contents

ColdFusion provides a variety of ways to set and change container tag contents:

- You can use bind expressions in the container tag source (or for cfdiv, bind) attribute. The container then dynamically updates any time a bound control changes.

- You can call the ColdFusion.navigate function to change the container body to be the contents returned by a specified URL. This function lets you specify a callback handler to do additional processing after the new content loads, and also lets you specify an error handler.

  The callback handler can be useful to provide information about a successful navigation operation. For example, you could make a pod’s title bar italic to indicate loading (just before the navigate call), and use the callback handler to switch it back to normal once the navigate completes. Similarly, if a pod is shows pages from a book, the callback handler could update a page number in a separate field once a page loads.

- You can use the special `controlName_body` variable to access and change the body contents for cfpod and cfwindow controls. For example, you can use the `controlName_body.innerHTML` property to set the body HTML. For cfpod and cfwindow tags, you can also use the `controlName_title` to get or set the control’s title bar contents.

These different techniques provide you with flexibility in writing your code. For example, the ColdFusion.navigate function and the `controlName_body` variable provide similar functionality. However, with the `controlName_body` technique, you must make explicit Ajax requests to get markup for the body, and the JavaScript functions in the retrieved markup might not work properly. ColdFusion.navigate takes care of these issues. Therefore, you might limit use of the `controlName_body` technique to simpler use cases.

The following example shows how you can use various techniques to change container contents. It consists of a main page and a second windowcontent.cfm page with text that appears in a main page window when you click a button. The main page has a cfpod control, two cfwindow controls, and the following buttons:

- The “Simple navigate” button calls a ColdFusion.navigate function to change the contents of the second window.
- The “Change w2 body & title” button replaces the second window’s body and title innerHTML values directly to specific strings.
- The “Change pod body” button changes the pod body innerHTML to the value of the second window’s title innerHTML.

The following examples shows the main page:

```html
<html>
<head>
!---- Callback handler puts text in the window.cfm callback div block. ---->
<script language="javascript">
  var mycallBack = function(){
    document.getElementById("callback").innerHTML = "<br><br>
    <b>This is printed by the callback handler.</b>
  }
</script>
<!--- The error handler pops an alert with the error code and message. --->
<script language="javascript">
  var myerrorHandler = function(errorCode,errorMessage){
    alert("[In Error Handler]" + "\n\n" + "Error Code: " + errorCode + "\n\n" +
```
Error Message: " + errorMessage);
}
</script>
</head>

<body>
<cfpod height="50" width="200" title="The Title" name="theTitle">
  This is a cfpod control.
</cfpod><br>
<!--- Clicking the link runs a ColdFusion.navigate function that replaces the second window's contents with windowsource.cfm. The callback handler then updates the window contents further. --->
<cfwindow name="w1" title="CF Window 1" initShow=true
  x=10 y=200 width="200">
  This is a cfwindow control.<br>
  <a href="javascript:ColdFusion.navigate('windowsource.cfm','w2',
    mycallBack,myerrorHandler);">Click</a> to navigate Window 2</a>
</cfwindow>

<cfwindow name="w2" title="CF Window 2" initShow=true
  x=250 y=200 width="200">
  This is a second cfwindow control.
</cfwindow>

<cfform>
  <!--- This button only replaces the second window body with the body of the windowsrc.cfm page. --->
  <cfinput type="button" name="button" value="Simple navigate"
    onClick="ColdFusion.navigate('windowsource.cfm','w2');">
  <!--- This button replaces the second window body and title content. --->
  <cfinput type="button" name="button2" value="Change w2 body & title"
    onClick="w2_body.innerHTML='New body inner HTML';w2_title.innerHTML=
       'New Title inner HTML'">">
  <!--- This button puts the second window title in the pod body. --->
  <cfinput type="button" name="button3" value="Change pod body"
    onClick="theTitle_body.innerHTML=w2_title.innerHTML;">">
</cfform>
</body>
</html>

The following examples shows the windowsource.cfm page:

This is markup from "windowsource.cfm"

<!--- The callback handler puts its output in the following div block. --->
<div id="callback"></div>

Using menus and toolbars

The cfmenu and cfmenuitem tags let you create vertical menus and horizontal toolbars.

Defining menus

You define menus and toolbars as follows:

- You use a single cfmenu tag to define the general menu characteristics.
You create a horizontal (toolbar) menu or vertical menu by specifying a `cfmenu` type attribute value of `horizontal` or `vertical` (the default).

Menus can have submenus, but only the top menu can be horizontal. All children of a horizontal menu are vertical.

The top-level menu shows initially, a submenu shows when the user moves the mouse over the menu root in the parent menu.

You use `cfmenuitem` tags to specify individual menu items.

To create submenus, you nest `cfmenuitem` tags. The parent tag becomes the root of the submenu.

All `cfmenuitem` tags, except tags for dividers, must have a `display` attribute, which defines the text to show on the menu item, and can optionally have an `image` attribute.

A horizontal menu has dividers between all items. You put dividers in vertical menus by specifying a `cfmenuitem` tag with a `divider` attribute.

To make a menu item active, you specify a `href` attribute with a URL or a JavaScript function to call when the user clicks the menu item.

The following example shows a simple horizontal menu with submenus that uses JavaScript to change the display contents. When the user selects an end item in a menu, the text in the `div` block below the menu shows the path to the selected menu.

```html
<html>
<head>
</head>
<body>

<!--- The selected function changes the text in the selectedItemLabel div block to show the selected item. --->
<script type="text/javascript">
 function selected(item) {
   var el = document.getElementById("selectedItemLabel");
   el.innerHTML = "You selected: " + item;
 }
</script>

<!--- A horizontal menu with nested submenus. Clicking an end item calls the selected function. --->
<cfmenu name="hmenu" bgcolor="#9999ff" selectedfontcolor="#0000dd" selecteditemcolor="#ddddff">
 <cfmenuitem display="Home" href="javascript: selected('Home');" />
 <cfmenuitem display="File">
   <cfmenuitem display="Open...">
     <cfmenuitem display="Template" href="javascript: selected('File &gt; Open... &gt; Template');" />
   </cfmenuitem>
   <cfmenuitem divider="true" />
   <cfmenuitem display="CSS" href="javascript: selected('File &gt; Open... &gt; CSS');" />
 </cfmenuitem>
 <cfmenuitem display="Close" href="javascript: selected('File &gt; Close');" />
 </cfmenuitem>
 <cfmenuitem display="Help">
   <cfmenuitem display="About" href="javascript: selected('Help &gt; About');" />
 </cfmenuitem>
</cfmenu>

<!--- A div with initial text. --->
</body>
</html>
```
Styling menus

The cfmenu and cfmenuitem tags have several attributes that let you easily control the menu appearance. These attributes consist of two types: basic and CSS style. Basic attributes, such as the cfmenu tag fontColor attribute, control individual menu characteristics. CSS style attributes let you specify a CSS style specification for a whole menu or part of a menu. The following information describes how the CSS style specifications interact and affect the menu style. For descriptions of all style-related attributes, see the cfmenu and cfmenuitem descriptions in the CFML Reference.

The cfmenu and cfmenuitem tags provide a hierarchy of CSS style attributes that affect different parts of the menu. The following table describes these attributes in hierarchical order:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfmenu attributes</td>
<td></td>
</tr>
<tr>
<td>menuStyle</td>
<td>Applies to the menu, including any parts of the menu that surround the menu items. If you do not override this style in a cfmenu tag childStyle attribute or by specifying style information in the cfmenuitem tags, this attribute controls the style of the top-level items.</td>
</tr>
<tr>
<td>childStyle</td>
<td>Applies to the items in the top level menu and all child menu items, including the children of submenus. This attribute lets you use a single style specification for all menu items.</td>
</tr>
<tr>
<td>cfmenuitem attributes</td>
<td></td>
</tr>
<tr>
<td>style</td>
<td>Applies to the current menu item only. It is not overridden by the childStyle attribute.</td>
</tr>
<tr>
<td>menuStyle</td>
<td>Controls the overall style of any submenu of this menu item. This attribute controls the submenu of the current menu item, but not to any child submenus of the submenu.</td>
</tr>
<tr>
<td>childStyle</td>
<td>Applies to all child menu items of the current menu item, including the children of submenus.</td>
</tr>
</tbody>
</table>

In addition to these styles, you must consider any style-related attributes, such as bgcolor, that you set on the cfmenu tag.

When you design your menu, you should keep the following issues in mind:

- Keep font sizes at 20 pixels or smaller. Larger sizes can result in menu text in vertical menus exceeding the menu boundaries.

- Consider how the style attributes interact. Because each menu and submenu consists of a surrounding menu area and individual child items, you must particularly careful when you choose background colors. For example, if you specify different background-color styles in the cfmenu tag's menuStyle and childStyle attributes, the menu items are one color and the surrounding menu area are a different color.

For an application that shows some of the effects of menu style attributes, see the example in the cfmenuitem tag in the CFML Reference.

ColdFusion attributes provide most style options that you are likely to require. However, you can, if necessary, modify the basic menu styles for all menus by editing the menu-related styles in the CSS files in the yui.css file. This file is located by default in the web_root/CFID/scripts/ajax/resources/yui directory. For more information about these styles, see the Yahoo! User Interface Library menu documentation.
Using Ajax form controls and features

ColdFusion HTML format forms and controls provide the following Ajax-based features:

- The `cfgrid`, `cfinput`, `cfselect`, `cftextarea`, and `cftree` controls support binding to get control contents.
- ColdFusion functions support asynchronous submission of forms without refreshing the entire page. When a form is in an Ajax container control, this is done automatically. Also, the `ColdFusion.Ajax.SubmitForm` JavaScript function and Ajax proxy `setForm` function support manual asynchronous submissions.
- The `cfgrid` and `cftree` tags provide HTML format grids and trees that do not require a Java applet or Flash.
- The `cftextarea` control has a rich text editor option. The text editor is configurable.
- The `cfinput` tag supports a `datefield` type with an Ajax-based pop-up calendar from which user can select the date.
- The `cfinput` tag with `text` type supports an `autosuggest` attribute that lets you dynamically supply a drop-down list of field completions based on the current user input.
- The `cfinput`, `cfselect`, and `cftextarea` tags support a `tooltip` attribute that specifies a pop-up tool tip to display when the user moves the mouse over the control. The `cftooltip` tag displays a tool over any region of a page, not just a form control.

Using Ajax form controls

ColdFusion Ajax-based form controls let you submit Ajax forms in your applications without refreshing the entire page.

Using Ajax containers for form submission

The ColdFusion Ajax container tags, `cfdiv`, `cflayoutarea`, `cfpod`, and `cfwindow`, automatically submit any forms that they contain asynchronously. When the form is submitted, the result returned by the action page replaces the contents of the container, but has no effect on the rest of the page.

The following example shows this behavior in the `submitSimple.cfm` page:

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
</head>
<body>
<cflayout type="vbox" name="layout1">
  <cflayoutarea>
    <h3>This area is not refreshed when the form is submitted.</h3>
    <br />
  </cflayoutarea>
  <cflayoutarea>
    <h3>This form is replaced by the action page</h3>
    <cfform name="myform" format="html" action="showName.cfm">
      <cfinput type = "Text" name = "name">
      <cfinput type = "submit" name = "submit" value = "Enter name">
    </cfform>
  </cflayoutarea>
</cflayout>
</body>
</html>
```
In the following example, when you enter a name in the text input and click the Enter name button, the entered text replaces the form on the page, but the rest of the page is not refreshed. This example shows the showName.cfm action page:

```cfif IsDefined("Form.name")>
   <cfoutput>The Name is : <strong>#Form.name#</strong></cfoutput>
</cfif>

**Using the cfajaxproxy SetForm function**

The SetForm function of the proxy object created by the cfajaxproxy tag causes the proxy to pass the form values as arguments to the next CFC function that you call after the SetForm function. This way, you can pass the current values of fields in a form to a CFC function, which can then do the necessary processing and return a result.

When you use the SetForm function, the following rules apply to the arguments in the called CFC function:

- The function does not need to specify the form fields in cfargument tags, and the function gets the field values passed by name.
- Form fields that have the same names as CFC arguments override the CFC argument values.
- If you do not specify form fields in the in cfargument tags, They do not necessarily immediately follow any declared arguments when you use positional (array) notation to access them in the arguments structure.
- The arguments scope in the CFC function includes two fields that ColdFusion uses to control its behavior. These fields are intended for internal use, and their names might change in future releases. Both field values are set to true:
  - _CF_NODEBUG tells ColdFusion not to return debugging output in the call response.
  - _CF_NOCACHE tells ColdFusion to send a no cache header on the response, which prevents the browser from caching the response and ensures that every Ajax request results in a network call.

The following example shows how you could use a the SetForm tag to submit the contents of a login form. When the user clicks the Login! button, the doLogin function calls the proxy setForm function and then the AuthenticationSystem.cfc validateCredentials method. The validateCredentials method checks the user's password and if it is valid, returns true to the proxy. Because the proxy is synchronous (the default), the doLogin method gets the returned value. If the value is true, it hides the login window; the user can then access the page contents. If the return value is false, the doLogin function displays a message in the login window title bar.

The following examples shows the setForm.cfm application:

```html
<html>
<head>
<script type="text/javascript">
 function doLogin() {
    // Create the ajax proxy instance.
    var auth = new AuthenticationSystem();

    // setForm() implicitly passes the form fields to the CFC function.
    auth.setForm("loginForm");
    //Call the CFC validateCredentials function.
    if (auth.validateCredentials()) {
        ColdFusion.Window.hide("loginWindow");
    } else {
        var msg = document.getElementById("loginWindow_title");
        msg.innerHTML = "Incorrect username/password. Please try again!";
    }
}
</script>
</head>
```
<body>
<cfajaxproxy cfc="AuthenticationSystem" />
<cfif structKeyExists(URL,"logout") and URL.logout>
  <clogout />
</cfif>
<cflogin>
  <cfwindow name="loginWindow" center="true" closable="false"
    draggable="false" modal="true"
    title="Please login to use this system"
    initshow="true" width="400" height="200">
    <!-- Notice that the form does not have a submit button.
    Submission is done by the doLogin function. ---->
    <cfform name="loginForm" format="xml">
      <cfinput type="text" name="username" label="username" /><br />
      <cfinput type="password" name="password" label="password" />
      <cfinput type="button" name="login" value="Login!" onclick="doLogin();" />
    </cfform>
  </cfwindow>
</cflogin>
<p>This page is secured by a login. You can see the window containing the login form. The window is modal so the page cannot be accessed until you login.
<ul>
  <li><a href="setForm.cfm">Continue using the application</a>!</li>
  <li><a href="setForm.cfm?logout=true">Logout</a>!</li>
</ul>
</p>
</body>
</html>

The following examples shows the AuthenticationSystem.cfc file:

<cfcomponent output="false">
  <cffunction name="validateCredentials" access="remote" returntype="boolean"
    output="false">
    <cfargument name="username" type="string"/>
    <cfargument name="password" type="string"/>
    <cfset var validated = false/>
    <!-- Ensure that attempts to authenticate start with new credentials. ---->
    <clogout/>
    <cflogin>
      <cfif arguments.username is "user" and arguments.password is "secret">
        <cfloginuser name="#arguments.username#" password="#arguments.password#" roles="admin"/>
        <cfset validated = true/>
      </cfif>
    </cflogin>
  </cffunction>
</cfcomponent>
**Using the ColdFusion.Ajax.submitForm function**

You can use the `ColdFusion.Ajax.submitForm` function to submit form contents to a CFML page (or other active page) at any time. For example, you could use this function to automatically save a partially completed form.

When you use this function, you pass it the name of the form to submit and the URL of the page that processes the form. You can also specify the following optional parameters:

- A callback function that handles the returned results
- An error handler that takes two parameters, an HTTP error code and a message
- The HTTP method (by default, POST)
- Whether to submit the form asynchronously (by default, true)

The following proof of concept example uses the `ColdFusion.Ajax.submitForm` function to submit two form fields to an `asyncFormHandler.cfm` page, which simply echoes the form values. The callback handler displays an alert with the returned information.

```html
<html>
<head>
    <!--- The cfajaximport tag is required for the submitForm function to work because the page does not have any Ajax-based tags. --->
    <cfajaximport>
        <script>
            function submitForm() {
                ColdFusion.Ajax.submitForm('myform', 'asyncFormHandler.cfm', function(text) {
                    alert("Callback: " + text);
                }, function(code, msg) {
                    alert("Error!!! " + code + ": " + msg);
                });
            }
        </script>
    </cfajaximport>
    <script>
        function submitForm() {
            ColdFusion.Ajax.submitForm('myform', 'asyncFormHandler.cfm', callback, errorHandler);
        }
        function callback(text) {
            alert("Callback: " + text);
        }
        function errorHandler(code, msg) {
            alert("Error!!! " + code + ": " + msg);
        }
    </script>
</head>
<body>
    <cfform name="myform">
        <cfinput name="mytext1"><br /> <cfinput name="mytext2">
    </cfform>
    <a href="javascript:submitForm()">Submit form</a>
</body>
</html>
```

The `asyncFormHandler.cfm` page consists of a single line, as follows:

```cfoutput
Echo: #form.mytext1# #form.mytext2#</cfoutput>```
Using the ColdFusion.navigate function to submit a form

The ColdFusion.navigate JavaScript function can submit a form to a URL and have the returned output appear in a specified container control, such as a cfdiv, cflayout, cfpod, or cfwindow tag. This function lets you populate a control other than the one that contains the form when the user submits the data. You can also use the function to submit the form asynchronously when a user performs an action outside the form, such as clicking on a menu item.

For an example that uses this function, see the ColdFusion.navigate function in the CFML Reference.

Using HTML format grids

The ColdFusion HTML format cfgrid control lets you use a bind expression to dynamically populate the grid. HTML format grids that use bind expressions are paged; as users navigate from page to page of the grid, the grid dynamically gets the data for only the required page from the data source. You also use bind expressions when you let users edit form contents, and other ColdFusion controls can bind to the grid. Also, HTML format grids provide several JavaScript functions that you can use to manage and manipulate the grids.

You can also create a static HTML format grid by specifying a cfgrid tag that does not use a bind expression. With static grids, all data is initially available.

Dynamically filling form data

HTML format grids can dynamically fill the grid data by using a bind attribute with a bind expression that calls a CFC or JavaScript function, or a URL. The bind expression uses bind parameters to specify dynamic information provided by the grid and the values of any other form field attributes.

You must pass the following bind parameters to the bind expression. If you omit any of the parameters in the function call or URL, you get an error. These parameters send information about the grid and its state to the data provider function. The data for these parameters is provided automatically. You do not set any values manually.

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfgridpage</td>
<td>The number of the page for which to retrieve data.</td>
</tr>
<tr>
<td>cfgridpagesize</td>
<td>The number of rows of data in the page. The value of this parameter is the value of the pageSize attribute.</td>
</tr>
<tr>
<td>cfgridsortcolumn</td>
<td>The name of the column that determines the sorting order of the grid. This value is set only after the user clicks on a column heading.</td>
</tr>
<tr>
<td>cfgridsortdirection</td>
<td>The direction of the sort, may be ‘ASC’ (ascending) or ‘DESC’ (descending). This value is set only after the user clicks on a column heading.</td>
</tr>
</tbody>
</table>

Note: The cfgridsortcolumn and cfgridsortdirection parameters can be empty if the user or application has not sorted the grid, for example, by clicking a grid column header.

For more information on binding and bind parameters, see “Using Ajax Data and Development Features” on page 647 in the CFML Reference.

You can use optional parameters to specify additional information to pass to the called function. These parameters provide data that the called function requires to determine the data to return. For example, if the function returns the cities in a state, you would pass it the state name. Any or all of the optional function parameters can be bind parameters. A state name, for example, could come from the selection in a states cfselect control.

If you do not want the grid to refresh automatically when other controls change, you can use the @none specifier on all optional bind parameters. This prevents automatic updating of the grid based on the bound control values. You use the ColdFusion.Grid.refresh JavaScript function to explicitly refresh the grid contents. For more information on this use of the @none specifier and explicitly refreshing the control, see “Specifying bind parameters” on page 650.
If the grid supports user sorting of the data (the `sort` attribute is true), the function called by the bind expression must return data in the desired sorted order, and must use the values of the `cfgridsortcolumn` and `cfgridsortdirection` bind parameters to determine the order. Even if you do not allow user sorting, you must still pass these parameters to the function; otherwise, you get an error. Also, your function or action page must handle cases where these parameters are empty strings, because their values are not set until the user selects a column header to sort the grid, or you call the JavaScript `ColdFusion.Grid.sort` function.

The format of the returned data depends on how you get the data:

<table>
<thead>
<tr>
<th>Bind type</th>
<th>Return value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC</td>
<td>A ColdFusion structure. ColdFusion automatically converts the structure for return to the caller. Alternatively, you can return a JSON representation of the structure.</td>
</tr>
<tr>
<td>URL</td>
<td>A JSON representation of a structure. No other body contents is allowed.</td>
</tr>
<tr>
<td>JavaScript</td>
<td>A JavaScript object.</td>
</tr>
</tbody>
</table>

When you specify a CFC in the `bind` attribute, use the `queryConvertForGrid` function to convert a query directly into a structure that you can use as your CFC return value.

When you specify a CFML page in the `bind` attribute, use the `queryConvertForGrid` function to convert a query into a structure, and then use the `serializeJSON` function to convert the structure into a JSON representation.

If you manually create a JavaScript object or its JSON representation, it must have two top-level keys:

- **TOTALROWCOUNT**: The total number of rows in the query data set being returned. This value is the total number of rows of data in all pages in the grid, and not the number of rows in the current page.
- **QUERY**: The contents of the query being returned. The `QUERY` value must also be an object with two keys:
  - **COLUMNS**: An array of the column names.
  - **DATA**: A two-dimensional array, where the first dimension corresponds to the rows and the second dimension corresponds to the field values, in the same order as the `COLUMNS` array.

**Note:** If a CFC manually creates a return structure, the `QUERY` value can be a ColdFusion query object; ColdFusion automatically converts it for remote access.

The following example defines an object that a JavaScript bind function can return to provide the data for a `cfgrid` tag:

```javascript
var myobject = {
  "TOTALROWCOUNT": 6,
  "QUERY": {
    "COLUMNS": ["EMP_ID", "FIRSTNAME", "EMAIL"],
    "DATA": [
      [1, "Carolynn", "CPETERSON"],
      [2, "Dave", "FHEARTSDALE"],
      [3, "Linda", "LSTEWART"],
      [4, "Aaron", "ASMITH"],
      [5, "Peter", "PBARKEN"],
      [6, "Linda", "LJENNINGS"]
    ]
  }
};
```

The following example uses a bind expression and a CFC to populate a dynamic, paged, data grid. The CFML page contains the following form:

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
</head>
<body>
<form name="form01">
  <cfgrid format="html" name="grid01" pagesize=5 sort=true bind="cfc:places.getData({cfgridpage},{cfgridpagesize}, {cfgridsortcolumn},{cfgridsortdirection})">
    <cfgridcolumn name="Emp_ID" display=true header="eid" />
  </cfgridcolumn>
</form>
</body>
</html>
```
The places.cfc file looks as follows. Notice that the query gets the full data set each time the function gets called. The QueryConvertForGrid function selects and returns only the required page of data:

```cfc
cfcomponent
cffunction name="getData" access="remote" output="false">
  <cfargument name="page"/>
  <cfargument name="pageSize"/>
  <cfargument name="gridsortcolumn"/>
  <cfargument name="gridsortdirection"/>
  <cfquery name="team" datasource="cfdocexamples">
    SELECT Emp_ID, FirstName, EMail
    FROM Employees
    <cfif gridsortcolumn neq "" or gridsortdirection neq "">
      order by #gridsortcolumn# #gridsortdirection#
    </cfif>
  </cfquery>
  <cfreturn QueryConvertForGrid(team, page, pageSize)>
</cffunction>
</cfcomponent>
```

The following example is equivalent to the previous one, but uses a URL bind expression in the main page and a CFML page to return the data.

The main page contains the following form:

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head></head>
<body>
<cfform name="form01">
  <cfgrid format="html" name="grid01" pagesize=5 sort=true
    bind="url:getdata.cfm?page={cfgridpage}&pageSize={cfgridpagesize}
      &sortCol={cfgridsortcolumn}&sortDir={cfgridsortdirection}">
    <cfgridcolumn name="Emp_ID" display=true header="eid" />
    <cfgridcolumn name="FirstName" display=true header="Name" />
    <cfgridcolumn name="Email" display=true header="Email" />
  </cfgrid>
</cfform>
</body>
</html>
```

The following examples shows the getdata.cfm page:

```cfmx
<!--- Empty string, the default end of the query SQL. --->
<cfset queryEnd="">
<cfquery name="team" datasource="cfdocexamples">
  SELECT Emp_ID, FirstName, EMail
  FROM Employees
  <cfif sortcol neq "" or sortdir neq "">
    order by #sortcol# #sortdir#
  </cfif>
</cfquery>
```
<!--- Format the query so the bind expression can use it. --->
<cfoutput>$serializeJSON(QueryConvertForGrid(team, page, pageSize))#$
</cfoutput>

If your database lets you specify SQL to retrieve only the required page of data in a query, you can optimize efficiency by using such a query. Do not use the QueryConvertForGrid function. Instead, manually create the return structure and return only the single page of data. Ensure that you set the TotalRowCount field to the number of rows in the entire data set, not the number of rows in the returned page of data.

**Using the bindOnLoad attribute**

The bindOnLoad attribute causes a control to execute its bind expression immediately when it loads, and not wait until the event that normally triggers the bind expression evaluation to occur. This way, the control can be filled with an initial value. This attribute is false by default for all ColdFusion Ajax controls that have the attribute, except cfdiv and cfgrid, for which it is true by default. Having a true bindOnLoad value on these controls ensures that they are populated when they load.

When a control with a true bindOnLoad attribute is bound to a control that also binds when the page loads, the first and second control load themselves at the onLoad page event. Then the first control loads itself again in response to a change event from the second control when that control completes loading. So, the first control makes two Ajax calls, whereas it should make only one, when the second control finished loading.

Because the cfinput, cfselect, and cftextarea control bindOnLoad attributes are false by default, you do not encounter any problems if a cfgrid or cfdiv tag binds to any of these controls and you do not explicitly set their bindOnLoad attributes. However, if the control does set its bindOnLoad attribute to true, you should set the cfgrid or cfdiv attribute to false to ensure that the control only fetches data when the control that it is bound to returns.

You can also get a double loading if a grid binds to a Spry data set. By default, the grid and data set load data at page load, and then the grid loads data again in response to a selection change event from the data set when the it sets focus to its first row. Set bindOnLoad to false to ensure that the grid fetches data only when it receives a selection change event from the data set.

**Dynamically editing grid contents**

When you use a bind expression to get cfgrid data dynamically, you can also update the data source dynamically with user input, without requiring the user to submit the form. You can use dynamic updating to update or delete data in the data source. (To edit cfgrid data, select the contents of a field and type the new value; to delete a row, select a field in the row and click the delete button at the bottom of the grid.)

You cannot insert new rows directly in a grid that uses a bind expression. To add rows, you must enter the data in a form, and make sure the grid refreshes after the form has been submitted.

To update or delete data dynamically, do the following:

- Specify selectmode="edit" in the cfgrid tag. This lets the user edit the grid.
- Specify an onChange attribute in the cfgrid tag. The attribute must use a bind expression to specify a CFC method, JavaScript function, or URL of a page that updates the data source. The bind expression has the same format as the bind expression described in “Dynamically filling form data” on page 630; however, it must take the following bind parameters, which are automatically passed by the grid. These parameters send information about the grid and its state to the onChange function.

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfgridaction</td>
<td>The action performed on the grid. 'U' for update, or 'D' for delete.</td>
</tr>
</tbody>
</table>
When you update data dynamically, you can also use the `onError` attribute to specify the name of a JavaScript function to handle any errors that result in a CFC or URL returning an HTTP error status. The method must take two parameters: the HTTP error code and a text message that describes the error. The following example shows an `onError` handler function:

```javascript
<script type="text/javascript">
function errorhandler(id,message) {
  alert("Error while updating \n Error code: "+id+\nMessage: "+message);}
</script>
```

The following example displays the members of a department and lets users edit the data in the fields. When the focus leaves the edited field an `onChange` event triggers and the form calls the `editData` CFC function to update the data source.

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<script type="text/javascript">
function errorhandler(id,message) {
  alert("Error while updating\n Error code: "+id+\nMessage: "+message);
}
</script>
</head>
<body>
<cfform name="form01">
<cfgrid format="html" name="grid01" pagesize=11
  stripeRows=true stripeRowColor="gray"
  bind="cfc:places.getData({cfgridpage},{cfgridpagesize},
  {cfgridsortcolumn},{cfgridsortdirection})"
  delete="yes" selectmode="edit"
  onchange="cfc:places.editData({cfgridaction},{cfgridrow},{cfgridchanged})">
<cfgridcolumn name="Emp_ID" display=true header="Employee ID"/>
<cfgridcolumn name="FirstName" display=true header="Name"/>
<cfgridcolumn name="Email" display=true header="Email"/>
</cfgrid>
</cfform>
</body>
</html>
```

The `getData` function is identical to the `getData` function in “Dynamically filling form data” on page 630. This example shows the `editData` function in the CFC:

```cfm
<cffunction name="editData" access="remote" output="false">
  <cfargument name="gridaction">
  <cfargument name="gridrow">
  <cfargument name="gridchanged">
  <cfif isStruct(gridrow) and isStruct(gridchanged)>
    <cfif gridaction eq "U">
      <cfset colname=structkeylist(gridchanged)>
      <cfset value=structfind(gridchanged,#colname#)>
```
<cfquery name="team" datasource="cfdocexamples">
  update employees set <cfoutput>#colname#</cfoutput> = 
    '<cfoutput>#value#</cfoutput>
  where Emp_ID = <cfoutput>#gridrow.Emp_ID#</cfoutput>
</cfquery>
<cfelse>
<cfquery name="team" datasource="cfdocexamples">
  delete from employees where emp_id = <cfoutput>#gridrow.Emp_ID#</cfoutput>
</cfquery>
</cfif>
</cffunction>

Binding controls to grid contents

You can bind the contents of a form control to the data in a grid field by specifying a bind parameter as the form control bind attribute value. To do so, use the following syntax:

<cfinput type="text" bind="{gridName.columnName}"/>

By default, each time the selected row in the grid changes, the bind parameter is reevaluated, and the control value changes to the value of the specified column of selected grid cell.

Grid JavaScript functions

You can use the following JavaScript functions to manage an HTML format grid:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColdFusion.Grid.getGridObject</td>
<td>Gets the underlying Ext JS JavaScript library object.</td>
</tr>
<tr>
<td>ColdFusion.Grid.refresh</td>
<td>Manually refreshes a displayed grid.</td>
</tr>
<tr>
<td>ColdFusion.Grid.sort</td>
<td>Sorts the grid.</td>
</tr>
</tbody>
</table>

For more information, see the ColdFusion.Grid.getGridObject, ColdFusion.Grid.refresh, and ColdFusion.Grid.sort functions in the CFML Reference.

Using HTML format trees

An HTML format cftree tag creates an Ajax-based tree data representation that you can populate from a query or a bind expression. The behavior with a query is equivalent to that of applet or Flash format trees. Bind expressions let you populate the tree based on the values of other controls or Spry data sets. Also, when you use a bind expression, the tree loads dynamically, getting only the data required for the current display.

Populating the tree using a bind expression

You use the bind attribute and bind expressions to dynamically and incrementally load and display tree data as the user navigates the tree. The child tree items do not exist until the parent node expands. This behavior avoids prefilling a tree with large amounts of data, lets the tree children change dynamically (you can optionally get the children each time the item expands), and can enhance application responsiveness.

For more information about binding and bind parameters, see "Binding data to form fields" on page 649.

Bind expressions in trees work in the following ways:

- If you use a bind expression, the cftree tag can have only a single cftreeitem tag. Therefore, the function or URL called by the bind expression must be able to populate all levels of the tree.
• When a tree item expands, the CFC or JavaScript function or active page specified by the bind attribute returns an array with the values for the item's child nodes, and the dynamic tree code on the client constructs the child items by using these values.

• When a control to which the tree is bound generates an event that the tree is listening for, the tree is refreshed. For example, if the tree uses a bind expression that includes a select box as a bind parameter, the tree collapses to the root nodes when the selected value in the select box changes.

When you use a bind expression to populate a cftree control, you must specify a CFC function, JavaScript function, or URL, and must pass it the following bind parameters. If you omit either of the parameters from your function call or URL, you get an error. These parameters provide information about the tree and its state, and are automatically provided by the control.

<table>
<thead>
<tr>
<th>Bind parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{cftreeitempath}</td>
<td>Passes the path in the of the current (parent) node to the method, which will use it to generate the next node.</td>
</tr>
<tr>
<td>{cftreeitemvalue}</td>
<td>Passes the current tree item value (normally the value attribute)</td>
</tr>
</tbody>
</table>

The called function or URL cannot return nested arrays and structures, that is, it can only return a single level of items.

When a function or URL is first called to populate the root-level tree items, the value passed in the cftreeitemvalue variable is the empty string. Your bind function can test for an empty string to determine that it is populating the root level of the tree.

The @none event specifier is also useful if you use the ColdFusion.Tree.refresh JavaScript function to manually refresh the tree. When you call the Refresh function, the bind expression fetches data from all bind parameters, including @none parameters. If you specify @none in all bind parameters that specify other controls, the tree does not respond automatically to changes in the other controls, but it does pick up data from the bind parameters when you use the ColdFusion.Tree.Refresh function to explicitly refresh the tree.

The format of the data that the function or URL in a bind expression must return depends on the type of bind expression

<table>
<thead>
<tr>
<th>Bind type</th>
<th>Return value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC</td>
<td>A ColdFusion array of structures. ColdFusion automatically converts the structure to JSON format when it returns the result to the caller. Alternatively, you can return a JSON representation of the structure.</td>
</tr>
<tr>
<td>JavaScript</td>
<td>A JavaScript Array of Objects.</td>
</tr>
<tr>
<td>URL</td>
<td>A JSON representation of an array of structures. No other body content is allowed.</td>
</tr>
</tbody>
</table>

Each structure in the array of structures or objects defines the contents and appearance of the node for a child item. Each structure must have a VALUE field, and can have the following fields. With the exception of LEAFNODE, these structure keys correspond to cftreeitem attributes.

• DISPLAY
• EXPAND
• HREF
• IMG
• IMGOPEN
• LEAFNODE
• TARGET
**Note:** If a CFC does not return a value field, you do not get an error, but the tree does not work properly.

The LEAFNODE structure element is only used in the bind response structures. It must be a Boolean value that identifies whether the node is a leaf. If the value is `true`, the tree does not show a +/- expansion indicator in front of the node, and users cannot expand the node.

If your bind expression specifies a JavaScript function, the function must use all-uppercase letters for the field names; for example, use `VALUE` and `DISPLAY`, not `value` and `display`. ColdFusion uses all capital letters in the structure key names. ColdFusion is case-insensitive, so CFCs can use lowercase letters for the field names; JavaScript is case-sensitive, so the JavaScript function must match the uppercase field names.

If you use a URL to get the tree items from a CFML page, you can use the `serializeJSON` function to convert the array to JSON format. If the array with the tree items is named `itemsArray`, for example, the following line specifies the page output:

```
<cfoutput>#{serializeJSON(itemsArray)}#</cfoutput>
```

**Example 1: a simple tree**

The following simple example creates a simple hierarchical tree of unlimited depth, with one node per level. Each node label (specified by the `display` attribute) identifies the node depth:

The following example shows the CFML page:

```
<cfform name="testform">
   <cftree name="t1" format="html">
      <cftreeitem bind="cfc:makeTree.getNodes({cftreeitemvalue},{cftreeitempath})">
   </cftree>
</cfform>
```

The following examples show the `maketree.cfc` file with the `getNodes` method that is called when the user expands a node:

```cfc
<cfcomponent>
   <cffunction name="getNodes" returnType="array" output="no" access="remote">
      <cfargument name="nodeitemid" required="true">
      <cfargument name="nodeitempath" required="true">
      <!--- The initial value of the top level is the empty string. --->
      <cfif nodeitemid IS ">"
         <cfset nodeitemid =0>
      </cfif>
      <!--- Create a array with one element defining the child node. --->
      <cfset nodeArray = ArrayNew(1)>
      <cfset element1 = StructNew()>
      <cfset element1.value = nodeitemid + 1>
      <cfset element1.display = "Node #nodeitemid#">
      <cfset nodeArray[1] = element1>
      <cfreturn nodeArray>
   </cffunction>
</cfcomponent>
```

**Handling leaf nodes**

Code that returns the information for leaf nodes of the tree should always set the LEAFNODE structure field to `true`. This prevents the tree from displaying a +/- expansion indicator in the tree leaf node tree entries and from attempting to expand the node. The following example shows how you use the LEAFNODE field.
Example 2: a more complex tree with leaf node handling

The following tree uses the cfartgallery database to populate a tree where the top level is the art medium, the second level is the artist, and the leaf nodes are individual works of art. When the user clicks on an art work, the application shows the art image.

This example shows how to generate return values that are specific to the level in the tree and the parent value and the use of the LEAFNODE return structure element.

In this application, the CFC return structure keys are specified in lowercase letters, and ColdFusion automatically converts them to uppercase. Notice that the database contains entries only for the painting, sculpture, and photography categories, so just those top-level tree nodes have child nodes.

The following examples shows the main application page:

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<!--- The loadimage function displays the image of the selected art. --->
<script>
  function loadImage(img) {
    var imgURL = '<img src="/cfdocs/images/artgallery/'+img+'">';
    var imgDiv = document.getElementById('image');
    imgDiv.innerHTML = imgURL;
  }
</script>
</head>
<body>
<!--- The form uses a table to place the tree and the image. --->
<cfform name="ex1" action="ex1.cfm" method="post">
  <table>
    <tr valign="top">
      <td>
        <cftree name="mytree" format="html">
          <!--- When you use a bind expression, you must have only one cftreeitem, which populates the tree level. --->
          <cftreeitem bind="cfc:tree.getItems({cftreeitempath}, {cftreeitemvalue})">
          </cftreeitem>
        </cftree>
      </td>
      <td>
        <div id="image"></div>
      </td>
    </tr>
  </table>
</cfform>
</body>
</html>
```

The following example shows the tree.cfc file:

```cfcomponent output="false">
<cfset variables.dsn = "cfartgallery">
<!---- Function to populate the current level of the tree. --->
<cffunction name="getItems" returnType="array" output="false" access="remote">
  <cfargument name="path" type="string" required="false" default=""/>
  <cfargument name="value" type="string" required="false" default=""/>
  <cfset var result = arrayNew(1)>
```

```
<cfset var q = ">
<cfset var s = ">

<!--- The cfif statements determine the tree level. --->
<!--- If there is no value argument, The tree is empty. Get the media types. --->
<cfif arguments.value is ">
  <cfquery name="q" datasource="#variables.dsn#">
    SELECT mediaid, mediatype
    FROM media
  </cfquery>
  <cfloop query="q">
    <cfset s = structNew()>
    <cfset s.value = mediaid>
    <cfset s.display = mediatype>
    <cfset arrayAppend(result, s)>
  </cfloop>

<!--- If the value argument has one list entry, its a media type. Get the artists for the media type. --->
<cfelseif listLen(arguments.value) is 1>
  <cfquery name="q" datasource="#variables.dsn#">
    SELECT artists.lastname, artists.firstname, artists.artistid
    FROM art, artists
    WHERE art.mediaid = <cfqueryparam cfsqltype="cf_sql_integer" value="#arguments.value#">
    AND art.artistid = artists.artistid
    GROUP BY artists.artistid, artists.lastname, artists.firstname
  </cfquery>
  <cfloop query="q">
    <cfset s = structNew()>
    <cfset s.value = arguments.value & "," & artistid>
    <cfset s.display = firstName & " " & lastname>
    <cfset arrayAppend(result, s)>
  </cfloop>

<!--- We only get here when populating an artist's works. --->
<cfelse>
  <cfquery name="q" datasource="#variables.dsn#">
    SELECT art.artid, art.artname, art.price, art.description,
    art.largeimage, artists.lastname, artists.firstname
    FROM art, artists
    WHERE art.mediaid = <cfqueryparam cfsqltype="cf_sql_integer" value="#listFirst(arguments.value)#">
    AND art.artistid = artists.artistid
    AND artists.artistid = <cfqueryparam cfsqltype="cf_sql_integer" value="#listLast(arguments.value)#">
  </cfquery>
  <cfloop query="q">
    <cfset s = structNew()>
    <cfset s.value = arguments.value & "," & artid>
    <cfset s.display = artname & " (" & dollarFormat(price) & ")">
    <cfset s.href = "javascript:loadImage('#largeimage#');">
    <cfset s.children=arrayNew(1)>
    <!--- leafnode=true prevents node expansion and further calls to the bind expression. --->
    <cfset s.leafnode=true>
    <cfset arrayAppend(result, s)>
  </cfloop>

</cfif>
<cfreturn result>
</cffunction>
</cfcomponent>

**Binding other controls to a tree**

ColdFusion tags that use bind expressions can bind to the selected node of a tree by using the following formats:

- `{form:tree.node}` retrieves the value of the selected tree node.
- `{form:tree.path}` retrieves the path of the selected tree node. If the `completePath` attribute value is `true`, the bound path includes the root node.

The bind expression is evaluated each time a `select` event occurs on an item in the tree. If you specify any other event in the bind parameter, it is ignored.

**Tree JavaScript functions**

You can use the following JavaScript functions to manage an HTML format tree:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColdFusion.Tree.getTreeObject</td>
<td>Gets the underlying Yahoo User Interface Library TreeView JavaScript object.</td>
</tr>
<tr>
<td>ColdFusion.Tree.refresh</td>
<td>Manually refreshes a tree.</td>
</tr>
</tbody>
</table>

For more information, see the `ColdFusion.Tree.getTreeObject` and `ColdFusion.Tree.refresh` functions in the **CFML Reference**.

**Using the rich text editor**

The ColdFusion rich text editor lets users enter and format rich HTML text by using an icon-driven interface based on the open source FCKeditor Ajax widget. The editor includes numerous formatting controls, and icons for such standard operations as searching, printing, and previewing text. This topic does not cover the text editor controls. For detailed information on the editor icons and controls, see [http://wiki.fckeditor.net/UsersGuide](http://wiki.fckeditor.net/UsersGuide).

The following example shows a simple rich text editor. When a user enters text and clicks the Enter button, the application refreshes and displays the formatted text above the editor region.

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
</head>
<body>

<!--- Display the text if the form has been submitted with text. --->
<cif isdefined("form.text01") AND (form.text01 NEQ ")"> 
  <cfoutput>#form.text01#</cfoutput><br />
</cif>

<!--- A form with a basic rich text editor and a submit button. --->
<cfform name="form01">
  <cftextarea richtext=true name="text01" />
  <cfinput type="submit" value="Enter" name="submit01" />
</cfform>
</body>
</html>

**Note:** If you use the rich text editor in your pages, you cannot configure your web server to have ColdFusion process files with the .html or .htm extensions. The default HTML processor must handle pages with these extensions.
Configuring the rich text editor
You can customize the rich text editor in many ways. The cftextarea attributes support some basic customization techniques. For more detailed information, see the FCKEditor website at http://wiki.fckeditor.net/.

Defining custom toolbars
You can use the following techniques to control the appearance of the toolbar:

- Specify the toolbar name in the toolbar attribute
- Create custom toolbars in the fckconfig.js file.

The editor has a single toolbar consisting of a set of active icons and fields, and separators. The toolbar attribute lets you select the toolbar configuration. The attribute value specifies the name of a toolbar set, which you define in a FCKConfig.ToolbarSets entry in the cf_webRoot/CFIDE/scripts/ajax/FCKEditor/fckconfig.js file.

The rich text editor comes configured with two toolbar sets: the Default set, which contains all supported editing controls, and a minimal Basic set. By default, the editor uses the Default set. To create a custom toolbar named BasicText with only text-editing controls, create the following entry in the fckconfig.js file, and specify toolbar="BasicText" in the textarea tag.

FCKConfig.ToolbarSets["BasicText"] = [
    ['Source','DocProps','-', 'NewPage','Preview'],
    ['Cut','Copy','Paste','PasteText','PasteWord','-', 'Print','SpellCheck'],
    ['Undo','Redo','-', 'Find','Replace','-', 'SelectAll','RemoveFormat'],
    ['Bold','Italic','Underline'],
    ['Outdent','Indent'],
    ['JustifyLeft','JustifyCenter','JustifyRight','JustifyFull'],
    '/',
    ['Style','FontFormat','FontName','FontSize'],
    ['TextColor','BGColor'],
    ['FitWindow','-', 'About']
];

This configuration defines a toolbar with two rows that contain a subset of the full tool set designed to support basic text editing.

Follow these rules when you define a toolbar:

- Start the definition with FCKConfig.ToolbarSets.
- Specify the toolbar name in double quotation marks ([""]). You must use this name, case correct, in the cftextarea tag toolbar attribute.
- Follow the toolbar name with an equals sign (=).
- Place all the toolbar controls inside a set of square brackets, and follow the definition with a semicolon (;).
- Group controls in square brackets.
- Put each entry in single quotation marks (') and separate the entries with commas (,).
- Use the hyphen (-) character to specify a separator.
- Use a forward slash (/) character to start a new row.

For a complete list of the valid toolbar entries, see the Default configuration in fckconfig.js.

Defining custom styles
You can add custom styles that users can choose in the Styles selector and apply to selected text. To create a custom style, add a Style element to /CFIDE/scripts/ajax/FCKEditor/fckstyles.xml. The Style XML element has the following format:
• The name attribute specifies the name that appears in the Style selector.
• The element attribute specifies the HTML element that surrounds the text.
• Each Attribute child element defines the name and value of an attribute of the HTML tag.

For example, the following definition creates a style that makes the selected text bold and underlined:

```xml
<Style name="Custom Bold And Underline" element="span">
  <Attribute name="style" value="font-weight: bold; text-decoration: underline;"/>
</Style>
```

You can use a custom XML file, instead of fckstyles.xml, to define your styles. If you do so, specify the filepath in the stylesXML attribute.

**Defining custom templates**

The editor includes a set of basic templates that insert HTML formatting into the textarea control. For example, the Image and Title template puts a placeholder for an image on the left of the area, and a title and text to the right of the image. Then you can right-click the image area to specify the image source and other properties, and replace the placeholder title and text.

You create your own templates by creating entries in cf_webRoot/CFIDE/scripts/ajax/FCKEditor/fcktemplates.xml file. Each template XML entry has the following format:

```xml
<Template title="template title" image="template image">
  <Description>template description</Description>
  <Html>
    <![CDATA[
      HTML to insert in the text area when the user selects the template.
    ]]> 
  </Html>
</Template>
```

The template title, image and description appear in the Templates dialog box that appears when the user clicks the template icon on the rich text editor toolbar.

The following example template defines a title followed by text:

```xml
<Template title="Title and Text" image="template1.gif">
  <Description>A Title followed by text.</Description>
  <Html>
    <![CDATA[
      <h3>Type the title here</h3>
      Type the text here
    ]]> 
  </Html>
</Template>
```

The name "Title and Text" and the template1.gif image appear in the template selection dialog box.

You can use a custom XML file, instead of fcktemplates.xml, to define your templates. If you do so, specify the file path in the templatesXML attribute.

**Defining custom skins**

To create a custom skin that you can specify in the skin attribute, create a subdirectory of the cf_webRoot/CFIDE/scripts/ajax/FCKEditor/editor/skins directory. The name of this subdirectory is the name that you use to specify the skin in the skin attribute. The custom skin directory must contain an images subdirectory and have the following files:
• **fck_editor.css**: Defines the main interface, including the toolbar, its items (buttons, panels, etc.) and the context menu.

• **fck_dialog.css**: Defines the basic structure of dialog boxes (standard for all dialogs).

• **fck_strip.gif**: Defines the Default toolbar buttons and context menu icons. It is a vertical image that contains all icons placed one above the other. Each icon must correspond to a 16x16 pixels image. You can add custom images to this strip.

• **images/toolbar.buttonarrow.gif**: Defines the small arrow image used in the toolbar combos and panel buttons. Place all other images used by the skin (those that are specified in the CSS files) in the images subfolder.

The most common way of customizing the skin is to make changes to the fck_editor.css and fck_dialog.css files. For information on the skin format and contents, see the comments in those files.

### Using the datefield input control

The HTML format `cfinput` control with a type value of `datefield` lets users select dates from a pop-up calendar or enter the dates directly in the input box. When you use the control, you must keep the following considerations in mind:

- To correctly display label text next to the control in both Internet Explorer and Firefox, you must surround the label text in a `<div style="float:left;">` tag and put three `<br>` tags between each line.

- Consider specifying an `overflow` attribute with a value of `visible` in the `cflayoutarea` tag so that if the pop-up calendar exceeds the layout area boundaries, it appears completely.

- If you use a `mask` attribute to control the date format, it does not prevent the user from entering dates that do not conform to the mask. The `mask` attribute determines the format for dates that users select in the pop-up calendar. Also, if the user types a date in the field and opens the pop-up calendar, the calendar displays the selected date only if the entered text follows the mask pattern. If you do not specify a `mask` attribute, the pop-up only matches the default matching pattern.

- If the user types a date with a month name or abbreviation in the control, instead of picking a date from the calendar, the selected date appears in the pop-up calendar only if both of the following conditions are true:
  - The month position and name format match the mask pattern.
  - The month name matches, case correct, the month names specified by the `monthNames` attribute, or, for an `mmm` mask, their three-letter abbreviations.

- If the date mask specifies `yy` for the years, the pop-up calendar uses dates in the range 1951-2050, so if the user enters `3/3/49` in the text field, the calendar displays March 3, 2049.

- If the user enters invalid numbers in a date, the pop-up calendar calculates a valid date that corresponds to the invalid input. For example, if the user enters `32/13/2007` for a calendar with a `dd/mm/yyyy` mask, the pop-up calendar displays `01/02/2008`.

The following example shows a simple tabbed layout where each tab contains a form with several datefield controls.

```html
<html>
<head>
</head>

<body>
<cflayout type="tab" tabheight="250px" style="width:400px;">
  <cflayoutarea title="test" overflow="visible">
    <br>
    <cfform name="mycfform1">
```
Using autosuggest text input fields

When you create a text input (type="text") in an HTML format form, you can use the autosuggest attribute to specify a static or dynamic source that provides field completion suggestions as the user types. Use the autosuggestMinLength attribute to specify the number of characters the user must type before first displaying any suggestions.

Note: To put label text next to a cfinput control that uses an autosuggest attribute and have it display correctly in both Internet Explorer and Firefox, you must surround the label text in an HTML div tag with a style="float: left" attribute. Also if you have multiple controls, and put them on separate lines, follow the input controls with three <br> tags, as in the following example. Otherwise, the label and control do not lay out properly.

The control can suggest entries from a static list of values. To use a static suggestion list, specify the list entries in the autosuggest attribute, and separate the entries by the character specified by the delimiter attribute (by default, a comma), as the following example shows:

```
<cfinput type="text"
    autosuggest="Alabama,Alaska,Arkansas,Arizona,Maryland,Minnesota, Missouri"
    name="city" delimiter=" ">
```
In this example, if you type the character a (in uppercase or lowercase) in the cfinput control, the list of states that start with A appears in a drop-down list. You navigate to a selection by using the arrow keys, and press Enter to select the item.

You can also have the control suggest values from a dynamically generated suggestion list. To use a dynamic list, specify a CFC function, JavaScript function, or URL in the autosuggest attribute. Use the autosuggestBindDelay attribute to specify the minimum time between function invocations as the user types, and thereby limit the number of requests that are sent to the server. If you use a dynamic list, the input field has an icon to its right that animates while suggestions are fetched.

When you use a bind expression you must include a {cfautosuggestvalue} bind parameter in the function call or URL parameters. This parameter binds to the user input in the input control and passes it to the function or page.

A CFC or JavaScript autosuggest function must return the suggestion values as a one-dimensional array or as a comma-delimited list.

The HTTP response body from a URL must consist only of the array or list of suggestion values in JSON format. In ColdFusion you can use the serializeJSON function to convert an array to JSON format. If an array with the suggestions is named nodeArray, for example, the following line would specify the only output on a CFML page that is called by using a bind expression with a URL:

```
<cfoutput>#serializeJSON(nodeArray)#</cfoutput>
```

You do not have to limit the returned data to values that match the cfautosuggestvalue contents, because the client-side code displays only the values that match the user input. In fact, the called function or page does not even have to use the value of the cfautosuggestvalue parameter that you pass to it. You should, however, use the parameter if the returned data would otherwise be long.

The following example shows how you can a bind expression to populate autosuggest lists. The Last Name text box displays an autosuggest list with all last names in the database that match the keys typed in the box. The First Name text box uses binding to the Last Name text box to display only the first names that correspond to the last name and the text entered in the box. The database query limits the responses to only include results that match the autosuggest criteria, so the autosuggest list displays all the returned results, and the suggestions only match if the database entry has a case-correct match.

To test this example with the cfdocexamples database, type S in the first box and the autosuggest list shows Smith and Stewart. If you select Smith and enter A or J in the First Name box, you get a name suggestion.

The following example shows the application:

```html
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
</head>
<body>
<cfform>
 Last Name:<br />
 <cfinput type="text" name="lastName"
 autosuggest="cfc:suggestcfc.getLNames({cfautosuggestvalue})"><br />
<br />
 First Name:<br />
 <cfinput type="text" name="firstName"
 autosuggest="cfc:suggestcfc.getFNames({cfautosuggestvalue},{lastName})">
</cfform>
</body>
</html>
```

The following example shows the suggestcfc.cfc file:
<cfcomponent>

<cffunction name="getLNames" access="remote" returntype="array" output="false">
  <cfargument name="suggestvalue" required="true">
  <!--- The function must return suggestions as an array. --->
  <cfset var myarray = ArrayNew(1)>  
  <!--- Get all unique last names that match the typed characters. --->
  <cfquery name="getDBNames" datasource="cfdocexamples">
    SELECT DISTINCT LASTNAME FROM Employees
    WHERE LASTNAME LIKE <cfqueryparam value="#suggestvalue#%" cfsqltype="cf_sql_varchar">
  </cfquery>  
  <!--- Convert the query to an array. --->
  <cfloop query="getDBNames">
    <cfset arrayAppend(myarray, lastname)>  
  </cfloop>  
  <cfreturn myarray>
</cffunction>

<cffunction name="getFNames" access="remote" returntype="array" output="false">
  <cfargument name="suggestvalue" required="true">
  <cfargument name="lastName" required="true">
  <cfset var myarray = ArrayNew(1)>  
  <cfquery name="getFirstNames" datasource="cfdocexamples">
    <!--- Get the first names that match the last name and the typed characters. --->
    SELECT FIRSTNAME FROM Employees
    WHERE LASTNAME = <cfqueryparam value="#lastName#" cfsqltype="cf_sql_varchar">
    AND FIRSTNAME LIKE <cfqueryparam value="#suggestvalue & '%'#" cfsqltype="cf_sql_varchar">
  </cfquery>  
  <cfloop query="getFirstNames">
    <cfset arrayAppend(myarray, Firstname)>  
  </cfloop>  
  <cfreturn myarray>
</cffunction>

</cfcomponent>
Chapter 35: Using Ajax Data and Development Features

Adobe ColdFusion supports Ajax features to use data dynamically in web pages.

For information on ColdFusion Ajax user interface capabilities, see “Using Ajax UI Components and Features” on page 613.

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About ColdFusion Ajax data and development features

Ajax (Asynchronous JavaScript and XML) is a set of web technologies for creating interactive web applications. Ajax applications typically combine:

- HTML and CSS for formatting and displaying information.
- JavaScript for client-side dynamic scripting
- Asynchronous communication with a server using the XMLHttpRequest function.
- XML or JSON (JavaScript Object Notation) as a technique for serializing and transferring data between the sever and the client.

ColdFusion provides a number of tools that simplify using Ajax technologies for dynamic applications. By using ColdFusion tags and functions, you can easily create complex Ajax applications.

ColdFusion Ajax features
ColdFusion provides data management and development, and user interface Ajax features.

Data and development features
ColdFusion data and development features help you develop effective Ajax applications that use ColdFusion to provide dynamic data. They include many features that you can use with other Ajax frameworks, including Spry.
ColdFusion supports data binding in many tags. Binding allows an application that uses form and display tags, such as `cfselect` and `cfwindow`, to dynamically display information based on form input. In the simplest application, you display form data directly in other form fields, but usually you pass form field data as parameters to CFC or JavaScript functions or URLs and use the results to control the display. Data binding uses events to automatically update the display, typically when the bound input data changes. You can also use the `ColdFusion.Ajax.submitForm` JavaScript function to get the current value of any bindable element.

The `cfajaxproxy` tag creates a JavaScript proxy that represents a CFC on the server. It manages the communication between the client and server, and provides several functions to simplify and manage handling the communication and its results. This tag provides access to all remote functions in a CFC. It also lets applications, including applications that use Ajax frameworks or widget sets such as Dojo or Backbase, easily access data from ColdFusion servers.

The `cfsprydataset` tag lets you use bind expressions to dynamically create and update Adobe Spry data sets. Applications that use Spry framework elements, such as dynamic regions, can use this tag to populate the Spry elements with information based on ColdFusion control input. This feature lets you easily intermix Spry and ColdFusion controls.

The `cfajaximport` tag specifies the location of the JavaScript and CSS files that a ColdFusion page imports. You can also use this tag to selectively import files required by specific Ajax-based tags and functions. The ability to change the file location lets you support a wide range of configurations and use advanced techniques, such as application-specific styles. Although ColdFusion can automatically determine and import the required files, sometimes you must manually specify the information.

ColdFusion provides several CFML functions that let you create and consume JSON format data on the server and let you prepare data for use in HTML format `cfgrid` tags.

You can display a floating logging window that shows client-side logging and debugging information. ColdFusion Ajax features display information and error messages in this window, and several logging tags let you display additional information, including the structure of complex JavaScript variables.

**User interface features**

- Ajax-based HTML controls including the following:
  - Tree
  - Grid
  - Rich text editor
  - Date field
  - Autosuggest text input
  - Pop-up menus and menu bars.
  - Container tags that provide bordered, box, and tabbed layouts, pop-up windows, and pod regions.
  - A `cfdiv` container tag that enables asynchronous form submission and binding in HTML `div` and other regions.
  - Tooltips for specific controls and HTML regions.

For detailed information on using the UI features, see “Using Ajax UI Components and Features” on page 613.

**ColdFusion Ajax tags**

The following table lists ColdFusion Ajax-related tags and functions, including all tags that support Ajax-based features. It does not include subtags that are used only in the bodies of the listed tags:
Binding data to form fields

Many ColdFusion Ajax features use binding to provide dynamic interactivity based on user input or changing data. When you use binding, a bind expression gets evaluated, and the display gets updated based on new data each time a specific event (onChange by default) occurs on a form control field specified by a bind parameter. This way, the value of the tag that specifies the bind expression, and the display, get updated dynamically based on changing information, including user-entered form data. When you use binding the page contents updates, but the entire page is not refreshed.

Note: When a bound window is not visible, or a tab is not selected, its contents is not updated when the controls it is bound to change. When the tab or window is made visible, it is updated only if events have been received from the bound controls while the control was not visible.

Depending on the specific ColdFusion tag, a bind expression can use bind parameter values directly or pass bind parameter values as parameters to a CFC function, a JavaScript function, or an HTTP request and use the function or request response to update the page. You can use the following as the data source for a bind expression:

- ColdFusion form control attributes and values. You can bind to the following controls:
  - cfgrid
  - cfinput with checkbox, datefield, file, hidden, radio, or text types
  - cfselect
  - cftextarea
  - cftree
  - Spry data set elements

Note: You cannot use a bind expression to bind to controls in a dynamically loaded region. For example, you cannot bind from a control on one page to a control in a layout area on that page if the cflayoutarea tag uses a source attribute for its contents. However, a dynamically loaded region can bind to controls on the page that loads it, so the file specified by the source attribute can use bind expressions that specify controls on the page that contains the cflayoutarea tag.

The results of the bind expression determine the value of the tag that uses the expression. For example, if you specify a URL in a bind expression as the source attribute of a cfwindow control, the page specified by the URL must return the full contents of the window.

For more examples, see “Using Ajax UI Components and Features” on page 613 and the reference pages for controls that support binding.
Using bind expressions

To specify a bind expression, use one of the following formats:

- `cfc:componentPath.functionName(parameters)`
  
  **Note:** The component path cannot use a mapping. The `componentPath` value must be a dot-delimited path from the web root or the directory that contains the current page.

- `javascript:functionName(parameters)`
- `url:URL?parameters`
- `URL?parameters`

- A string containing one or more instances of `{bind parameter}`, such as `{firstname}.{lastname}@{domain}`

In formats 1-4 the parameters normally include one or more bind parameters. The following table lists the tag attributes that support bind expressions and the formats each can use:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tags</th>
<th>Supported formats</th>
</tr>
</thead>
<tbody>
<tr>
<td>autosuggest</td>
<td><code>cfinput type=&quot;text&quot;</code></td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>bind</td>
<td><code>cfdiv,cfinput,cftextarea</code></td>
<td>1, 2, 3, 5</td>
</tr>
<tr>
<td>bind</td>
<td><code>cfajaxproxy,cfgrid,cfselect,cfsprydataset,cftreeitem</code></td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>onChange</td>
<td><code>cfgrid</code></td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>source</td>
<td><code>cflayoutarea,cfpod,cfwindow</code></td>
<td>4</td>
</tr>
</tbody>
</table>

The following tables show some of these uses:

```coldfusion
bind="cfc:myapp.bookorder.getChoices({book})"
source="/myApp/innerSource/cityWindow.cfm?cityname={inputForm:city}
```

In these examples, `{book}` and `{inputForm:city}` specify bind parameters that dynamically get data from the book and city controls, and the city control is in the inputForm form.

If a bind attribute specifies a page that defines JavaScript functions, the function definitions on that page must have the following format:

```coldfusion
functionName = function(arguments) {function body}
```

Function definitions that use the following format may not work:

```coldfusion
function functionName (arguments) {function body}
```

However, Adobe recommends that you include all custom JavaScript in external JavaScript files and import them on the application's main page, and not write them in-line in code that you get using the source attribute. Imported pages do not have this function definition format restriction.

Specifying bind parameters

A bind parameter specifies a form control value or other attribute, as in the following example:

```coldfusion
bind="cfc:myapplication.bookSearch.getStores({form1:bookTitle})"
```

In this example, the bind parameter is `form1:bookTitle` and specifies the `value` attribute of the `bookTitle` field of the `form1` form.

Bind parameters have either of the following formats:

```coldfusion
{{formName:}controlName{.attributeName}[@event]}
```
The square brackets ([ ]) indicate optional contents and are not part of the parameter.

**Note:** To include a literal brace character in a bind expression, escape the character with a backslash, as `\{, \}`.

**The formname value**

The formname entry identifies the form that contains the control you are binding to. You must specify a form name if multiple forms contain bind targets with the same names. To specify the form name, start the bind expression with the form's id attribute the name attribute if you did not specify an id attribute, and follow it with a colon (:). To specify the book control that is in a form named inputForm, for example, use the following format:

```
bind="cfc:myapp.bookorder.getChoices({inputForm:book})"
```

**The controlName value**

To bind to a form field, the controlName value must be the value of the id or name attribute of the form control to which you are binding. If a control has both an id and a name attribute, you can use either value.

You can bind to any ColdFusion form control, including `cfgrid` and `cftree`. You cannot bind to values in other ColdFusion tags, such as `cftable`.

To bind to a Spry data set, specify the data set name in this part of the bind parameter.

You can bind to multiple radio buttons or check boxes by giving them the same name value. If all the radio buttons in a radio button group have the same name value, the bind parameter represents the selected button. If multiple check boxes have the same name value, the bind parameter represents the values of the selected controls in a comma-delimited list. If you also specify a unique id attribute for each check box or radio button, you can specify an HTML label tag for each button or check box and use the id value in the for attribute; in this case, users can select items by clicking the label, not just the button or box.

If a `cfselect` control supports multiple selections, the bind expression returns the information about the selected items in a comma-delimited list.

You can bind only to controls that are available in the DOM tree when the bind is registered. Binds are registered when the page with the bind expression loads, either in the browser window or in a container tag. As a result, if you have two `cfdiv`, `layoutarea`, `cfpod`, or `cfwindow` containers that you load by using a source (or for `cfdiv` tag, bind) attribute, you cannot bind controls in one container to controls in the other, because one container cannot be assured that the other is loaded when it loads. Similarly, elements on the main page cannot bind to elements on a dynamically loaded container. To prevent this problem, you should define the bind target in line on the main page, instead of using a source or bind attribute to retrieve the markup that contains the bind target. In other words, the "master" form with fields that serve as sources of bind expressions should be loaded statically (on the main page), and the "child" controls that depend on the data can be loaded dynamically, on a page that is specified in a source or bind attribute.

**The attributeName value**

When you bind to a form control, by default, the bind expression represents the value attribute of the specified control. If the bind target is a `cfselect` tag, the bind expression represents a comma delimited list of the values of the selected items.

To bind to a different attribute, follow the control name or id with a period (.) and the attribute name. To pass the checked attribute of a checkbox `cfinput` tag as a CFC parameter, for example, use an expression such as the following:

```
bind="cfc:myapp.bookorder.useStatus({myForm:approved.checked"@click}""
```
**Note:** You can bind to the display text of a select box, instead of the value, by specifying an attribute name of `innerHTML`. When you bind to a check box, use the `@click` event specifier to ensure that the bind expression is triggered in Internet Explorer when the user selects or deselects the check box, not when the box loses focus.

Grids and trees do not have default bind attributes.

- You must always specify a grid target attribute by using the format `{gridID.columnName}`. The bind expression gets the value of the specified column in the selected row.
- For trees, you must bind to a specific node in the tree. You can specify the node by using the node ID or an explicit path to the node.

To bind to a Spry data set element or attribute, use standard Spry path notation. For example, specify an element name.

**The event value**

By default, the bind expression function executes each time the control specified in the bind parameter has an `onChange` event. To trigger updates on a different JavaScript event, end the bind expression with an at sign (@) and the event name, without the "on" prefix. The following code, for example, executes the `getChoices` CFC each time the user presses the mouse button while the pointer is over the book control:

```javascript
bind="cfc:myapp.bookorder.getChoices({inputForm:book@mousedown})"
```

**Note:** To bind to a `cfinput` control with `type` attribute of `button`, you must specify a bind event setting, such as `click`. The `change` event is the default event has no effect.

When you bind to a Spry data set, do not specify an event. The expression is evaluated when the selected row changes in the data set, or when the data set reloads with new data.

You can also specify that a specific bind parameter never triggers bind expression reevaluation, by specifying `@none` as the event. This is useful, for example, if a bind expression uses multiple bind parameters binding to different form fields, and you want the bind expression to trigger changes only when one of the fields changes, not when the others change. In this case, you would specify `@none` for the remaining fields, so events from those fields would not trigger the bind. The following code shows this use:

```javascript
bind="cfc:books.getinfo({iForm:book}, {iForm:author@none})"
```

The `@none` event specifier can also be useful when used with autosuggest text inputs, trees and grids, as follows:

- When you use an autosuggest text input, the bind expression is evaluated as a user types in text, and picks up data from all bind parameters, including those with `@none` specified. Therefore, for autosuggest, you can specify `@none` for all bind parameters, because there is no way for it to react to changes in the parameters.
- When you call the `ColdFusion.Grid.refresh` or `ColdFusion.Tree.refresh` function, the function fetches data from all bind parameters when it evaluates the bind expression, including any parameters with `@none` specified. If you specify `@none` for all bind parameters, the tree or grid might not respond to changes in other controls, but it will get data from all the bind parameters each time you explicitly refresh it.

**Using CFC functions in bind expressions**

As with JavaScript functions, you can pass arguments to a CFC function specified in a bind expression positionally. When you do this, the argument names in a CFC function definition do not have to be the same as the bind parameter names, but the arguments in the bind expression must be in the same order as those in the CFC function definition.
Alternatively, you can pass named CFC function arguments. Then, the bind expression and CFC function must use the same names for the arguments, and the function does not have to define the arguments in the same order as they are passed. To specify argument names in a bind expression, use a format such as the following, which uses two named parameters, arg1 and arg2:

```
bind="cfc:mycfc.myfunction(arg1={myform:myfield1},arg2={myform:myfield2})"
```

**Using binding in control attributes**

When you use direct binding you specify a bind expression in a ColdFusion form or display control attribute. In the simplest form of binding you can use form fields, such as a name field, to fill other fields, such as an e-mail field, as the following example shows. When you enter a name or domain and tab to click in another field, the name is added to the e-mail field.

```html
<html>
<head>
</head>
<body>
<cfform name="mycfform">
  First Name: <cfinput type="text" name="firstname" value=""> <br>
  Last Name: <cfinput type="text" name="lastname" value=""> <br>
  Domain: <cfinput type="text" name="domain" value=""> <br>
  E-mail: <cfinput type="text" name="email1" size="30"
                 bind="{firstname}.{lastname}@{domain}"/>
</cfform>
</body>
</html>
```

The following example shows the results of binding to radio buttons and check boxes with the same name attribute but different id attributes. Notice that because each control as a separate id value that is used in the label tags, you can click the labels to select and deselect the controls.

```html
<html>
<head>
</head>
<body>
<cfform name="myform">
  Pick one: 
  <cfinput id="pickers1" name="pickone" type="radio" value="Apples"> 
    <label for="pickers1">Apples</label>
  </cfinput>
  <cfinput id="pickers2" name="pickone" type="radio" value="Oranges"> 
    <label for="pickers2">Oranges</label>
  </cfinput>
  <cfinput id="pickers3" name="pickone" type="radio" value="Mangoes"> 
    <label for="pickers3">Mangoes</label>
  </br/>
  <cfinput name="pickone-selected" bind="{pickone}"> <br />
</cfinput>

  Pick as many as you like:
  <cfinput id="pickers4" name="pickmany" type="checkbox" value="Apples"> 
    <label for="pickers4">Apples</label>
  </cfinput>
  <cfinput id="pickers5" name="pickmany" type="checkbox" value="Oranges"> 
    <label for="pickers5">Oranges</label>
  </cfinput>
  <cfinput id="pickers6" name="pickmany" type="checkbox" value="Mangoes"> 
    <label for="pickers6">Mangoes</label>
  </br/>
  <cfinput name="pickmany-selected" bind="{pickmany}"> <br />
</cfinput>
</cfform>
</body>
</html>
```
Most applications call a CFC function, or JavaScript function, or use a URL to make an HTTP request (typically to a CFML page), and pass bind parameters as the function or URL parameters.

The following example uses the same form as the first example in the preceding section, but uses a different bind expression with the following features:

- It uses the keyup events of the name and domain fields to trigger binding. So the e-mail field gets updated each time that you enter a letter in any of these fields.
- It calls a CFC, which uses only the first letter of the first name when forming the e-mail address, and forces the domain name to be all lowercase.

The following example shows the bindapp.cfm page:

```html
<html>
<head>
</head>
<body>
<cfform name="mycfform">
  First Name: <cfinput type="text" name="firstname" value=""><br>
  Last Name: <cfinput type="text" name="lastname" value=""><br>
  Domain: <cfinput type="text" name="domain" value=""><br>
  E-mail: <cfinput type="text" name="email"
               bind="cfc:bindFcns.getEmailId({firstname@keyup},{lastname@keyup},
                              {domain@keyup})"/>
</cfform>
</body>
</html>
```

The following example shows the bindFcns.cfc CFC file:

```cfcomponent>
  <cffunction name="getEmailId" access="remote">
    <cfargument name="firstname"/>
    <cfargument name="lastname"/>
    <cfargument name="domain"/>
    <cfreturn 
      
      
      
      "#left(arguments.firstname,1)#. arguments.lastname##lcase(arguments.domain)#" >
  </cffunction>
</cfcomponent>
```

Many of the examples in the documentation for ColdFusion Ajax features use binding, including more complex forms of binding.

**Using the cfajaxproxy tag to bind to display controls**

The cfajaxproxy tag with a bind attribute makes any of the following elements dependent on one or more bound ColdFusion Ajax controls:

- A single CFC function
- A single JavaScript function
- An HTTP request; for example, the URL of a CFML page

The function or request executes whenever a specific event (by default, the onChange event) of the bound control occurs.
Note: if you specify a bind attribute with a URL, the HTTP request includes a _CF_NODEBUG URL parameter. ColdFusion checks this value, and when it is true, does not append to the response any debugging information that it normally would send. This behavior ensures that JSON responses to Ajax requests do include any non-JSON (i.e., debugging information) text.

The cfajaxproxy tag includes the following attributes that determine how the proxy handles the data returned by the function or the page:

- The onError function specifies code to handle an HTTP error return. You can use this attribute with a URL or CFC bind.
- The onSuccess function handles a valid return from the function or page and updates the display as required with the returned information.

Binding a function or request by using the cfajaxproxy tag enables you to perform a server-side action, such as updating a database by using bind parameter values based on a user action in some control, and then invoke a specific action or set of actions in one or more controls based on the server response. Because it uses an onSuccess function to process the return from the server, this form of binding provides substantially more flexibility than a CFML control bind parameter. This format also lets you use a control bind parameter for one kind of action, and the cfajaxproxy tag for a different activity.

For example, you might have a form with an editable cfgrid control and a delete button that a user clicks to delete a grid row. The application must have the following behaviors:

- When the user clicks the delete button two things must happen:
  - The application must call a mycfc.deleteButton CFC function to delete the row from the database.
  - The grid must update to remove the deleted row.
- When the user edits the grid content, the grid must call a mycfc.update function to update the database.

You can implement these behaviors by doing the following:

- In the cfgrid tag, specify a bind attribute that uses a bind expression to call a mycfc.update function each time the user changes the grid contents.
- In a cfajaxproxy tag, specify a bind attribute that calls the mycfc.deleterow CFC function, and specify an onSuccess attribute that calls the ColdFusion.Grid.refresh function to update the displayed grid when the CFC function returns successfully.

The following code snippets show how you could do this:

```<cfajaxproxypbind="cfc:mycfc.deleteRow({deletebutton@click},
  {mygrid.id@none})"onSuccess="ColdFusion.Grid.refresh('mygrid', true)"

...<cfinput type="button" name="deletebutton"
<cfgrid name="mygrid" bind="mycfc.update({cfgridpage}, {cfgridpagesize},
  {cfgridsortcolumn}, {cfgridsortdirection})"
```

The following complete example shows a simple use of the bind attribute in a cfajaxproxy tag. For the sake of brevity, the bind expression calls a JavaScript function; as a result, the cfajaxproxy tag cannot use a onError attribute.

```html
<head>
  <script language="javascript">
    function test(x,y){
      return "Hello, " + x + "!";
    
```
Getting bindable attribute values in JavaScript

You can use the ColdFusion.Ajax.submitForm function in your JavaScript code to get the current value of any attribute of a bindable control. This technique is particularly useful for getting values for complex controls such as cfgrid and cftree. For more information, see the ColdFusion.Ajax.submitForm function in the CFML Reference.

Managing the client-server interaction

You can manage the client-server interaction in several ways:

- Use the cfajaxproxy tag to create a client-side JavaScript proxy for a CFC and its functions. You can then call the proxy functions in client JavaScript code to access the server-side CFC functions.

- Use the cfsprydataset tag to dynamically populate a Spry data set from a URL or a CFC. You can then use the data set to populate Spry dynamic regions. You can also use Spry data sets in bind expressions.

- Use the cfajaxproxy tag to bind fields of ColdFusion Ajax form controls as parameters to a specific CFC function, JavaScript function, or HTTP request, and specify JavaScript functions to handle successful or error results. The function is invoked each time the event determined by the bind expression occurs.

- Use ColdFusion Ajax-based UI tags, such as cftree or cfgrid that automatically get data from CFCs or URLs by using data binding.

For information on working with Spry, including how to use the cfsprydataset tag, see “Using Spry with ColdFusion” on page 661. For detailed information on using binding, including how to use binding with ColdFusion UI tags and the cfajaxproxy tag, see “Binding data to form fields” on page 649. For more information on using the ColdFusion Ajax-based UI tags, see “Using Ajax UI Components and Features” on page 613.

Using ColdFusion Ajax CFC proxies

You can use the cfajaxproxy tag to create a client-side JavaScript proxy for a CFC and its functions. The proxy object has the following characteristics:

- It provides a JavaScript function the corresponds to each CFC remote function. Calling these functions in your client-side JavaScript code remotely calls the CFC functions on the server.
• It provides JavaScript support functions for controlling the communication, which specifies asynchronous result and error handler callbacks, and sends form data to the server. For detailed information on these functions, see “CFC proxy utility functions” on page 42 in the cfajaxproxy tag in the CFML Reference.

• It manages the interactions between the client and the CFC, including serializing and deserializing JavaScript arrays and structures to and from JSON format for transmission over the web.

• It ensures automatic serialization (into JSON format) and deserialization of CFC return values.

By using a ColdFusion Ajax proxy, any JavaScript code can call the proxied CFC functions. Thus, any Ajax application, not just one that uses ColdFusion Ajax UI elements, can use dynamic data provided by CFCs. Also, the proxy provides access to all of the functions in a CFC, not just the single function that you can specify in a bind expression.

Creating a JavaScript CFC proxy
The cfajaxproxy tag with a cfc attribute generates a JavaScript proxy that represents a CFC on the web client. Because a ColdFusion page that uses the cfajaxproxy tag is used as an Ajax client web page, the page typically starts with the cfajaxproxy tag (or tags), and the remainder of the page consists of the HTML and JavaScript required to control the display and perform the page logic on the client.

Note: Because JavaScript is case-sensitive, you must make sure that you match the case of the keys in any ColdFusion structure or scope that you send to the client. By default, ColdFusion sets variable names and structure element names to all-uppercase. (You can create structure element names with lowercase characters by specifying the names in associative array notation, for example, myStruct["myElement"]="value"). The keys for the two arrays in the JSON object that the ColdFusion SerializeJSON function generates to represent a query are COLUMNS and DATA, for example, not columns and data.

For more information about creating and using CFC proxies, see the cfajaxproxy tag in the CFML Reference.

Configuring the CFC proxy
The proxy provides several JavaScript functions that you use to control the behavior of the proxy:

• You use the setAsyncMode and setSyncMode functions to control the call mode. By default, all calls to remote CFC functions are asynchronous, the most common synchronization method for Ajax applications.

• You use the setCallbackHandler and setErrorHandler functions to specify the functions that handle the results of successful and unsuccessful asynchronous calls.

Note: For error handling to work properly, you must select the Enable HTTP Status Codes option on the Server Settings > Settings page of the ColdFusion Administrator.

• You use the setHTTPMethod function to control whether the call uses a GET HTTP request (the default) or a POST request.

• You use the setForm function to prepare the proxy to send full form data to the remote function. This function causes the proxy to pass each form field as a separate parameter to the CFC function.

• You use the setReturnFormat function to specify whether to return the result in JSON format (the default), in WDDX format, or as plain text. You use the setQueryFormat function to specify whether to return a JSON format query as an object with an array of column names and an array of row arrays, or as an object that corresponds to the WDDX query format. These functions only affect the format of data returned by ColdFusion. Data sent from the proxy to the server is always in JSON format.
Submitting data to a CFC

When you use an Ajax CFC proxy, you can send to the CFC function any client-side data that can be serialized to JSON format, not just form data. However, the proxy cannot serialize DOM tree elements because they are wrappers on native code. Therefore, you cannot use DOM tree elements directly as parameters to a CFC function that you call by using an Ajax proxy. To ensure correct serialization to JSON for sending to the CFC, you must use basic JavaScript types only: array, object, and simple types. Instead of using a DOM element directly, you can pass only the specific element attributes that you require to the CFC function, either individually or in an array or object.

When you use the cfc attribute, you can submit form data to the CFC without refreshing the client page by calling the proxy setForm function before you call a CFC proxy function in your JavaScript. The proxy function then passes all field values of the specified form to the CFC function. In the CFC function Arguments scope, the argument names are the form control ID attributes (or, by default, the name attributes) and the argument values are the control values.

**Note:** You cannot use the setForm function to submit the contents of file fields.

To pass the form parameters to your proxy function, you must invoke the proxy function immediately after you call the setForm function. Subsequent proxy function invocations do not get the form parameters.

If you also pass arguments explicitly to the CFC, cfargument tags in the CFC function that specify the explicitly passed arguments must precede any cfargument tags for the form fields. For example, you might have the following submitForm JavaScript function:

```javascript
function submitForm() {
    var proxy = new remoteHandler();
    proxy.setCallbackHandler(callbackHandler);
    proxy.setErrorHandler(errorHandler);
    proxy.setForm('myform');
    proxy.setData('loggedIn');
}
```

In this example, the remoteHandler.cfc setData function should start as follows:

```xml
<cffunction name="setData" access="remote" output="false">
    <cfargument name="loggedIn">
    <cfargument name="userName">
    ...  
</cffunction>
```

In this example, userName is the name of a form field. If the cfargument tag for userName preceded the cfargument tag for the loggedIn explicitly passed variable, the CFC function would not get the value of loggedIn.

Your CFC function can omit cfargument tags for the form fields.

**Example: Using an asynchronous CFC proxy**

The following example uses a remote CFC method to populate a drop-down list of employees. When you select a name from the list, it uses a call to the CFC method to get information about the employee, and displays the results.

The main application page has the following lines:

```xml
<!---- The cfajaxproxy tag creates a client-side proxy for the emp CFC.
      View the generated page source to see the resulting JavaScript.
      The emp CFC must be in the components subdirectory of the directory
      that contains this page. ---->
<cfajaxproxy cfc="components.emp" jsclassname="emp">

<html>
<head>
    <script type="text/javascript">
        // Function to find the index in an array of the first entry
```
// with a specific value.
// It is used to get the index of a column in the column list.
Array.prototype.findIndex = function(value){
  for (var i=0; i < this.length; i++) {
    if (this[i] == value) {
      return i;
    }
  }
}

// Use an asynchronous call to get the employees for the
// drop-down employee list from the ColdFusion server.
var getEmployees = function(){
  // Create an instance of the proxy.
  var e = new emp();
  // If you set a callback handler for the proxy, the proxy's calls
  // are asynchronous.
  e.setCallbackHandler(populateEmployees);
  e.setErrorHandler(myErrorHandler);
  // The proxy getEmployees function represents the CFC
  // getEmployees function.
  e.getEmployees();
}

// Callback function to handle the results returned by the
// getEmployees function and populate the drop-down list.
var populateEmployees = function(res)
{
  with(document.simpleAJAX){
    var option = new Option();
    option.text='Select Employee';
    option.value='0';
    employee.options[0] = option;
    for(i=0;i<res.DATA.length;i++){
      var option = new Option();
      option.text=res.DATA[i][res.COLUMNS.findIndex('FIRSTNAME')]
        + ' ' + res.DATA[i][res.COLUMNS.findIndex('LASTNAME')];
      option.value=res.DATA[i][res.COLUMNS.findIndex('EMP_ID')];
      employee.options[i+1] = option;
    }
  }
}

// Use an asynchronous call to get the employee details.
// The function is called when the user selects an employee.
var getEmployeeDetails = function(id){
  var e = new emp();
  e.setCallbackHandler(populateEmployeeDetails);
  e.setErrorHandler(myErrorHandler);
  // This time, pass the employee name to the getEmployees CFC
  // function.
  e.getEmployees(id);
}

// Callback function to display the results of the getEmployeeDetails
// function.
var populateEmployeeDetails = function(employee)
{
  var eId = employee.DATA[0][0];
  var efname = employee.DATA[0][1];
  var elname = employee.DATA[0][2];
  var eemail = employee.DATA[0][3];
var ephone = employee.DATA[0][4];
var edepartment = employee.DATA[0][5];

with(document.simpleAJAX) {
    empData.innerHTML =
    '<span style="width:100px">Employee Id:</span>'
    + '<font color="green"><span align="left">' + eId + '</span></font><br>'
    + '<span style="width:100px">First Name:</span>'
    + '<font color="green"><span align="left">' + efname + '</span></font><br>'
    + '<span style="width:100px">Last Name:</span>'
    + '<font color="green"><span align="left">' + elname + '</span></font><br>'
    + '<span style="width:100px">Email:</span>'
    + '<font color="green"><span align="left">' + eemail + '</span></font><br>'
    + '<span style="width:100px">Phone:</span>'
    + '<font color="green"><span align="left">' + ephone + '</span></font><br>'
    + '<span style="width:100px">Department:</span>'
    + '<font color="green"><span align="left">' + edepartment + '</span></font>'
}

// Error handler for the asynchronous functions.
var myErrorHandler = function(statusCode, statusMsg) {
    alert('Status: ' + statusCode + ', ' + statusMsg);
}
</script>
</head>
<body>
<!--- The form to display the employee drop-down list and employee data. --->
<form name="simpleAJAX" method="get">
List of Employees:
<select name="employee" onChange="getEmployeeDetails(this.value)">
<script language="javascript">
getEmployees();
</script>
</select>
<br><br>
<span id="empData"></span>
</form>
</body>
</html>

The following component, which gets the data from the data source, must be in a file named emp.cfc in the components subdirectory of the application directory. The CFC uses the cfdocexamples data source that is installed with ColdFusion if you install the documentation.

<cfcomponent>
<cfset this.dsn = "cfdocexamples">
<cffunction name="getEmployees" access="remote" returnFormat="json" output="false">
<cfargument name="empid" required="no" type="string" default="0">
<cfquery name="qryEmp" datasource="#this.dsn#">
select * from Employees
</cfquery>
</cffunction>
</cfcomponent>
Using Spry with ColdFusion

ColdFusion provides support for mixing native ColdFusion elements and Spry elements in a single application.

- ColdFusion tags can use Spry data sets directly in bind expressions. Therefore, a ColdFusion form element, such as cfinput, can bind to a field in a dynamic Spry data set, and is updated each time the data set updates, including when the user selects an item in a Spry control or dynamic region that the data set populates.

  To bind to a Spry data set, specify the data set name followed by the path to the specific element that you bind to, by using standard Spry path syntax. For example, if dsFilters is a Spry data set with a name column, the {dsFilters.name} bind parameter binds to the value of the current row's name column. The bind parameter cannot specify an event; the bind expression is re-evaluated each time the selected row in the data set changes.

  The following example shows the bind syntax:

  ```coldfusion
  <cfinput name="Input1" type="text"
  bind="/CFC:DataManager.getInData(filter={dsFilters.name})"
  />
  ```

- Spry data sets can use a CFC function as the data source. To do this, you simply specify the URL of the CFC in the Spry.Data.XMLDataSet function, just as you would invoke any remote CFC method using a URL. Specify the method name with a method URL parameter, and pass data to the function in additional URL parameters, as in the following example:

  ```coldfusion
  Spry.Data.XMLDataSet("MyAppMgr.cfc\?method=getFilter&filter="scores","filters/filter");
  ```

- The cfsprydataset tag can dynamically create and update Spry XML or JSON data sets based on ColdFusion form data. Spry dynamic regions and other elements can then use this data to control their display.

  The following example shows a cfsprydataset tag that creates a Spry XML data set named dsProducts by calling the getData.getProductDetails function and passing it the value of the selected name in a cfgrid control. The data set updates each time the name value changes.

  ```coldfusion
  <cfsprydataset
  name="dsProducts"
  type="xml"
  bind="/CFC:getData.getProductDetails(prodname={myform:mygrid.name})"
  xpath="products/product"
  options="\{method: 'POST'}"
  onbinderror="errorHandler">
  ```

ColdFusion includes the complete Spry 1.5 framework release in web_root/CFIDE/scripts/ajax/spry directory. For more information, see the Adobe Labs Spry framework pages. For more information, see the cfsprydataset tag in the CFML Reference.

Spry data set example

This example has the following behavior:

1. It uses a CFC function directly to populate a Spry XML data set, from an XML file.
2. It displays information from the Spry data in a Spry dynamic region list box.

3. It uses the selected item in the Spry data set to control the contents of a cfgrid control. The cfgrid bind expression calls a CFC and passes it a parameter bound to the selected item in the Spry XML data set.

4. It creates a second Spry XML data set by using a cfsprydataset tag that binds to the selected item in the cfgrid control and calls a CFC function.

5. It displays information from the second Spry data set in a second Spry dynamic region.

The example lets a user select the genre of books to display: all books, fiction, or nonfiction from a Spry list box populated from the XML file. The selected genre determines the information displayed by a cfgrid control, and a text input control shows the selected genre. The selected item in the cfgrid control determines the information that is displayed in a second Spry dynamic region.

The application consists of the following files:

- A roundtrip.cfm page with the display controls and related logic
- A GridDataManager.cfc file with two functions:
  - A getFilter function that gets the XML for the spry data set
  - A getData function that gets the contents of the cfgrid control
  - A getProduct function that gets detailed information on the selected book
- A Filters.xml file with the XML data for the spry data set

For this example to display images, you must also create an images subdirectory of your application directory that contains images with the names specified by the BOOKIMAGE column of the cfbookclub database BOOKS table.

The roundtrip.cfm page

```html
<html xmlns="http://www.w3.org/1999/xhtml" xmlns:spry="http://ns.adobe.com/spry">
  <head>
    <!--- The screen.css style sheet is provided in the Spry distribution. --->
    <link href="screen.css" rel="stylesheet" type="text/css" media="all"/>
    <!--- Include the XPath and Spry JavaScript files. --->
    <script type="text/javascript" src="/CFIDE/scripts/ajax/spry/includes/xpath.js"></script>
    <script type="text/javascript" src="/CFIDE/scripts/ajax/spry/includes/SpryData.js"></script>
    <!--- Create the dsFilters Spry XML data set used to populate the FiltersList dynamic region that lists the filters. Call the GridDataManager CFC getFilter method directly from a Spry XMLDataSet function because no binding is needed. --->
    <script>
      var dsFilters = new Spry.Data.XMLDataSet("GridDataManager.cfc?method=getFilter", "filters/filter");
    </script>
    <!--- Use a cfsprydataset tag with binding to generate a dsProduct Spry data set with details about the book grid selection. --->
    <cfsprydataset name="dsProduct" type="xml" bind="CFC:GridDataManager.getProductDetails(prodname={bookform:bookgrid.TITLE})" xpath="products/product" options="{method: 'POST'}" onBindError="errorHandler">
```
<!--- Function to handle bind errors. --->
<script language="javascript">
errorHandler = function(code,msg){
    alert("Error w/bind occurred. See details below:
    Error Code: "+ code + ": \n" + "Error Message: "+ msg);
}
</script>

<!--- Specify the size of the FiltersList Spry dynamic region.
By default it would be unnecessarily large. --->
<style type="text/css">
#FiltersList {
    height:100px;
    width: 150px;
}
</style>

<body>
<!--- A Spry dynamic region containing repeated ListBoxItem controls.
Each item specifies a filter to use in filling the book list grid.
The items are populated by the data from the CFC getFilter method. --->
<div id="FiltersList" spry:region="dsFilters" class="SpryHiddenRegion">
<div spry:repeat="dsFilters" class="ListBoxItemGroup">
<div class="ListBoxItem"
    onclick="dsFilters.setCurrentRow('{dsFilters::ds_RowID}');"
    spry:selectgroup="feedsList" spry:select="SelectedListBoxItem"
    spry:hover="ListBoxItemHover">
    {dsFilters::description}
</div>
</div>
</div>

<!--- A ColdFusion form with the book list data grid. --->
<cfform name="bookform">
<!--- Create a book list grid.
Users select the book for which to get details from this grid.
Populate it with the results of the CFC getData method.
Pass the method the value of the name field of the selected
item in the dsfilters Spry dynamic region. --->
<cfgrid name="bookgrid" format="html"
    bind="CfC:GridDataManager.getData(page={cfgridpage},
    pageSize={cfgridpagesize},sortCol={cfgridsortcolumn},
    sortDir={cfgridsortdirection},filter={dsFilters.name})"
    selectMode="browse"
    width=400
    delete="true"
    pageSize=7>
    <cfgridcolumn name="TITLE" header="Name" width=200>
    <cfgridcolumn name="GENRE" header="Type" width=200>
</cfgrid>
<!--- Show the value of the name field of the selected item in the Spry dynamic region. --->
<cfinput name="filter" bind="[{dsFilters.name}]">
</cfform>
<hr>
<!---- A Spry dynamic region that uses the dsProduct data set to display information on the selected product. ---->
<div id="RSSResultsList" spry:detailregion="dsProduct" class="SpryHiddenRegion">
  <strong>{name}</strong><br>
  <img src="images/{bookimage}" alt="product box shot" width="238" height="130" />
  <div>{desc}</div>
</div>
<hr>
</body>
</html>

The gridDataManager.cfc file

<cfcomponent name="GridDataManager">
  <!--- The getFilter function gets the filter XML to populate the dsFilters Spry data set. It specifies returnFormat=plain to send XML text. --->
  <cffunction name="getFilter" access="remote" output="false" returnFormat="plain">
    <cffile action="read" file="#ExpandPath('.')#\Filters.xml" variable="filtersxml">
    <cfcontent type="text/xml" reset="yes">
      <cfreturn filtersxml>
  </cffunction>
  <!--- The getData function returns books that match the specified genre, or all books if there is no genre. --->
  <cffunction name="getData" access="remote" output="false">
    <cfargument name="page" required="yes">
    <cfargument name="pageSize" required="yes">
    <cfargument name="sortCol" required="yes">
    <cfargument name="sortDir" required="yes">
    <cfargument name="filter" required="no">
    <cfquery name="books" datasource="cfbookclub">
      select TITLE, GENRE from BOOKS
      <cfif isDefined("arguments.filter") AND arguments.filter NEQ ">
        where GENRE = '#arguments.filter#'
      </cfif>
      <cfif arguments.sortCol NEQ "" AND arguments.sortDir NEQ ">
        order by #arguments.sortCol# #arguments.sortDir#
      </cfifelse>
      order by TITLE ASC
    </cfquery>
    </cfargument>
  </cffunction>
  <!--- The getProductDetails gets data for a single book and converts it to XML for use in the dsProduct Spry data set. --->
  <cffunction name="getProductDetails" access="remote" output="false">
    <cfargument name="prodname" default="The Road">
    <!--- Get the information about the book from the database. --->
    <cfquery name="bookDetails" datasource="cfbookclub">
      select TITLE, GENRE, BOOKIMAGE, BOOKDESCRIPTION from BOOKS
      where TITLE = '#arguments.prodname#'
    </cfquery>
    <!--- Convert the query results to XML. --->
    <coutput>
      <cfxml variable="BookDetailsXML">
        <?xml version="1.0" encoding="iso-8859-1"?>
<products>
  <product>
    <name>#BookDetails.TITLE#</name>
    <category>#BookDetails.GENRE#</category>
    <bookimage>#BookDetails.BOOKIMAGE#</bookimage>
    <desc>#BookDetails.BOOKDESCRIPTION#</desc>
  </product>
</products>

<!--- Convert the XML object to an XML string. --->
<cfset xmldata = xmlparse(BookDetailsXML)>
<cfcontent type="text/xml" reset="yes">
<cfreturn xmldata>
</cfcomponent>

The Filters.xml file
<?xml version="1.0" encoding="iso-8859-1"?>
<filters>
  <filter>
    <filterid>1</filterid>
    <name></name>
    <description>No Filter</description>
  </filter>
  <filter>
    <filterid>2</filterid>
    <name>Fiction</name>
    <description>Look for Fiction</description>
  </filter>
  <filter>
    <filterid>3</filterid>
    <name>Non-fiction</name>
    <description>Look for Nonfiction</description>
  </filter>
</filters>

Specifying client-side support files

By default, ColdFusion does the following:

• Gets all the client-side JavaScript, CSS, and other files required for Ajax-based features from the
  web_root/CFIDE/scripts/ajax directory.
• For each application page, imports only the JavaScript files required for the tags that are explicitly included on the page.

In some cases you must override these default behaviors.
Specifying a custom script or CSS location

In some situations, you cannot use the default location for the CFIDE directory, often because a hosting site blocks access to it to prevent access to the ColdFusion Administrator. Then you must move the CFIDE/scripts directory, or the subdirectories that you use in your applications, to a different location.

In other situations, you might have custom versions of some of the client-side files, such as the CSS files that specify form control appearance, that apply only to certain applications.

In both situations, you must inform ColdFusion of the new location. You can specify the location of either or both directories containing the following files:

- All client-side resources required by the ColdFusion Ajax features
- Only the CSS files required by the ColdFusion Ajax features

Specifying the client-side resource location

You can use any of the following techniques to control the location of the directory that contains the client-side resources required by the ColdFusion Ajax features:

- If the ColdFusion client-side files required by all applications, including the files used by cfform tags are in a single location, you can specify the directory in the ColdFusion Administrator > Server Settings > Settings page, Default CFFORM ScriptSrc Directory field. The directory you specify and its subdirectories must have the same structure and contents as the CFIDE/scripts directory tree.

- If the client-side files required for Ajax features on a specific page are in one location, you use the cfajaximport tag scriptsrc attribute to specify the source directory. This tag overrides the setting in the administrator, and does not affect the files used for standard cfform features. The directory you specify must have an ajax subdirectory with the same structure and contents as the CFIDE/scripts/ajax directory tree.

- You can specify the client-side source directory for a specific form in the cfform tag scriptsrc attribute. This setting overrides any cfajaximport tag setting for the form and its child controls. The directory you specify and its subdirectories must have the same structure and contents as the CFIDE/scripts directory tree.

You must be careful if you require multiple resource locations for a single page. Each JavaScript file is imported only once on a page, the first time it is required. Therefore, you cannot use different copies of one JavaScript file on the same page.

To prevent problems, ColdFusion generates an error if you specify more than one scriptsrc attribute on a page. Therefore, if multiple forms require custom client-side resource files, you must specify their location in a single cfajaximport tag, not in scriptsrc attributes in the cfform tags.

Specifying the CSS file location

You can use the cfajaximport tag cssSrc attribute to specify the location of a directory that contains only the CSS files that control the style of ColdFusion Ajax-based controls. This attribute overrides any scriptsrc value in determining the CSS file location. Therefore, you could use the CSS files in the scriptsrc directory tree for most pages, and specify a cssSrc attribute on selected application pages that require a custom look.

For detailed information on how to use the scriptsrc and cssSrc attributes, and requirements for the contents of the specified directory, see the cfajaximport tag in the CFML Reference.

Importing tag-specific JavaScript files

In the following situations, ColdFusion does not automatically import the JavaScript files that are required for Ajax-based tags:
• If you use a ColdFusion Ajax-based tag on a page that you specify by using a source or bind attribute in a container tag, such as cfdiv, cflayoutarea, cfpod, or window, you must put a cfajaximport tag on the page that has the container tag and use the tags attribute to specify the Ajax feature tags that are on the other pages. (You do not have to do this for any tags that are also used on the page with the source attribute.)

• If you use a ColdFusion Ajax JavaScript function, such as ColdFusion.Window.create or ColdFusion.navigate, on a page that does not otherwise import the required ColdFusion Ajax JavaScript functions, you must use the cfajaximport tag to import the required JavaScript functions. If you are using a function, such as coldFusion.navigate, that is not used for a specific control, you can omit any attributes; the default behavior is to import the base functions that are not control-specific. If you are using a function such as ColdFusion.Window.create, you must use the tags attribute and identify the associated control, for example, cfwindow in the following line:

  <cfajaximport tags="cfwindow">

For detailed information on importing tag-specific JavaScript files, see the cfajaximport tag in the CFML Reference.

### Using data interchange formats

All complex data that is communicated over an HTTP connection must be serialized into a string representation that can be transmitted over the web. Most commonly, web client applications use XML or JSON.

As a general rule, ColdFusion automatically handles all necessary serialization and deserialization when you use ColdFusion Ajax features. The proxies that you create with the cfajaxproxy tag, and the bind expressions that call CFC functions automatically request data in JSON format, and automatically deserialize JSON data to JavaScript variables.

ColdFusion also provides the capability to create, convert, and manage data in web interchange formats. This can be helpful, for example, if you use custom Ajax elements to get data from ColdFusion servers.

Also, you can use ColdFusion data serialization capability for any applications that must create or consume complex data transmitted over an HTTP connection. You might want to make a web service or feed available in JSON format. For example, many Yahoo! web services currently are accessible by using simple URLs that return data as JSON.

**Note:** For information on ColdFusion tags and functions for handling XML or WDDX data, see “Using XML and WDDX” on page 865.

### Controlling CFC remote return value data format

By default, CFC functions convert data that they return to remote callers to WDDX format. However, they can also return the data in JSON format, or as plain string data. (XML objects are automatically converted to string representation when returning plain data.)

ColdFusion Ajax elements that request data from CFC functions, including bind expressions and the function proxies generated by the cfajaxproxy tag, automatically generate a returnFormat parameter in the HTTP URL to request JSON data from the CFC function.

You can control the CFC function return format in the following ways:

• Use the returnFormat attribute on the cffunction tag.

• Set a returnFormat parameter in the HTTP request that calls the CFC function.
• Use the CFC proxy\texttt{setReturnFormat} function. (You do this only if your client-side code requires non-JSON format data, for example, XML or WDDX.)

If the requested return format is JSON and the function returns a query, ColdFusion serializes the query into a JSON object in either of the following formats:

• As a JSON object with two entries: an array of column names, and an array of column data arrays.
  These entries are returned in the following situations:
  • By default
  • If you specify an HTTP URL parameter of \texttt{queryFormat=row}
  • If you use the \texttt{cfajaxproxy} tag and call the proxy object's \texttt{setReturnFormat} function with a parameter value of \texttt{row}

ColdFusion client-side binding and proxy code automatically converts this data into JavaScript that can be consumed directly by HTML format grids.

• As a JSON object with three entries: the number of rows, an array of column names, and an object where each key is a column name and each value is an array with the column data.
  These entries are returned in the following situations:
  • If you specify an HTTP URL parameter of \texttt{queryFormat=column}
  • If you use the \texttt{cfajaxproxy} tag and call the proxy object's \texttt{setQueryFormat} function with a parameter value of \texttt{column}

ColdFusion client-side binding and proxy code does not convert column format data into JavaScript that can be consumed directly by HTML format grids. However, use this format with the \texttt{cfajaxproxy} tag, because you can refer to the returned data by using the column names directly. For example, if a CFC function returns a query with user data, you can get the user names in your JavaScript by specifying values such as \texttt{userData.firstName[0]} and \texttt{userData.lastName[0]}.

For more information, see the \texttt{SerializeJSON} function in the \textit{CFML Reference}.

### Using JSON

JSON (JavaScript Object Notation) is a lightweight JavaScript-based data interchange format for transmission between computer systems. It is a much simpler format than XML or WDDX, and is an efficient, compact format for transmitting data required for Ajax applications. ColdFusion Ajax bind expressions that use CFCs tell the CFC function to send the data in JSON format by including a \texttt{returnformat=json} parameter in the HTTP request, and automatically handle the JSON-formatted result.

JSON represents objects by using \{key:value, key:value...\} notation, and represents arrays in standard \[value, value...\] notation. Values can be strings, numbers, objects, arrays, true, false, or null. Therefore, you can nest arrays and objects inside each other. For a detailed specification of the JSON format, see \texttt{www.JSON.org}.

Although ColdFusion Ajax-based controls and the \texttt{cffunction} tag interoperate transparently, without you converting anything to JSON format, other applications can take advantage of JSON format data. Many public feeds are now available in JSON format. For example, the Yahoo! search interface can return a JSON data set, del.icio.us provides JSON feeds showing your posts and tags, and Blogger feeds are available in JSON format. You don't have to use Ajax to display these feeds; you can use standard ColdFusion tags and functions to display the results.

The following CFML functions support using JSON format in server-side code:

• \texttt{DeserializeJSON}
• SerializeJSON
• IsJSON

For more information about these functions and examples, see the CFML Reference.

The following example shows how to use ColdFusion JSON functions in a non-Ajax application. It does a Yahoo search for references to "ColdFusion Ajax" and displays these results:

- The total number of web pages found
- The titles and summaries of the (by default 10) returned results. The title is a link to the web page URL.

<!--- Send an http request to the Yahoo Web Search Service. --->
<cfhttp
    url='http://api.search.yahoo.com/WebSearchService/V1/webSearch?appid=YahooDemo&query="ColdFusion Ajax"&output=json'>

<!--- The result is a JSON-formatted string that represents a structure. Convert it to a ColdFusion structure. --->
<cfset myJSON=DeserializeJSON(#cfhttp.FileContent#)>

<!--- Display the results. --->
<cfoutput>
    <h1>Results of search for "ColdFusion 8"</h1>
    <p>There were #myJSON.ResultSet.totalResultsAvailable# Entries.<br>
    Here are the first #myJSON.ResultSet.totalResultsReturned#.</p>
    <cfloop index="i" from="1" to="#myJSON.ResultSet.totalResultsReturned#">
        <h3><a href="#myJSON.ResultSet.Result[i].URL#">#myJSON.ResultSet.Result[i].Title#</a></h3>
        #myJSON.ResultSet.Result[i].Summary#
    </cfloop>
</cfoutput>

Debugging Ajax applications

ColdFusion provides a set of JavaScript functions that log information to a pop-up display window. ColdFusion also logs many standard client-side activities to the window.

Displaying logging information
To display the logging window you must do the following:

1. Enable ColdFusion to send information to the logging window
2. Request logging window information in the main CFML page request.

Enabling logging output
To enable ColdFusion to send information to the logging window, you must do the following:

- Select the Enable Ajax Debug Log Window option on the ColdFusion Administrator > Debugging & Logging > Debug Output Settings page. To view exception messages in the logging window, you must select the Enable Robust Exception Information option on the Debug Output Settings page.
- Make sure that the IP address of the system where you will be doing the debugging is included on the ColdFusion Administrator > Debugging & Logging > Debugging IP List page of the ColdFusion Administrator. By default this list includes only 127.0.0.1.
Displaying logging information for a page
To display the logging window when you request a CFML page in the browser, specify an HTTP parameter of cfdump in the URL when you request a page, as in the following URL:

http://localhost:8500/myStore/products.cfm?cfdump

After the debug log window appears, it continues running until you navigate to a new page in the browser. The logging window includes options that let you filter the messages by either or both of the following criteria:

- Severity
- Category

You can select to display logging information at any combination of four levels of severity: debug, info, error, and window. The specific logging function that you call determines the severity level.

The logging window always displays options to filter the output by using standard categories: bind, global, http, LogReader, and widget. (For information on these categories, see “Standard ColdFusion logging messages” on page 670.) It also displays a filter option for each custom category that you specify in a ColdFusion logging call. ColdFusion does not limit the number of categories you create, but you should create only as many categories as you require to debug your application effectively.

Logging information
You can call the following JavaScript functions to send information to the logger. In most cases, the function corresponds to a severity level, as follows:

<table>
<thead>
<tr>
<th>Function</th>
<th>Severity</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColdFusion.Log.debug</td>
<td>debug</td>
<td>A message that aids in debugging problems.</td>
</tr>
<tr>
<td>ColdFusion.Log.dump</td>
<td>debug</td>
<td>A representation of a single variable in a format similar to cfdump. This function can display the structure and contents of JavaScript Array and Object variables.</td>
</tr>
<tr>
<td>ColdFusion.Log.error</td>
<td>error</td>
<td>Information about an error. Use this function only in error-handling code.</td>
</tr>
<tr>
<td>ColdFusion.Log.info</td>
<td>info</td>
<td>Information about properly operating code that can be useful in tracing and analyzing the client-side code's execution.</td>
</tr>
</tbody>
</table>

You cannot generate a window-level message. This level is reserved for messages generated by the log reader window, including information about JavaScript errors in the log function calls.

When you call a logging function, you specify a message and a category.

- The message can include JavaScript variables and HTML markup, such as bold text and line breaks.
- The category should be a short descriptive name. ColdFusion generates a check box option for each category to filter the logging window output. This parameter is optional; the default value is global. You can specify a standard ColdFusion category or a custom category.

To log information for a page, you must have a ColdFusion Ajax tag on the page, or use the cfajaximport tag. The cfajaximport tag does not require any attributes to enable logging.

The following logging function generates an error level, Pod A category log message:

ColdFusion.Log.error("<b>Invalid value</b>:" + arg.A, "Pod A");

Standard ColdFusion logging messages
ColdFusion automatically logs messages in the following categories:
Ajax programming rules and techniques

The following techniques can help you to prevent Ajax application errors, improve application security, and develop more effective applications.

Preventing errors

The following rules and techniques can help you prevent errors in your applications:

- To ensure that your code works properly, make sure that all your pages, including dynamically loaded content and pages that contain dynamic regions, have valid html, head, and body tags, and that all script tags are located in the page head. This is particularly important for any page with ColdFusion Ajax tags and script tags, where it ensures that the script code is processed and that code is generated in the correct order. It can also prevent problems in some browsers, such as Internet Explorer.

- All JavaScript function definitions on pages that you include dynamically, for example by using a bind expression, the ColdFusion.navigate function, or a form submission within a ColdFusion Ajax container tag, must have the following syntax format:

  ```javascript
  functionName = function(arguments) {function body}
  ```

  Function definitions that use the following format might not work:

  ```javascript
  function functionName (arguments) {function body}
  ```

  However, Adobe recommends that you include all custom JavaScript in external JavaScript files and import them on the application’s main page, and not write them in-line in code that you get dynamically. Imported pages do not have this restriction on the function definition format.

- As a general rule, the id attributes or name attributes, when you do not specify id attributes, of controls should be unique on the page, including on any pages that you specify in source attributes. Exceptions to this rule include the following:
  - You can use the same name attribute for all options in a radio button group. Bind expressions get information about the selected button.
  - You can use the same name attribute for check boxes in a group if you want a single bind expression to get information about all selected controls in the group.
  - If you have multiple similar forms on a page, you might have controls in each form with the same name or ID. You specify the individual controls in bind expressions by including the form name in the bind parameter.
• Do not use an Application.cfc onRequestEnd function or onRequestEnd.cfm page that creates output in applications that use the cfajaxproxy tag or bind expressions that call CFC functions to get data. ColdFusion Ajax features normally require that all returned data from the server be in JSON format; the onRequestEnd method onRequestEnd.cfm page appends any output as non-JSON information to the end of the returned data.

• By default, all ColdFusion structure element names are in all uppercase characters. Therefore, your client-side Ajax code, such as an onSuccess function specified by a cfajaxproxy tag, must use uppercase letters for the returned object’s element names if you do not explicitly ensure that the element names are not all uppercase. (You can create structure element names with lowercase characters by specifying the names in associative array notation, for example, myStruct["myElement"]="value").

• ColdFusion Ajax controls can throw JavaScript errors if badly formed HTML causes errors in the browser DOM hierarchy order. One example of such badly formed HTML is a table that contains a cfform tag, which in turn contains table rows. In this situation, you should put the table tag inside the cfform tag.


**Improving security**

ColdFusion includes several capabilities that help to ensure the security of Ajax application. Also, the ColdFusion Administrator disables output to the client-side logging window by default (see “Enabling logging output” on page 669).

• To prevent cross-site scripting, you cannot use remote URLs in code that executes on the client. For example, if you use a URL such as http://www.myco.com/mypage.cfm in a cfwindow tag source attribute, the remote page does not load in the window and the window shows an error message. If you must access remote URLs, you must do so in CFML code that executes on the server, for example, by using a cfhttp tag on the page specified by a source attribute.

• When a CFC function returns remote data in JSON format, by default, the data is sent without any prefix or wrapper. To help prevent cross-site scripting attacks where the attacker accesses the JSON data, you can tell ColdFusion to prefix the returned data with one or more characters. You can specify this behavior in several ways. The value of an item in the following list is determined by the preceding item in this list:

  a In the Administrator, enable the Prefix Serialized JSON option on Server Settings > Settings page (the default value is false). You can also use this setting to specify the prefix characters. The default prefix is //, which is the JavaScript comment marker that turns the returned JSON code into a comment from the browser’s perspective. The // prefix helps prevent security breaches because it prevents the browser from converting the returned value to the equivalent JavaScript objects.

  b Set the Application.cfc file This.secureJSON and This.secureJSONPrefix variable values, or set the cfapplication tag secureJSON and secureJSONPrefix attributes.

  c Set the cffunction tag secureJSON attribute. (You cannot use the cffunction tag to set the prefix.)

As a general rule, you should use one of these techniques for any CFC or CFML page that returns sensitive data, such as credit card numbers.

When you use any of these techniques, the ColdFusion Ajax elements that call CFC functions, including bind expressions and the CFC proxies created by the cfajaxproxy tag, automatically remove the security prefix when appropriate. You do not have to modify your client-side code.
ColdFusion provides capabilities that help prevent security attacks where an unauthorized party attempts to perform an action on the server, such as changing a password. You can use the following techniques to help make sure that a request to a CFML page or remote CFC function comes from a ColdFusion Ajax feature, such as a bind expression or CFC proxy, that is a valid part of your application:

- In the \texttt{cffunction} tag in a CFC function that returns data to an Ajax client, specify a \texttt{verifyClient} attribute with a value of \texttt{yes}.
- At the top of a CFML page or function that can be requested by a ColdFusion Ajax client, call the VerifyClient ColdFusion function. This function takes no parameters.

The VerifyClient function and attribute tell ColdFusion to require an encrypted security token in each request. To use this function, enable client management or session management in your application; otherwise, you do not get an error, but ColdFusion does not verify clients.

Enable client verification only for code that responds to ColdFusion Ajax client code, because only the ColdFusion Ajax library contains the client-side support code. Enabling client verification for clients other than ColdFusion Ajax applications can result in the client application not running.

As a general rule, use this function for Ajax requests to the server to perform sensitive actions, such as updating passwords. You should typically \textit{not} enable client verification for public APIs that do not need protected, search engine web services. Also, do not enable client verification for the top-level page of an application, because the security token is not available when the user enters a URL in the browser address bar.

**Programming effectively**

The following recommendations can help improve or customize your ColdFusion Ajax application.

- Use the \texttt{AjaxOnLoad} function, which specifies a JavaScript function to run when the page loads, to perform any initialization actions that are required for a page to function properly. You should use the \texttt{AjaxOnLoad} function to call functions when a page is loaded in a container tag. One use for this function could be on a page that pops up a login window if the user is not already logged in when it displays. You can use the \texttt{AjaxOnLoad} function to specify a JavaScript function that determines the login status and pops up the window only if required.

- Use the following ColdFusion JavaScript functions to access the Ext JS or Yahoo YUI JavaScript library objects that underlie border and tab style \texttt{cflayout} controls, \texttt{cfwindow} controls, and HTML format \texttt{cfgrid} and \texttt{cftree} controls. Then you can use the raw object to modify the displayed control.

  - \texttt{ColdFusion.Layout.getBorderLayout}
  - \texttt{ColdFusion.Grid.getGridObject}
  - \texttt{ColdFusion.Layout.getTabLayout}
  - \texttt{ColdFusion.Tree.getTreeObject}
  - \texttt{ColdFusion.Window.getWindowObject}

For documentation on the objects and how to manage them, see the Ext documentation and the Yahoo toolkit documentation.
Chapter 36: Using the Flash Remoting Service

Using the Flash Remoting service of ColdFusion, ColdFusion developers can work together with Flash designers to build dynamic Flash user interfaces for ColdFusion applications.

For a complete description of Flash Remoting capabilities, including how ColdFusion interacts with Flash Remoting, see *Using Flash Remoting MX 2004* and *Flash Remoting ActionScript Dictionary* in Flash Help. You can also access the Flash Remoting documentation on the Flash Remoting Developer Center at www.adobe.com/devnet/mx/flashremoting.

About using the Flash Remoting service with ColdFusion

Using the Flash Remoting service of ColdFusion, ColdFusion developers can work together with Flash MX 2004 designers to build Flash user interfaces (UIs) for ColdFusion applications. Building Flash UIs requires the separation of UI code from business logic code. You build user interface controls in Flash MX, and you build the business logic in ColdFusion.

The following is a simplified representation of the relationship between Flash and ColdFusion:
Planning your Flash application

When you are planning ColdFusion application development with Flash UIs, remember the importance of separating display code from business logic. Separating display code from business logic enables your ColdFusion applications to interact with multiple client types, such as Flash applications, web browsers, and web services.

When you build ColdFusion applications for multiple clients, your ColdFusion pages and components return common data types, including strings, integers, query objects, structures, and arrays. Clients that receive the results can process the passed data according to the client type, such as ActionScript with Flash, or CFML with ColdFusion.

To use the Flash Remoting service with ColdFusion, you build ColdFusion pages and components or deploy Java objects. In ColdFusion pages, you use the Flash variable scope to interact with Flash applications. ColdFusion components (CFCs) natively support Flash interaction. The public methods of Java objects are also available to the Flash Remoting service.

The Flash Remoting ActionScript API has been updated to comply with ActionScript 2.0. The ActionScript 2.0 version of the API consists of the following significant features:

<table>
<thead>
<tr>
<th>Flash Remoting MX 2004 ActionScript 2.0 API Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforcement of strict data typing, which requires you to declare the data types of variables and prohibits you from assigning different types of data to them.</td>
</tr>
<tr>
<td>Enforcement of case sensitivity, which means that myvar and myVar are two different variables, though they were considered the same variable with different spellings in ActionScript 1.0.</td>
</tr>
<tr>
<td>A new Service class, which lets you create a gateway connection and at the same time obtain a reference to a service and its methods. It includes the connection property, which returns the connection and also lets you set credentials for authorization on the remote server.</td>
</tr>
<tr>
<td><strong>Note:</strong> The NetServices class is still supported but has been deprecated in favor of the new Service and Connection classes</td>
</tr>
<tr>
<td>A new Connection class that helps you create and use Flash Remoting connections.</td>
</tr>
<tr>
<td><strong>Note:</strong> The Connection class supersedes the former NetConnection class.</td>
</tr>
</tbody>
</table>
For more information on the ActionScript 2.0 Flash Remoting API, see Flash Remoting ActionScript Dictionary Help.

## Configuring the Flash Remoting Gateway

The following parameters in the ColdFusion web.xml file point the Flash Remoting gateway to the gateway-config.xml file.

```xml
<init-param>
  <param-name>gateway.configuration.file</param-name>
  <param-value>/WEB-INF/gateway-config.xml</param-value>
</init-param>

<init-param>
  <param-name>whitelist.configuration.file</param-name>
  <param-value>/WEB-INF/gateway-config.xml</param-value>
</init-param>

<init-param>
  <param-name>whitelist.parent.node</param-name>
  <param-value>gateway-config</param-value>
</init-param>
```

Both the web.xml file and the gateway-config.xml file are located in the WEB-INF directory of your ColdFusion server. As a general rule, there is no need to change these web.xml settings.

ColdFusion MX 7 and later versions of ColdFusion configure Flash gateways differently from previous ColdFusion releases. Parameters that worked prior to this release are no longer supported, and you specify all configuration parameters in the gateway-config.xml file. Also, the Flash gateway now supports a whitelist, which specifies which remote sources can be accessed through the gateway. The two web.xml entries that identify the whitelist should specify your gateway-config.xml file and gateway-config as the parent node.

You can modify the gateway-config.xml file to configure service adapters, add service names to the whitelist, change the logging level, and specify how the gateway handles case sensitivity.

You can configure gateway features in the gateway-config.xml file as follows:

### Flash Remoting MX 2004 ActionScript 2.0 API Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PendingCall object</td>
<td>A new PendingCall object returned on each call to a service method that is invoked using the Service object. The PendingCall object contains the responder property, which you use to specify the methods to handle the results of the service call.</td>
</tr>
<tr>
<td>RelayResponder class</td>
<td>A new RelayResponder class, which specifies the methods to which the result and fault outcomes of a service call are relayed.</td>
</tr>
<tr>
<td>RecordSet object</td>
<td>A RecordSet object that contains new properties (columnNames, items, and length), new methods (clear(), contains(), editField(), getEditingData(), getIterator(), getLocalLength(), getRemoteLength(), isEmpty(), and sortItems()), and the new modelChanged event.</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>service adapters</td>
<td>By default, the PageableResultSetAdapter, the ColdFusionAdapter, the CFCAdapter (for ColdFusion components), and the CFSSASAdapter (for server-side ActionScript) adapters are enabled in ColdFusion. You can also enable the JavaBeanAdapter, JavaAdapter, EJBAdapter, ServletAdapter, and CFWSAdapter (for web services) by removing their enclosing comment symbols (&lt;!-- and --&gt;). The following service adapter tags are defined as the default tag values:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;service-adapters&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;adapter&gt;flashgateway.adapter.resultset.PageableResultSetAdapter&lt;/adapter&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;adapter&gt;coldfusion.flash.adapter.ColdFusionAdapter&lt;/adapter&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;adapter&gt;coldfusion.flash.adapter.CFCAdapter&lt;/adapter&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;adapter&gt;coldfusion.flash.adapter.CFSSASAdapter&lt;/adapter&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;!-- &lt;adapter type=&quot;stateful-class&quot;&gt;flashgateway.adapter.java.JavaBeanAdapter&lt;/adapter&gt; --&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;!-- &lt;adapter type=&quot;stateless-class&quot;&gt;flashgateway.adapter.java.JavaAdapter&lt;/adapter&gt; --&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;!-- &lt;adapter type=&quot;ejb&quot;&gt;flashgateway.adapter.java.EJBAdapter&lt;/adapter&gt; --&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;!-- &lt;adapter type=&quot;servlet&quot;&gt;flashgateway.adapter.java.ServletAdapter&lt;/adapter&gt; --&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;!-- &lt;adapter&gt;coldfusion.flash.adapter.CFWSAdapter&lt;/adapter&gt; --&gt;</code></td>
</tr>
<tr>
<td></td>
<td><code>&lt;/service-adapters&gt;</code></td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>security</td>
<td>You can edit security settings in child tags of the <code>&lt;security&gt;</code> tag.</td>
</tr>
<tr>
<td></td>
<td>In the <code>&lt;login-command&gt;</code> tag, you can set the flashgateway.security.JRunLoginCommand implementation for performing local validation. By default, the <code>&lt;login-command&gt;</code> tag is set to the following values:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;login-command&gt;</code>&lt;br&gt;<code>&lt;class&gt;flashgateway.security.JRunLoginCommand&lt;/class&gt;</code>&lt;br&gt;<code>&lt;server-match&gt;JRun&lt;/server-match&gt;</code>&lt;br&gt;<code>&lt;/login-command&gt;</code></td>
</tr>
<tr>
<td></td>
<td>In the <code>&lt;show-stacktraces&gt;</code> tag, you can enable stack traces. Stack traces are useful for debugging and product support, but they should not be set to the client in production mode because they can expose internal information about the system. The following <code>&lt;show-stacktraces&gt;</code> tag is the default tag:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;show-stacktraces&gt;false&lt;/show-stacktraces&gt;</code></td>
</tr>
<tr>
<td></td>
<td>The <code>&lt;whitelist&gt;</code> tag specifies which remote sources can be accessed through the gateway. The <code>*</code> character can be used as a wildcard to imply ALL matches. The following <code>&lt;whitelist&gt;</code> tag shows the default value:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;whitelist&gt;</code>&lt;br&gt;<code>&lt;source&gt;&gt;*&lt;/source&gt;</code>&lt;br&gt;<code>&lt;/whitelist&gt;</code></td>
</tr>
<tr>
<td></td>
<td>When you deploy your application, ensure that you change this setting so that it specifies only the services that the gateway needs to access to run your application. Remember that for ColdFusion based services, directories are treated as “packages” and thus you specify a period delimited path from the web root to the directory or file containing the services you will allow access to. An asterisk wildcard allows access to all services in a particular directory. You can have multiple <code>&lt;source&gt;</code> tags. The following whitelist allows access to the <code>webroot/cfdocs/exampleapps/</code> directory, which includes the flash1 through flash5 Flash Remoting example directories. It also allows access to a <code>webroot/BigApp/remoting</code> directory and its children.</td>
</tr>
<tr>
<td></td>
<td><code>&lt;whitelist&gt;</code>&lt;br&gt;<code>&lt;source&gt;cfdocs.exampleapps.*&lt;/source&gt;</code>&lt;br&gt;<code>&lt;source&gt;BigApp.remoting.*&lt;/source&gt;</code>&lt;br&gt;<code>&lt;/whitelist&gt;</code></td>
</tr>
<tr>
<td>logger level</td>
<td>You can set the level of logging between None, Error, Info, Warning, and Debug. The following tag is the default logger level tag:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;logger level=&quot;Error&quot;&gt;coldfusion.flash.ColdFusionLogger&lt;/logger&gt;</code></td>
</tr>
<tr>
<td>redirect URL</td>
<td>In the <code>&lt;redirect-url&gt;</code> tag, you can specify a URL to receive HTTP requests that are not sent with AMF data. By default, the <code>&lt;redirect-url&gt;</code> tag is set to <code>{context.root}</code>, which is the context root of the web application:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;redirect-url&gt;{context.root}&lt;/redirect-url&gt;</code></td>
</tr>
<tr>
<td>case sensitivity</td>
<td>The <code>&lt;lowercase-keys&gt;</code> tag specifies how the gateway handles case sensitivity. ColdFusion uses case insensitive data structures to store associative arrays, objects, and structs. The Java representation of these data types requires a case-insensitive Map, which the gateway achieves by forcing all keys to lowercase. ActionScript 2.0 is case sensitive and requires a <code>&lt;lowercase-keys&gt;</code> tag value of false. The following <code>&lt;lowercase-keys&gt;</code> tag is the default tag:</td>
</tr>
<tr>
<td></td>
<td><code>&lt;lowercase-keys&gt;true&lt;/lowercase-keys&gt;</code></td>
</tr>
</tbody>
</table>
Using the Flash Remoting service with ColdFusion pages

When you build a ColdFusion page that interacts with a Flash application, the directory name that contains the ColdFusion pages translates to the service name that you call in ActionScript. The individual ColdFusion page names within that directory translate to service functions that you call in ActionScript.

**Note:** Flash Remoting cannot interact with virtual directories accessed through a ColdFusion mapping.

In your ColdFusion pages, you use the Flash variable scope to access parameters passed to and from a Flash application. To access parameters passed from a Flash application, you use the parameter name appended to the Flash scope or the Flash.Params array. To return values to the Flash application, use the Flash.Result variable. To set an increment value for records in a query object to be returned to the Flash application, use the Flash.Pagesize variable.

The following table shows the variables contained in the Flash scope:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>For more information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash.Params</td>
<td>Array that contains the parameters passed from the Flash application. If you do not pass any parameters, Flash.params still exists, but it is empty.</td>
<td>See “Accessing parameters passed from Flash” on page 680.</td>
</tr>
<tr>
<td>Flash.Result</td>
<td>The variable returned from the ColdFusion page to the Flash application that called the function. <strong>Note:</strong> Because ActionScript performs automatic type conversion, do not return a Boolean literal to Flash from ColdFusion. Return 1 to indicate true, and return 0 to indicate false.</td>
<td>See “Returning results to Flash” on page 681.</td>
</tr>
<tr>
<td>Flash.Pagesize</td>
<td>The number of records returned in each increment of a record set to a Flash application.</td>
<td>See “Returning records in increments to Flash” on page 682.</td>
</tr>
</tbody>
</table>

The following table compares the ColdFusion data types and their ActionScript equivalents:

<table>
<thead>
<tr>
<th>ActionScript data type</th>
<th>ColdFusion data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (primitive data type)</td>
<td>Number</td>
</tr>
<tr>
<td>Boolean (primitive data type)</td>
<td>Boolean (0 or 1)</td>
</tr>
<tr>
<td>String (primitive data type)</td>
<td>String</td>
</tr>
<tr>
<td>ActionScript Object</td>
<td>Structure</td>
</tr>
<tr>
<td>ActionScript Object (as the only argument passed to a service function)</td>
<td>Arguments of the service function. ColdFusion pages (CFM files): flash variable scope, ColdFusion components (CFC files): named arguments</td>
</tr>
<tr>
<td>Null</td>
<td>Null (Asc() returns 0, which translates to not defined)</td>
</tr>
<tr>
<td>Undefined</td>
<td>Null (Asc() returns 0, which translates to not defined)</td>
</tr>
<tr>
<td>Ordered array</td>
<td>Array</td>
</tr>
<tr>
<td><strong>Note:</strong> ActionScript array indexes start at zero (for example: my_ASArray[0]).</td>
<td></td>
</tr>
<tr>
<td>Named (or associative) array</td>
<td>Struct</td>
</tr>
<tr>
<td><strong>Note:</strong> ColdFusion array indexes start at one (for example: my_CFArray[1]).</td>
<td></td>
</tr>
</tbody>
</table>
Also, remember the following considerations regarding data types:

- If a string data type on the server represents a valid number in ActionScript, Flash can automatically cast it to a number if needed.
- To return multiple, independent values to the Flash application, place them in a complex variable that converts to a Flash Object, Array, or Associative Array, that can hold all of the required data. Return the single variable and access its elements in the Flash application.

For a complete explanation of using Flash Remoting data in ActionScript, see Using Flash Remoting MX 2004 Help.

### Accessing parameters passed from Flash

To access variables passed from Flash applications, you append the parameter name to the Flash scope or use the `Flash.Params` array. Depending on how the values were passed from Flash, you refer to array values using ordered array syntax or structure name syntax. Only ActionScript objects can pass named parameters.

For example, if you pass the parameters as an ordered array from Flash, `array[1]` references the first value. If you pass the parameters as named parameters, you use standard structure-name syntax like `params.name`.

You can use most of the CFML array and structure functions on ActionScript collections. However, the `StructCopy` CFML function does not work with ActionScript collections. The following table lists ActionScript collections and describes how to access them in ColdFusion:

<table>
<thead>
<tr>
<th>Collection</th>
<th>ActionScript example</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Strict array | `var myArray:Array = new Array(); myArray[0] = "zero"; myArray[1] = "one"; myService.myMethod(myArray);` | The Flash Remoting service converts the Array argument to a ColdFusion array. All CFML array operations work as expected.  
&   `<cfset p1=Flash.Params[1][1]>
&   `<cfset p2=Flash.Params[1][2]`
The Flash.Params array retains the order of the parameters as they were passed to the method. You use standard structure name syntax to reference the parameters; for example:

```cfquery name="flashQuery" datasource="cfdocexamples">
  SELECT ItemName, ItemDescription, ItemCost
  FROM tblItems
  WHERE ItemName EQ '#Flash.paramName#'
</cfquery>
```

In this example, the query results are filtered by the value of `Flash.paramName`, which references the first parameter in the passed array. If the parameters were passed as an ordered array from the Flash application, you use standard structure name syntax; for example:

```cfset Flash.Result = "Variable 1:#Flash.Params[1].zero#, Variable 2: #Flash.Params[1].one#">
```

**Note:** ActionScript array indexes start at zero. ColdFusion array indexes start at one.

## Returning results to Flash

In ColdFusion pages, only the value of the `Flash.Result` variable is returned to the Flash application. For more information about supported data types between ColdFusion and Flash, see the data type table in "Using the Flash Remoting service with ColdFusion pages" on page 679. The following procedure creates the service function `helloWorld`, which returns a structure that contains simple messages to the Flash application.

### Create a ColdFusion page that passes a structure to a Flash application

1. Create a folder in your web root, and name it `helloExamples`.
2. Create a ColdFusion page, and save it as `helloWorld.cfm` in the `helloExamples` directory.
3 Modify helloWorld.cfm so that the CFML code appears as follows:

```cfml
<cfset tempStruct = StructNew()>
<cfset tempStruct.timeVar = DateFormat(Now())>
<cfset tempStruct.helloMessage = "Hello World">

In the example, two string variables are added to a structure; one with a formatted date and one with a simple message. The structure is passed back to the Flash application using the Flash.Result variable.

```cfml
<cfset Flash.Result = tempStruct>
```

4 Save the file.

Remember, the directory name is the service address. The helloWorld.cfm file is a method of the helloExamples Flash Remoting service. The following ActionScript example calls the helloWorld ColdFusion page and displays the values that it returns:

```actionscript
import mx.remoting.*;
import mx.services.Log;
import mx.rpc.*;

// Connect to helloExamples service and create the howdyService service object
var howdyService:Service = new Service(
    "http://localhost/flashservices/gateway",
    null,
    "helloExamples",
    null,
    null);

// Call the service helloWorld() method
var pc:PendingCall = howdyService.helloWorld();
// Tell the service what methods handle result and fault conditions
pc.responder = new RelayResponder( this, "helloWorld_Result", "helloWorld_Fault" );

function helloWorld_Result(re:ResultEvent)
{
    // Display successful result
    messageDisplay.text = re.result.HELLOMESSAGE;
    timeDisplay.text = re.result.TIMEVAR;
}

function helloWorld_Fault(fe:FaultEvent)
{
    // Display fault returned from service
    messageDisplay.text = fe.fault;
}

Note: Due to ActionScript's automatic type conversion, do not return a Boolean literal to Flash from ColdFusion. Return 1 to indicate true, and return 0 to indicate false.
```

Returning records in increments to Flash

ColdFusion lets you return record set results to Flash in increments. For example, if a query returns 20 records, you can set the Flash.Pagesize variable to return five records at a time to Flash. Incremental record sets let you minimize the time that a Flash application waits for the application server data to load.

Create a ColdFusion page that returns a incremental record set to Flash

1 Create a ColdFusion page, and save it as getData.cfm in the helloExamples directory.

2 Modify getData.cfm so that the code appears as follows:

```cfml
<cfparam name="pagesize" default="10">
```
<cfif IsDefined("Flash.Params")>
 <cfset pagesize = Flash.Params[1]>
</cfif>
<cfquery name="myQuery" datasource="cfdocexamples">
 SELECT *
 FROM tblParks
</cfquery>
<cfset Flash.Pagesize = pagesize>
<cfset Flash.Result = myQuery>

In this example, if a single parameter is passed from the Flash application, the `pagesize` variable is set to the value of the `Flash.Params[1]` variable; otherwise, the value of the variable is the default, 10. Next, a statement queries the database. After that, the `pagesize` variable is assigned to the `Flash.Pagesize` variable. Finally, the query results are assigned to the `Flash.Result` variable, which is returned to the Flash application.

3 Save the file.

When you assign a value to the `Flash.Pagesize` variable, you are specifying that if the record set has more than a certain number of records, the record set becomes pageable and returns the number of records specified in the `Flash.Pagesize` variable. For example, the following code calls the `getData()` function of the CFMService and uses the first parameter to request a page size of 5:

```actionscript
import mx.remoting.*;
import mx.services.Log;
import mx.rpc.*;

// Connect to helloExamples service and create the CFMService service object
var CFMService:Service = new Service(
    "http://localhost/flashservices/gateway",
    null,
    "helloExamples",
    null,
    null );

// Call the service getData() method
var pc:PendingCall = CFMService.getData(5);

// Tell the service what methods handle result and fault conditions
pc.responder = new RelayResponder( this, "getData_Result", "getData_Fault" );

function getData_Result(re:ResultEvent)
{
    // Display successful result
    DataGlue.bindFormatStrings(employeeData, re.result, "#PARKNAME#, #CITY#, #STATE#");
}

function getData_Fault(fe:FaultEvent)
{
    // Display fault returned from service
    trace("Error description from server: " + fe.fault.description);
}
```

In this example, `employeeData` is a Flash list box. The result handler, `getData_Result`, displays the columns `PARKNAME`, `CITY`, and `STATE` in the `employeeData` list box. After the initial delivery of records, the RecordSet ActionScript class assumes the task of fetching records. In this case, the list box requests more records as the user scrolls the list box.

You can configure the client-side RecordSet object to fetch records in various ways using the `RecordSet.setDeliveryMode` ActionScript function.
Using Flash with CFCs

CFCs require little modification to work with a Flash application. The tag names the method and contains the CFML logic, the cfargument tag names the arguments, and the tag returns the result to the Flash application. The name of the CFC file (*.cfc) translates to the service name in ActionScript.

Note: For CFC methods to communicate with Flash applications, you must set the cffunction tag's access attribute to remote.

The following example replicates the helloWorld function that was previously implemented as a ColdFusion page. For more information, see "Using the Flash Remoting service with ColdFusion pages" on page 679.

Create a CFC that interacts with a Flash application

1. Create a CFC and save it as flashComponent.cfc in the helloExamples directory.

2. Modify the code in flashComponent.cfc so that it appears as follows:

```cfm
<cfcomponent name="flashComponent">
    <cffunction name="helloWorld" access="remote" returnType="Struct">
        <cfset tempStruct = StructNew()>
        <cfset tempStruct.timeVar = DateFormat(Now())>
        <cfset tempStruct.helloMessage = "Hello World">
        <cfreturn tempStruct>
    </cffunction>
</cfcomponent>
```

In this example, the helloWorld function is created. The cfreturn tag returns the result to the Flash application.

3. Save the file.

The helloWorld service function is now available through the flashComponent service to ActionScript. The following ActionScript example calls this function:

```as
import mx.remoting.*;
import mx.services.Log;
import mx.rpc.*;

// Connect to the Flash component service and create service object
var CFCService:Service = new Service("http://localhost/flashservices/gateway",
null,
"helloExamples.flashComponent",
null,
null);

// Call the service helloWorld() method
var pc:PendingCall = CFCService.helloWorld();

// Tell the service what methods handle result and fault conditions
pc.responder = new RelayResponder(this, "helloWorld_Result", "helloWorld_Fault");

function helloWorld_Result(re:ResultEvent)
{
    // Display successful result
    messageDisplay.text = re.result.HELLOMESSAGE;
    timeDisplay.text = re.result.TIMEVAR;
}

function helloWorld_Fault(fe:FaultEvent) {
```

```as
```
// Display fault returned from service
messageDisplay.text = fe.fault;
}

In this example, the CFCService object references the flashComponent component in the helloExamples directory. Calling the helloWorld function in this example executes the function that is defined in flashComponent.

For ColdFusion components, the component filename, including the directory structure from the web root, serves as the service name. Remember to delimit the path directories with periods rather than backslashes.

**Using the Flash Remoting service with ColdFusion Java objects**

You can run various kinds of Java objects with ColdFusion, including JavaBeans, Java classes, and Enterprise JavaBeans. You can use the ColdFusion Administrator to add additional directories to the classpath.

**Add a directory to ColdFusion classpath**

1. Open the ColdFusion Administrator.
2. In the Server Settings menu, click the Java and JVM link.
3. Add your directory to the Class Path form field.
4. Click Submit Changes.
5. Restart ColdFusion.

When you place your Java files in the classpath, the public methods of the class instance are available to your Flash movie.

For example, assume the Java class `utils.UIComponents` exists in a directory in your ColdFusion classpath. The Java file contains the following code:

```java
package utils;
public class UIComponents {
    public UIComponents() {
    }
    public String sayHello() {
        return "Hello";
    }
}
```

**Note:** You cannot call constructors with Flash Remoting. You must use the default constructor.

In ActionScript, the following `javaService` call invokes the `sayHello` public method of the `utils.UIComponents` class:

```actionscript
import mx.remoting.*;
import mx.services.Log;
import mx.rpc.*;

// Connect to service and create service object
var javaService:Service = new Service(
    "http://localhost/flashservices/gateway",
    null,
```
utils.UIComponents",
null,
null );
// Call the service sayHello() method
var pc:PendingCall = javaService.sayHello();
// Tell the service what methods handle result and fault conditions
pc.responder = new RelayResponder( this, "sayHello_Result", "sayHello_Fault" );

function sayHello_Result(re:ResultEvent)
{
    // Display successful result
    trace("Result is: " + re.result);
}

function sayHello_Fault(fe:FaultEvent)
{
    // Display fault returned from service
    trace("Error is: " + fe.fault.description);
}

Note: For more information about using Java objects with ColdFusion, see "Using Java objects" on page 936

Handling errors with ColdFusion and Flash

To help with debugging, use tags in your ColdFusion page or component to return error messages to the Flash Player. For example, the ColdFusion page, causeError.cfm, contains the code:

<cftry>
    <cfset dev = Val(0)>
    <cfset Flash.Result = (1 / dev)>
    <cfcatch type = "any">
        <cfthrow message = "An error occurred in this service: #cfcatch.message#">
    </cfcatch>
</cftry>

The second cfset tag in this example fails because it tries to divide by zero (0). The message attribute of the cfthrow tag describes the error; ColdFusion returns this attribute to the Flash application.

To handle the error in your Flash application, create a fault handler similar to causeError_Fault in the following example:

import mx.remoting. *;
import mx.services.Log;
import mx.rpc. *;

// Connect to service and create service object
var CFMService:Service = new Service(
    "http://localhost/flashservices/gateway",
    null,
    "helloExamples",
    null,
    null );
// Call the service causeError() method
var pc:PendingCall = CFMService.causeError();
// Tell the service what methods handle result and fault conditions
pc.responder = new RelayResponder( this, "causeError_Result", "causeError_Fault" );

function causeError_Result(re:ResultEvent)
{  
    // Display successful result  
    messageDisplay.text = re.result;
}

function causeError_Fault(fe:FaultEvent)  
{  
    // Display fault returned from service  
    trace("Error message from causeError is: " + fe.fault.description);
}

This example displays the trace message from the causeError_Fault function in the Flash Output panel. The portion of the message that is contained in fe.fault.description is the portion of the message that is contained in #cfcatch.message# in the causeError.cfm page.

Note: When you create a ColdFusion page that communicates with Flash, ensure that the ColdFusion page works before using it with Flash.
Chapter 37: Using Flash Remoting Update

You can use Flash Remoting Update to create Rich Internet Applications in ColdFusion.

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About Flash Remoting Update

The Flash Remoting Update lets you create rich Internet applications using Adobe Flex Builder 2, with the advanced data retrieval features of ColdFusion, such as the `cfpop`, `cfldap`, and `cfquery` tags. In addition, you can use Flash Remoting Update to create Flash Forms and Flash applications that contain features, such as server call backs and customized user interface.

You can use Flash Remoting Update with all configurations of ColdFusion (server, multiserver, and J2EE) on all the platforms that ColdFusion supports.

To use Flash Remoting Update, you must have the following installed:

• Flex Builder 2 or later
• Flash Player 8.5 or later
• ColdFusion MX 7.0.1 or later

Installing Flash Remoting Update

To install Flash Remoting Update:

1. Install ColdFusion.

2. If your ColdFusion server uses something other than port 8500, do the following:
   a. Open the file `<cf_root>/wwwroot/Web-INF/flex/flex-enterprise-services.xml`.
   b. Change the following to specify the port that you are using in the endpoint URL:
      `<endpoint uri="http://localhost:8500/flex2gateway/*" in flex-services.xml`
   c. Save the file.
   d. Restart the ColdFusion server.

Using Flash Remoting Update

To specify a CFC to connect to, you do one of the following:

• Specify the CFC, including the path from the web root, in the MXML.
• Create a named resource for each CFC that you connect to. This is similar to registering a data source.

Specify the CFC in the MXML
✓ Specify the CFC, including the path from the web root, in the MXML; for example:

```xml
<mx:RemotObject
  id="myCfc"
  destination="ColdFusion"
  source="myApplication.components.User"/>
```

The destination "ColdFusion" is preconfigured in the flex-enterprise-services.xml with the wildcard * as the source. To use the source attribute in MXML, you can use any destination by specifying the source="*" in flex-enterprise-services.xml. If you specify a source other that "*" in flex-enterprise-services.xml, that source definition overrides the source specified in the MXML.

Create a named resource for each CFC that you connect to
1 Edit the WEB-INF\flex\flex-enterprise-services.xml file by adding an entry for each CFC that you connect to, for example:

```xml
<destination id="CustomID">
  <channels>
    <channel ref="my-cfamf"/>
  </channels>
  <properties>
    <source>dot_path_to_CFC</source>
    <lowercase-keys>true</lowercase-keys>
  </properties>
</destination>
```

The source attribute specifies the dot notation to the CFC from the web root (the classpath to the CFC).

2 Restart the ColdFusion server.

Use the CFC resource in your Flex Builder 2 project
1 For each Flex Builder 2 project, set the Flex compiler property by doing the following:
   a Select Project > Properties.
   b Select the Flex compiler option.
   c Enter the following in the Additional Compiler Argument text box:

```
--services=C:\CFusion\wwwroot\WEB-INF\flex\flex-enterprise-services.xml
```

2 In the mxml file, you use the `<mx:RemoteObject>` tag to connect to your CFC named resource. With this connection you can call any remote method on the CFC.

3 Use the destination attribute of the `<mx:RemoteObject>` tag to point to the name that you defined in the flex-enterprise-services.xml file; for example:

```xml
<mx:RemoteObject
  id="a_named_reference_to_use_in_mxml"
  destination="CustomID"
  result="my_CFC_handler(event)"/>
```

4 Call a CFC method, for example, as the following example shows:

```xml
<mx:Button label="reload" click="my_CFC getUsers()"/>
```

In this example, when a user presses a button, the Click event calls the CFC method getUsers.
Specify a handler for the return result of the CFC method call for the `<mx:RemoteObject>` tag, as the following example shows.

```javascript
private function my_CFC_handler( event:ResultEvent )
{
    // Show alert with the value that is returned from the CFC.
    mx.controls.Alert.show(ObjectUtil.toString(event.result));
}
```
Chapter 38: Using the LiveCycle Data Services ES Assembler

To use Adobe ColdFusion as the back-end data manager for an Adobe Flex application, you use the Adobe LiveCycle Data Services ES assembler that is provided with ColdFusion. You configure the LiveCycle Data Services ES assembler and write an application that uses the assembler.

To use LiveCycle Data Services ES with ColdFusion, you should be familiar with ColdFusion components; accessing and using data in ColdFusion applications; and using LiveCycle Data Services ES.

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About ColdFusion and Flex

The LiveCycle Data Services ES assembler lets you use ColdFusion components (CFCs) to provide the back-end data management for a Flex application that uses the Data Management Service. You can run LiveCycle Data Services ES as part of ColdFusion or remotely. If you are running LiveCycle Data Services ES as part of ColdFusion, LiveCycle Data Services ES and ColdFusion communicate directly. If you are running LiveCycle Data Services ES remotely, LiveCycle Data Services ES and ColdFusion communicate by using RMI. The following diagram shows how ColdFusion and LiveCycle Data Services ES interact in both cases:

Note: To use the LiveCycle Data Services ES assembler, the Flex application must be running on Flex Data Services 2.0.1 or LiveCycle Data Services 2.5, although not every feature is supported in Flex Data Services 2.0.1.
The Flex server includes a ColdFusion Data Service adapter. The adapter processes changes to data to ensure that data on the client is synchronized with back-end data and vice versa; it executes the `sync`, `fill`, `count` and `get` operations, identifies conflicts, and passes results to LiveCycle Data Services ES.

ColdFusion includes the LiveCycle Data Services ES assembler; along with the ActionScript translator, it converts the input arguments where necessary and translates the return values.

**Note:** If you install LiveCycle Data Services ES, ColdFusion does not map .SWF files. This means that all .SWF files are served through the ColdFusion web application instead of the web server.

The following diagram shows the process that LiveCycle Data Services ES and ColdFusion use when a Flex application calls a method in a ColdFusion component:

1. A Flash client requests data that is handled by the LiveCycle Data Management Service adapter.
2. Flex calls a `fill`, `sync`, `get`, or `count` method in the Data Service.
3. The ColdFusion Data Service adapter sends the request to the LiveCycle Data Services ES assembler. If you are running LiveCycle Data Services ES remotely, the adapter sends the request by using Java Remote Method Invocation (Java RMI).
4. The LiveCycle Data Services ES assembler and the ActionScript translator convert ActionScript 3.0 data types to the appropriate ColdFusion values.
5. The ColdFusion server invokes the `fill`, `sync`, `get`, or `count` method of the assembler CFC, which invokes the appropriate methods in the DAO CFC.
6. The ColdFusion application creates an array of Value Objects or appropriate return value, which it sends to the ColdFusion server.
7. The ColdFusion server sends the results to the LiveCycle Data Services ES assembler.
8. The LiveCycle Data Services ES assembler and the ActionScript translator convert ColdFusion values to the appropriate ActionScript 3.0 data types, and then the assembler sends the results to the ColdFusion Data Service adapter.
9. The ColdFusion Data Service adapter sends the results to the LiveCycle Data Management Service.
10. The LiveCycle Data Management Service passes the results to the Flash client.

**Note:** The RMI registry, which facilitates communication between the ColdFusion Data Service assembler and the remote LiveCycle Data Management Service uses port 1099, which is the default port for Java RMI. You can change the port number by adding `-Dcoldfusion.rmiport=1234` to the Java JVM arguments on both the ColdFusion server and the Flex server.
Application development and deployment process

The following is a typical process for developing and deploying a Flex application that uses the ColdFusion Data Service adapter and LiveCycle Data Services ES assembler to manage back-end database tasks:

1. Design your application.

2. Create the Flex application, in which you define a DataService component in MXML or ActionScript. The DataService component calls methods on a server-side Data Management Service destination to perform activities such as filling client-side data collections with data from remote data sources and synchronizing the client and server versions of data.

3. Configure a destination for the ColdFusion Data Service adapter so that the Flex application to connect to the ColdFusion back-end application. For more information, see “Configuring a destination for the ColdFusion Data Service adapter” on page 693.

4. Write your ColdFusion CFCs. For more information, see “Writing the ColdFusion CFCs” on page 697.

Note: To make creating the CFCs easier, ColdFusion includes wizards that you can use in Flex Builder. For more information, see “Using the ColdFusion Extensions for Eclipse” on page 1142.

5. Test your application by using Flex.

Configuring a destination for the ColdFusion Data Service adapter

To provide the information necessary for the Flex application to connect to the ColdFusion back-end application, you configure a destination. In the destination, you specify the ColdFusion Data Service adapter, the channels to use to transport messages to and from the destination, the CFC that contains the fill, get, sync, and count methods, and other settings.

To provide configuration information, you edit the following files:

1. services-config.xml
   
   You specify channel definitions and enable ColdFusion-specific debugging output in the Flex console in this file. You must also change the port numbers in the services-config.xml file for the RTMP channels if you run more than one ColdFusion instance with the integrated LiveCycle Data Services ES.

2. data-management-config.xml
   
   You specify adapters and destinations in this file.

To ensure that Flex recognizes the LiveCycle Data Services ES assembler and can transport messages to and from the destination, by doing the following:

- Specifying ColdFusion-specific channel definitions
- Specifying the ColdFusion Data Service adapter
- Specifying a destination
- Enabling ColdFusion-specific debugging output
Specifying ColdFusion-specific channel definitions
LiveCycle Data Services ES transports messages to and from destinations over message channels that are part of the Flex messaging system. When you configure a destination, you reference the messaging channels to use. To connect to a ColdFusion back-end application, ensure that the services-config.xml file contains definitions for the cf-polling-amf channel and the cf-rtmp channel in the channels section. If you are running LiveCycle Data Services ES in ColdFusion, the services-config.xml file is in the wwwroot\WEB-INF\flex directory and contains the channel definitions by default. If you are running LiveCycle Data Services ES remotely, the services-config.xml file is located in the C:\lcds\jrun4\servers\default\samples\WEB-INF\flex folder when you install Flex in the default location.

The channel definitions include the following:

```xml
<channel-definition id="cf-polling-amf" class="mx.messaging.channels.AMFChannel">
    <endpoint url="http://{server.name}:{server.port}{context.root}/flex2gateway/cfamfpolling" class="flex.messaging.endpoints.AMFEndpoint"/>
    <properties>
        <polling-enabled>true</polling-enabled>
        <serialization>
            <instantiate-types>false</instantiate-types>
        </serialization>
    </properties>
</channel-definition>

<channel-definition id="cf-rtmp" class="mx.messaging.channels.RTMPChannel">
    <endpoint url="rtmp://{server.name}:2048" class="flex.messaging.endpoints.RTMPEndpoint"/>
    <properties>
        <idle-timeout-minutes>20</idle-timeout-minutes>
        <serialization>
            <!-- This must be turned off for any CF channel -->
            <instantiate-types>false</instantiate-types>
        </serialization>
    </properties>
</channel-definition>
```

Specifying the ColdFusion Data Service adapter
Flex provides adapters to connect to various back-end applications. To use the ColdFusion Data Service adapter, you specify it in the data management configuration file by copying the following adapter-definition to the adapters section of the data-management-config.xml file that is in the WEB-INF/flex folder of the server on which you want to run the Flex application. If you are running LiveCycle Data Services ES in ColdFusion, the data-management-config.xml file contains the adapter definitions by default.

The adapter definition includes the following line:

```xml
<adapter-definition id="coldfusion-dao" class="coldfusion.flex.CFDataServicesAdapter"/>
```

Specifying a destination
A destination is the server-side service or object that you call. You configure Data Management destinations in the data-management-config.xml file.

The destination contains the following elements:
The following code shows a sample destination:

```xml
<destination id="cfcontact">

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>destination id</td>
<td>The ID must be unique for each destination.</td>
</tr>
<tr>
<td>adapter</td>
<td>The name of the adapter to use. You use the ColdFusion adapter element for any ColdFusion specific destinations.</td>
</tr>
<tr>
<td>channels</td>
<td>Use the ColdFusion configured channels that have the instantiate-types flag set to false.</td>
</tr>
<tr>
<td>component</td>
<td>The name or path of the assembler CFC.</td>
</tr>
<tr>
<td>scope</td>
<td>The scope, which can be application, session, or request. The application value specifies that there is only one instance; request specifies that there is a new CFC for each call. ColdFusion does not support session. (Do not confuse this setting with the ColdFusion variable scope; they are not related.)</td>
</tr>
<tr>
<td>use-accessors</td>
<td>Whether the Value Object CFC has getters and setters. Set the value of use-accessors to true if there are getters and setters in the Value Object CFC. However, if you set use-accessors to true and there are no getters and setters in the value object CFC, ColdFusion sets the value of any property of the value object CFC in the this scope. If your CFC does not have any getters and setters, you can increase performance by setting this to false so that ColdFusion does not spend time looking for these methods. The default value is true.</td>
</tr>
<tr>
<td>use-structs</td>
<td>Whether to translate ActionScript to CFCs. Set the value of use-structs to true if you don't require any translation of ActionScript to CFCs. The assembler can still return structures to Flex, even if the value is false. The default value is false.</td>
</tr>
<tr>
<td>hostname</td>
<td>The hostname or IP address of the ColdFusion host. If you are running LiveCycle Data Services as part of ColdFusion you do not specify a hostname or IP address; however, if you are running LiveCycle Data Services ES remotely, you must specify a hostname or IP address.</td>
</tr>
<tr>
<td>identity</td>
<td>The ID of the ColdFusion Data Management server as configured in the ColdFusion Administrator. This is required only if you are accessing a ColdFusion server remotely using RMI and have more than one instance of ColdFusion on a machine.</td>
</tr>
<tr>
<td>remote-username</td>
<td>Credentials to pass to the assembler CFC for all clients. It is generally preferable to use the ActionScript setRemoteCredentials() API on the client.</td>
</tr>
<tr>
<td>remote-password</td>
<td>Credentials to pass to the assembler CFC for all clients. It is generally preferable to use the ActionScript setRemoteCredentials() API on the client.</td>
</tr>
<tr>
<td>method-access-invoke</td>
<td>The access level of the CFC, which can be public (including remote) or remote.</td>
</tr>
<tr>
<td>force-cfc-lowercase</td>
<td>Whether to make property names, query column names, and structure keys lowercase when converting to ActionScript. Query column names must precisely match the case of the corresponding ActionScript variables. The default value is false.</td>
</tr>
<tr>
<td>force-query-lowercase</td>
<td>Whether to make property names, query column names, and structure keys lowercase when converting to ActionScript. Query column names must precisely match the case of the corresponding ActionScript variables. The default value is false.</td>
</tr>
<tr>
<td>force-struct-lowercase</td>
<td>Whether to make property names, query column names, and structure keys lowercase when converting to ActionScript. Query column names must precisely match the case of the corresponding ActionScript variables. The default value is false.</td>
</tr>
<tr>
<td>identity property</td>
<td>The property or list of properties that are the primary key in the database.</td>
</tr>
<tr>
<td>query-row-type</td>
<td>Optional. If the assembler fill method returns a query, you must define an ActionScript type for each row in the query that the ArrayCollection returned.</td>
</tr>
<tr>
<td>fill-method</td>
<td>Whether to update the results of a fill operation after a create or update operation.</td>
</tr>
<tr>
<td>use-fill-contains</td>
<td>Optional. Whether the assembler has a fill-contains method. This method is used to determine whether to refresh the fill. If the specified method returns true, the fill is re-executed after a create or update operation. Set use-fill-contains to true only when auto-refresh is set to true. The default value is false.</td>
</tr>
<tr>
<td>auto-refresh</td>
<td>Optional. Whether to refresh the fill after a create or update operation. The default value is true.</td>
</tr>
<tr>
<td>ordered</td>
<td>Optional. Whether order is important for this filled collection. Allows performance optimization when order is not important. The default value is true.</td>
</tr>
</tbody>
</table>

```xml
</destination>
```
Enabling ColdFusion-specific debugging output

You enable ColdFusion-specific debugging output in the Flex console by adding the following `<pattern>` tag in the `<filters>` tag in the logging section in the services-config.xml file:

```xml
<pattern>DataService.coldfusion</pattern>
```

For more information, see “Configuring the Data Service” in Developing Flex Applications, which is included in the Flex documentation.

**Note:** The ColdFusion Administrator lets you enable or disable LiveCycle Data Management support. If you are running more than one instance of ColdFusion, you must use a unique ID to specify each instance of ColdFusion for which you enable LiveCycle Data Management support. You do so by specifying the identity in the `identity` element in the data-management-config.xml file.
Writing the ColdFusion CFCs

When you create your ColdFusion CFCs, you can do one of the following:

- Create an assembler CFC and a Value Object CFC.
- Create an assembler CFC, a Data Access Object (DAO) CFC, and a Value Object CFC.

You put the database manipulation functionality directly in the methods in the assembler CFC and create a Value Object CFC, which is a CFC that contains property definitions and related get and set methods.

To separate the lower level database functionality from the high-level Flex assembler operations, you create a Data Access Object (DAO) CFC that contains the lower level database functionality. Using this approach, which is the Bean/DAO methodology, requires that you put the fill, get, sync, and count methods in the assembler CFC. The methods in the assembler CFC call methods in the DAO CFC that perform the lower level database functions such as retrieving records. The DAO CFC creates Value Objects, which are CFCs that contain the values. A Value Object is essentially a row in the result set.

The following diagram shows the two methodologies:

![Diagram showing two methodologies for writing ColdFusion CFCs](image)

The LiveCycle Data Management Service recognizes the methods: fill, get, sync, and count. The fill method retrieves records from a database and populates an array with the records. The get method retrieves a specific record. The sync method lets you keep track of synchronization conflicts by accepting a change list, which is an array of change objects. The count method returns a number that indicates how many records are in a result set. To perform any of these database tasks, the Flex application calls the appropriate fill, get, sync, or count method in the assembler CFC. You can also use a fillContains method, which checks whether to update the results of a fill. For more information, see "Managing fills" on page 700.

Creating the fill method

The fill method retrieves records from a database and populates an array with the records. If you use the Bean/DAO methodology, you create the lower level read method separately in the DAO CFC.

The fill method returns the results of a read operation. In the fill method, you create an array to hold the results of the read, and then return the results of the read operation. The essential elements of a fill method appear as follows:

```coldfusion
<cffunction name="fill" output="no" returntype="samples.contact.Contact[]" access="remote">
    <cfreturn variables.dao.read()>
</cffunction>
```
You can return a Value Object CFC, a query, or an array of CFML structures. Using a query instead of a Value Object CFC may improve performance. However, ColdFusion cannot handle nested results sets when you use a query. For example, if one of the CFC properties you are returning from the fill method was populated with another complex type such as another CFC type, ColdFusion cannot automatically convert a column in the query to an object with a custom type. In this case, you return an array of CFCs, and the fill method or the read method in the DAO CFC constructs the correct object.

You can use structures wherever you currently create a ColdFusion component in the Assembler. However, you still receive CFC Value Objects from Flex. For example, the Change Objects that you receive in the sync method contain CFCs, assuming you have a remote alias defined in the ActionScript type.

You can create Value Object CFCs in the get method. However, using the structure functionality, you can create and return a structure instead of a CFC, because the structures are translated in exactly the same way as CFCs. You can also return an array of structures from the fill method instead of an array of CFCs, for example, if you have to do processing on your data and working with CFCs isn’t fast enough. Generally, structures are faster than CFCs. You also use structures when a member of the result object is a complex object. In this case, you create another structure as the value of that key and provide the __type__ key for it.

You specify the returntype of the fill method as a Value Object CFC, a query, or an array:

1. Value Object:
   ```coldfusion
   <cffunction name="fill" output="no"
        returntype="samples.contact.Contact[]" access="remote">
   ```

2. Query:
   ```coldfusion
   <cffunction name="fill" output="no"
        returntype="query" access="remote">
   ```

3. Array of structures:
   ```coldfusion
   <cffunction name="fill" output="no"
        returntype="array" access="remote">
   ```

In addition to specifying the returntype of the fill function depending on whether you are using Value Objects, a query, or an array of structures, you also do the following in the lower level read function:

- Specify the returntype of the read function as the Value Object CFC, a query, or an array, for example:
  ```coldfusion
  <cffunction name="read" output="false" access="public"
       returntype="samples.contact.Contact[]">
  ```

- If you are using Value Objects:
  ```coldfusion
  <cffunction name="read" output="false" access="public" returntype="array">
  ```

- Create the array to contain the Value Objects, as follows:
  ```coldfusion
  <cfset var ret = ArrayNew(1)>
  ```

- Loop through the query to create each Value Object based on each row of the query, for example:
  ```coldfusion
  <cfloop query="qRead">
      <cfscript>
      obj = createObject("component",
          "samples.contact.Contact").init();
      obj.setcontactId(qRead.contactId);
      obj.setfirstName(qRead.firstName);
      obj.setlastName(qRead.lastName);
      obj.setaddress(qRead.address);
      obj.setcity(qRead.city);
      ```
obj.setstate(qRead.state);
obj.setzip(qRead.zip);
obj.setphone(qRead.phone);
ArrayAppend(ret, obj);
</cfscript>
</cfloop>

- If you are using a query:
  - Ensure that you configured the destination with the row type for the destination so that ColdFusion correctly labels each rows in the query with the corresponding ActionScript type. Use the `query-row-type` element, which is in the metadata section of the destination.
  - Specify the following in the `fill` method:
    
    ```
    <cffunction name="fill" output="no" returntype="query"
    access="remote">
    <cfargument name="param" type="string" required="no">
    <cfquery name="myQuery" .>
    <!--- Return the result --->
    <cfreturn myQuery>
    </cffunction>
    ```
  
  - If you are using a DAO CFC, edit the `read` method to return a query instead of an array of CFCs.
  - Ensure that the query column names match the case of the properties in the ActionScript object. Use the `property-case` settings in the destination to do so. Set the `force-query-lowercase` element to false so that ColdFusion converts all column names to lowercase.

- If you are using an array of structures:
  - Create the array to contain the Value Objects, as follows:
    
    ```
    <cfset var ret = ArrayNew(1)>
    ```
  
  - Loop through the query to create the structure that contains the results of the query, for example:
    
    ```
    <cfloop query="qRead">
    <cfscript>
    stContact = structNew();
stContact["_type_"] = "samples.contact.Contact";
stContact["contactId"] = qRead.contactId;
stContact["firstName"] = qRead.firstName;
stContact["lastName"] = qRead.lastName;
stContact["address"] = qRead.address;
stContact["city"] = qRead.city;
stContact["state"] = qRead.state;
stContact["zip"] = qRead.zip;
stContact["phone"] = qRead.phone;
    ArrayAppend(ret, duplicate(stContact));
    </cfscript>
    </cfloop>
    ```
  
  - Use the `"type"` structure element to specify that the Value Object CFC is the type, for example:
    
    ```
    stContact["_type_"] = "samples.contact.Contact";
    ```
  
  - Use the associative array syntax, for example, `contact["firstName"]` to ensure that you match the case of the ActionScript property. If you use the other syntax, for example, `contact.firstName="Joan"`, ColdFusion makes the key name uppercase.
Managing fills

To determine whether to refresh a fill result after an item is created or updated, you include a `fillContains` method in the assembler and set both `use-fill-contains` and `auto-refresh` to `true` in the fill-method section of the `data-management-config.xml` file. The following examples shows a fill-method section:

```xml
<fill-method>
  <use-fill-contains>true</use-fill-contains>
  <auto-refresh>true</auto-refresh>
  <ordered>false</ordered>
</fill-method>
```

In this example, `ordered` is set to `false` because the fill result is not sorted by any criteria. However, if the fill result is sorted, you set `ordered` to `true`. When an item changes in a fill result that is ordered, you must refresh the entire fill result.

The `fillContains` method tells the Flex application whether it is necessary to run the fill again after an item in the fill result has changed. The `fillContains` method returns a value that indicates how the fill should be treated for that change. When the `fillContains` method returns `true`, the fill is executed after a create or update operation.

The following example shows the `fillContains` method signature:

```xml
<cffunction name="fillContains" output="no" returnType="boolean" access="remote">
  <cfargument name="fillArgs" type="array" required="yes">
  <cfargument name="item" type="samples.contact.Contact" required="yes">
  <cfargument name="isCreate" type="boolean" required="yes">
  </cffunction>
```

The `fillContains` method has the following arguments:

- `fillArgs` is a list of arguments to pass to the `fill` method.
- `item` is the record to check to determine if it is in the result set.
- `isCreate` indicates whether the record is new.

A sample `fillContains` method, which determines whether the `fill` arguments (part of the first or last name) are in the Contact item passed to the function, is as follows:

```xml
<cffunction name="fillContains" output="no" returnType="boolean" access="remote">
  <cfargument name="fillArgs" type="array" required="yes">
  <cfargument name="item" type="samples.contact.Contact" required="yes">
  <cfargument name="isCreate" type="boolean" required="yes">
  </cffunction>
```

```xml
<cfif ArrayLen(fillArgs) EQ 0>
  <!--- This is the everything fill. --->
  <creturn true>
</cfif>
<cfelseif ArrayLen(fillArgs) EQ 1>
  <!--- This is a search fill. --->
  <cfset search = fillArgs[1]>
  <cfset first = item.getFirstName()>
  <cfset last = item.getLastName()>
  <!--- If the first or last name contains the search string, --->
  <cfif (FindNoCase(search, first) NEQ 0) OR (FindNoCase(search, last) NEQ 0)>
  <!--- this record is in the fill. --->
  <creturn true>
  <cfelse>
  <!--- this record is NOT in the fill. --->
  <creturn false>
</cfif>
</cffunction>
```
!<!-- By default, do the fill.--->
<cffunction output="true">
<cfreturn true>
</cffunction>

If you are running LiveCycle Data Services ES locally, you can determine whether a fill operation is a refresh or a client triggered fill. You do so by calling the DataServiceTransaction.getCurrentDataServiceTransaction().isRefill() method in your ColdFusion application as follows:
<cfscript>
dst = CreateObject("java", "flex.data.DataServiceTransaction");
t = dst.getCurrentDataServiceTransaction();
isRefill = t.isRefill();
</cfscript>

This does not work over RMI when ColdFusion and Flex are not in the same web application.

Creating the get method

The get method retrieves a specific record. The get method calls the lower level read method. If you use the Bean/DAO methodology, as described in “Writing the ColdFusion CFCs” on page 697, you create the lower level read method separately in the DAO CFC.

The following examples shows the essential elements of a get method:
<cffunction name="get" output="true" returnType="samples.contact.Contact" access="remote">
<cfargument name="uid" type="struct" required="yes">
<cfset key = uid.contactId>
<cfset ret=variables.dao.read(id=key)>
<cfreturn ret[1]>
</cffunction>

The returntype of a get method can be any of the following:

- The Value Object CFC
- Any
- An array

Creating the sync method

The sync method lets you keep track of synchronization conflicts by accepting a change list, which is an array of change objects. In the sync method, you pass in an array of changes, loop over the array and apply the changes, and then return the change objects, as follows:
<cffunction name="sync" output="true" returnType="array" access="remote">
<cfargument name="changes" type="array" required="true">
<!-- Create the array for the returned changes. -->
<cfset var newchanges=ArrayNew(1)>
<!-- Loop over the changes and apply them. -->
<cfloop from="1" to="#ArrayLen(changes)#" index="i" >
<cfset co = changes[i]>
<cfif co.isCreate()>
<cfset x = doCreate(co)>
<cfelseif co.isUpdate()>
<cfset x = doUpdate(co)>
<cfelseif co.isDelete()>
<cfset x = doDelete(co)>
</cfif>
<cfset ArrayAppend(newchanges, x)>  
</cfloop>

<!-- Return the change objects, which indicate success or failure. -->
<cfreturn newchanges>  
</cffunction>

Creating the count method

The count method returns a number that indicates how many records are in a result set. If you use the Bean/DAO methodology, as described in “Writing the ColdFusion CFCs” on page 697, you create the lower level count method separately in the DAO CFC.

The count method contains the following essential elements, without any error handling:

<cffunction name="count" output="no" returntype="Numeric" access="remote">
   <cfargument name="param" type="string" required="no">
   <cfreturn variables.dao.count()>  
</cffunction>

This count method calls a different count method in the DAO CFC, which contains the following essential elements, without any error handling:

<cffunction name="count" output="false" access="public" returntype="Numeric">
   <cfargument name="id" required="false">
   <cfargument name="param" required="false">
   <cfset var qRead="">
   <cfquery name="qRead" datasource="FDSCFCONTACT">
      select COUNT(*) as totalRecords from Contact  
   </cfquery>
   <cfreturn qRead.totalRecords>  
</cffunction>

Notifying the Flex application when data changes

You use the LiveCycle Data Services ES event gateway type provided with ColdFusion, to have ColdFusion applications notify Flex when data that is managed by a destination has changed. You configure the LiveCycle Data Services ES event gateway and write an application that uses the event gateway. For more information, see “Using the Data Management Event Gateway” on page 1124.

Authentication

To authenticate users when using the LiveCycle Data Services ES assembler, you use the Flex setRemoteCredentials() method on the DataService object. The credentials, which are in the FlexSession object, are passed to the ColdFusion application, where you can use the cflogin tag to perform authentication. Alternatively, you can set credentials in the Flex destination, although this is not the recommended way to do so.

You can set the credentials by doing either of the following:

- Specifying credentials in ActionScript
Specifying credentials in the Flex destination

Specifying credentials in ActionScript
To specify credentials in ActionScript, you use the setRemoteCredentials() method, as the following example shows:

ds = new DataService("mydest");
ds.setRemoteCredentials("wilsont", "password");

Specifying credentials in the Flex destination
To specify credentials in the Flex destination, you edit the data-management-config.xml file that is in the WEB-INF/flex folder of the server on which you run the Flex application. In the properties element, you include the remote-username and remote-password elements, as follows:

```xml
<destination id="cfcontact">
    <adapter ref="coldfusion-dao" />
    <channels>
        <channel ref="cf-dataservice-rtmp" />
    </channels>
    <properties>
        <source>samples.contact.ContactAssembler</source>
        <scope>application</scope>
        <remote-username>wilsont</remote-username>
        <remote-password>password</remote-password>
    </properties>
</destination>
```

Enabling SSL
You encrypt communication between ColdFusion and Flex by enabling Secure Sockets Layer (SSL). Enabling SSL only makes sense if you are running LiveCycle Data Services ES remotely. To use SSL, you must create a keystore file. The keystore is a self-signed certificate. (You do not require a certificate signed by a Certificate Authority, although if you do use one, you do not have to configure Flex as indicated in the following steps.) The information in the keystore is encrypted and can be accessed only with the password that you specify. To create the keystore, you use the Java keytool utility, which is included in your Java Runtime Environment (JRE).

To enable SSL, you do the following:
- Create the keystore
- Configure Flex
- Enable SSL in the ColdFusion Administrator

Create the keystore
1. Generate the SSL server (ColdFusion) keystore file by using the keytool utility, with a command similar to the following:

```bash
keytool -genkey -v -alias FlexAssembler -dname "cn=FlexAssembler" -keystore cf.keystore -keypass mypassword -storepass mypassword
```

The following table describes the parameters of the keytool utility that you use:
Next, you place the certificate that you created in the file that the JVM uses to decide what certificates to trust. The file in which you put the certificate, (usually named cacerts), is located in the JRE, under the lib/security folder.

**Configure Flex**

1. Export the keystore to a certificate by using the keytool utility, with a command similar to the following:

   ```bash
   keytool -export -v -alias FlexAssembler -keystore cf.keystore -rfc -file cf.cer
   ```

2. Import the certificate into the JRE cacerts file for your server by using the keytool utility, with a command similar to the following:

   ```bash
   keytool -import -v -alias FlexAssembler -file cf.cer -keystore C:\fds2\UninstallerData\jre\lib\security\cacerts
   ```

   The previous example specifies the location of the keystore for LiveCycle Data Services ES with integrated JRun, installed using the default settings. If you are using a different server, specify the location of the cacerts file for the JRE that you are using. For example, if you are using JBoss, you specify the keystore location as

   ```bash
   $JAVA_HOME/jre/lib/security/cacerts
   ```

**Enable SSL in the ColdFusion Administrator**

1. In the ColdFusion Administrator, select Data & Services > Flex Integration, and specify the keystore file in the Full Path to Keystore text box.

2. Specify the keystore password in the Keystore password text box.

3. Select the Enable RMI over SSL for Data Management option, and then click Submit Changes.

   If you specify an invalid keystore file or password, ColdFusion does not enable SSL, and disables Flex Data Management Support.

**Data translation**

The following table lists the ColdFusion data types and the corresponding Adobe Flash or ActionScript data type:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-alias</td>
<td>The name of the keystore entry. You can use any name for this, as long as you are consistent when referring to it.</td>
</tr>
<tr>
<td>-dname</td>
<td>The Distinguished Name, which contains the Common Name (cn) of the server.</td>
</tr>
<tr>
<td>-keystore</td>
<td>The location of the keystore file.</td>
</tr>
<tr>
<td>-keypass</td>
<td>The password for your private key.</td>
</tr>
<tr>
<td>-storepass</td>
<td>The password for the keystore. The encrypted storepass is stored in ColdFusion configuration files.</td>
</tr>
<tr>
<td>-rfc</td>
<td>Generates the certificate in the printable encoding format.</td>
</tr>
<tr>
<td>-file</td>
<td>The name of the keystore file.</td>
</tr>
<tr>
<td>-v</td>
<td>Generates detailed certificate information.</td>
</tr>
<tr>
<td>ColdFusion data type</td>
<td>Flash data type</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>String</td>
<td>String</td>
</tr>
<tr>
<td>Array</td>
<td>[] = Array</td>
</tr>
<tr>
<td>Struct</td>
<td>{} = untyped Object</td>
</tr>
<tr>
<td>Query</td>
<td>ArrayCollection</td>
</tr>
<tr>
<td>CFC</td>
<td>Class = typed Object (if a matching ActionScript class exists, otherwise the CFC becomes a generic untyped Object (map) in ActionScript)</td>
</tr>
<tr>
<td>CFC Date</td>
<td>ActionScript Date</td>
</tr>
<tr>
<td>CFC String</td>
<td>ActionScript String</td>
</tr>
<tr>
<td>CFC Numeric</td>
<td>ActionScript Numeric</td>
</tr>
<tr>
<td>ColdFusion XML Object</td>
<td>ActionScript XML Object</td>
</tr>
</tbody>
</table>
Chapter 39: Using Server-Side ActionScript

ColdFusion server configuration includes the Flash Remoting service, a module that lets Adobe Flash developers create server-side ActionScript. These ActionScript files can directly access ColdFusion query and HTTP features through two new ActionScript functions: CF.query and CF.http.

About server-side ActionScript

ColdFusion includes a module called the Flash Remoting service that acts as a broker for interactions between Flash and ColdFusion. Flash Remoting supports a range of object types, and lets you reference an ActionScript file that lives on a ColdFusion server. You can partition data-intensive operations on the server, while limiting the amount of network transactions necessary to get data from the server to the client.

Flash developers can create server-side ActionScript files to access ColdFusion resources; they do not have to learn CFML (ColdFusion Markup Language). This ability lets you logically separate the Flash presentation elements of your applications from the business logic. You have the option of creating ActionScript files that reside on the server to partition this processing away from your client applications.

You have a very simple interface for building queries using server-side ActionScript, and an equally simple interface for invoking these queries from your client-side ActionScript.

Client-side ActionScript requirements

On the client side, you only need a small piece of code that establishes a connection to the Flash Remoting service and references the server-side ActionScript you want to use.

For example (notice the embedded comments):

```
// This #include is needed to connect to the Flash Remoting service
#include "NetServices.as"

// This line determines where Flash should look for the Flash Remoting service.
// Ordinarily, you enter the URL to your ColdFusion server.
// Port 8500 is the Flash Remoting service default.
```
NetServices.setDefaultGatewayUrl("http://mycfserver:8500");

// With the Flash Remoting service URL defined, you can create a connection.
gatewayConnection = NetServices.createGatewayConnection();

// Reference the server-side ActionScript.
// In this case, the stockquotes script file lives in the web root of the
// ColdFusion server identified previously. If it lived in a subdirectory
// of the web root called "mydir," you would reference it
// as "mydir.stockquotes".
stockService = gatewayConnection.getService("stockquotes", this);

// This line invokes the getQuotes() method defined in the stockquotes
// server-side ActionScript.
stockService.getQuotes("macr");

// Once the record set is returned, you handle the results.
// This part is up to you.
function getQuotes_Result ( result )
{
    // Do something with results
}

Note: Client-side ActionScript does not support the two new server-side ActionScript functions, CF.query and CF.http.

Server-side requirements
Creating ActionScript that executes on the server helps leverage your knowledge of ActionScript. It also provides direct access to ColdFusion query and HTTP features. The CF.query and CF.http ActionScript functions let you perform ColdFusion HTTP and query operations.

Note: On the server side, ActionScript files use the extension .asr.

For example, the following server-side ActionScript code builds on the client-side code shown previously:

// Filename: stockquotes.asr
// Here is the getQuotes method invoked in the client-side ActionScript.
// It accepts a single stock quote symbol argument.
function getQuotes(symbol)
{
    // Query some provider for the specified stock quote and return the
    // results. In this case, the getQuotesFromProvider method is
    // defined elsewhere in this ActionScript code.
    data = getQuotesFromProvider(symbol);
    // Return the data to the client.
    // Note: this example does not include any of the error checking
    // logic you would normally use prior to returning the data.
    return data;
}

The getQuotes function conducts the stock quote request and returns the results of the request to the client as a RecordSet object.

Software requirements
To use server-side ActionScript files, you must have the following software installed:

- Adobe Flash
Location of server-side ActionScript files
You can place ActionScript files (*.asr) on the server anywhere below the web server's root directory. To specify subdirectories of the web root or a virtual directory, use package dot notation (use dots instead of slashes in a fully qualified directory name). For example, in the following assignment code, the stockquotes.asr file is located in the mydir/stock/ directory:

```javascript
stockService = gatewayConnection.getService("mydir.stock.stockquotes", this);
```

You can also point to virtual mappings, such as cfsuite.asr.stock.stockquotes where cfsuite is a virtual mapping and asr.stock is subdirectories of that mapping.

Benefits
Server-side ActionScript lets your ActionScript engineers use their knowledge of ActionScript to write code for the back end of their Flash applications, which can mean more meaningful levels of interactivity for your users. Your Flash applications can share a library of server-side ActionScript functions, which means you can define functions that are specifically tailored to your own business.

You could, for example, create a server-side ActionScript file that defines a whole library of SQL query methods. With these query methods defined on the server side, your Flash designers only have to invoke the specific query function they want to return data to their Flash movies. They do not have to write any SQL, and they do not have to create a new query every time they need to retrieve data from a ColdFusion data source. It is a way of creating reusable queries that your entire Flash design team can use.

Coding the ColdFusion query and HTTP operations in ActionScript is very straightforward. The `CF.query` and `CF.http` functions provide a well-defined interface for building SQL queries and HTTP operations.

For example, the following is a typical server-side ActionScript function definition that returns query data:

```javascript
// This function shows a basic CF.query operation using only
// arguments for data source name and for SQL.
function basicQuery()
{
    mydata = CF.query({datasource:"customers",
                      sql:"SELECT * FROM myTable"});
    return mydata;
}
```

What to do next
If you are already familiar with ActionScript, you only need to know a few things to get started:

- How to establish a connection with the Flash Remoting service using client-side ActionScript. See “Connecting to the Flash Remoting service” on page 709
- How to code the server-side `CF.query` and `CF.http` functions. See “Using the CF.query function” on page 712 and “Using the CF.http function” on page 718. Also see the reference pages for these functions in the CFML Reference.
For additional information on using Flash Remoting, see "Using the Flash Remoting Service" on page 674 and Using Flash Remoting.

**Connecting to the Flash Remoting service**

Before you can use functions defined in your server-side ActionScript files, you must connect the Adobe Flash movie to the server-side Flash Remoting service.

**Create a Flash Remoting service connection**

1. Include the necessary ActionScript classes in the first frame of the Flash movie that will be using server-side ActionScript functions.
   a. Use the following command to include the NetServices class:
   ```
   #include "NetServices.as"
   ```
   b. (Optional) Use the following command to include the NetDebug class:
   ```
   #include "NetDebug.as"
   ```
   For more information about the NetDebug and RecordSet classes, see Using Flash Remoting.

2. Since the Flash Remoting service serves as a broker for calls to server-side ActionScript functions, you must identify the Flash Remoting service URL as an argument in the NetServices.setDefaultGatewayUrl function. For example:
   ```
   NetServices.setDefaultGatewayURL("http://localhost:8500/flashservices")
   ```
   You must specify a server hostname. The default port number for the Flash Remoting service is 8500.

3. Create the gateway connection using the NetServices.createGatewayConnection function; for example:
   ```
   gatewayConnection = NetServices.createGatewayConnection();
   ```

**Using server-side ActionScript functions**

After you connect to the Flash Remoting service, you call functions that are defined in your server-side ActionScript files, and return results.

**Call a function**

1. Create an instance of the server-side ActionScript file using the getService function. This function instantiates the server-side ActionScript file as an object to be used on the client side. For example:
   ```
   albumService = gatewayConnection.getService("recordsettest", this)
   ```
   Where recordsettest represents the name of the server-side ActionScript file, without the file extension .asr.

2. Call a function defined in your server-side ActionScript object. Use dot notation to specify the object name followed by the function name, for example:
   ```
   albumService.getAlbum("The Color And The Shape", "1999");
   ```
   Where albumService is the instance of the server-side ActionScript file and getAlbum is a function that passes two arguments, "The Color and The Shape" and "1999."
Note: Arguments must occur in the order defined in the function declaration.

3 Handle the function results in ActionScript. See “Using the function results in ActionScript” on page 710.

Using the function results in ActionScript

To use the results returned by server-side ActionScript, you must create a corresponding results function. The results function uses a special naming convention that ties it to the function that calls the server-side ActionScript. For example, if you defined a client-side ActionScript function called basicCustomerQuery, you also must create a results function called basicCustomerQuery_Result.

The results returned by server-side ActionScript functions differ somewhat depending on whether you are using CF.http or CF.query:

• The CF.query function returns a record set, which you manipulate using methods available in the RecordSet ActionScript class object. See “Using results returned by the CF.query function” on page 710.

• The CF.http function returns simple text strings through properties that you reference in your server-side ActionScript. See “Using results returned by the CF.http function” on page 710.

Using results returned by the CF.query function

You use functions in the RecordSet ActionScript object to access the data returned in a CF.query record set; for example, how many records are in the record set and the names of the columns. You can also use the RecordSet functions to pull the query data out of the record set. To do so, you reference a specific row number in the record set and use the getItemAt RecordSet function, as in the following example:

```
// This function populates a Flash text box with data in the first row
// of the record set under the "email" column name.
function selectData_Result ( result ) {
    stringOutput.text = result.getItemAt(0)['email'];
    _root.employeesView.setDataProvider(result);
}
```

In the example, the column name is referenced in the getItemAt function between square brackets [ ]. (In ActionScript, indexes start at 0, so getItemAt(0) returns the first row.)

For more information, see “Using the CF.query function” on page 712.

Using results returned by the CF.http function

The CF.http server-side ActionScript function returns data as simple text. You write server-side functions that reference the properties available in the object returned by the CF.http function. These properties store the file content of the retrieved file, HTTP status codes, the MIME type of the returned file, and so on. On the client side, you create return functions to handle data returned by the CF.http function. You write these functions to handle simple text data.

For more information, see “Using the CF.http function” on page 718.

Global and request scope objects

Global and request scope objects are implicitly available in all server-side ActionScript. The following table describes these scope objects:
You use the `CF.query` function to populate Flash movie elements with data retrieved from a ColdFusion data source. To use the `CF.query` function you do the following:

**Pull data into your Flash movie from a ColdFusion data source**
1. Create a server-side ActionScript file that performs queries against a ColdFusion data source.
2. Write ActionScript code in your Flash movie that references your ActionScript file (.asr) on the ColdFusion server.

You create server-side ActionScript to execute the query and return the data in a record set to the client—your Flash movie. You can use methods in the RecordSet ActionScript object on the client to manipulate data in the record set and present data in your Flash movie.

**Note:** Client-side ActionScript files use the `.as` extension. Server-side ActionScript files use the `.asr` (ActionScript remote) extension.

**Publishing dynamic data**
You use the server-side ActionScript feature in ColdFusion to publish dynamic data. To do this, you write server-side ActionScript files that perform queries against ColdFusion data sources. Before using ActionScript, you must understand how to do the following:

- Create database queries in the server-side ActionScript file using the `CF.query` ActionScript function. See “Using the CF.query function” on page 712.
- Reference the server-side ActionScript file in your Flash movie. See “Connecting to the Flash Remoting service” on page 709.

Using the `CF.query` function, you can do the following tasks:
• Create user login interfaces that validate users against a ColdFusion data source.
• Populate form elements and data grids with data from a ColdFusion data source.
• Create banners that pull data (such as URLs or image file paths) out of a database.

The CF.query function can retrieve data from any supported ColdFusion data source (see “About ColdFusion data sources” on page 712).

About ColdFusion data sources
For ColdFusion developers, the term data source can refer to a number of different types of structured data accessible locally or across a network. You can query websites, Lightweight Directory Access Protocol (LDAP) servers, POP mail servers, and documents in a variety of formats. For server-side ActionScript, a data source ordinarily means the entry point to a ColdFusion database.

Your ColdFusion administrator can help you identify and configure data sources. To create ActionScript files that successfully perform queries on ColdFusion data sources, you must know how the data source is identified by ColdFusion, as well as any other parameters that affect your ability to connect to that database, such as whether a user name and password are required to connect.

You use server-side ActionScript in ColdFusion to return record set data to a Flash client from a ColdFusion data source. You specify the ColdFusion data source name and the SQL statement you execute on the data source as arguments in the CF.query function in server-side ActionScript.

Typically, your server-side ActionScript handles the interaction with the ColdFusion data source, and returns a record set to the Flash client through the Flash Remoting service.

For more detailed information about ColdFusion data sources, see Configuring and Administering ColdFusion.

Using the CF.query function
You use the CF.query function in your server-side ActionScript to retrieve data from a ColdFusion data source. This function lets you perform queries against any ColdFusion data source.

Note: The CF.query function maps closely to the cfquery CFML tag, although it currently supports a subset of the cfquery attributes.

Use the CF.query function to do the following:
• Identify the data source you want to query.
• Pass SQL statements to the data source.
• Pass other optional parameters to the database.

For reference information about the CF.query function, see CF.query in the CFML Reference.

About CF.query function syntax
You can write the CF.query ActionScript function using either named arguments or positional arguments. The named argument style is more readable, but it requires more code. Although the positional argument style supports a subset of CF.query arguments, it allows a more compact coding style that is more appropriate for simple expressions of the CF.query function.
Using CF.query named argument syntax
The CF.query function accepts the following named arguments:

```javascript
// CF.query named argument syntax
CF.query(

   datasource:"data source name",
   sql:"SQL stmts",
   username:"username",
   password:"password",
   maxrows:number,
   timeout:milliseconds

)
```

Note: The named argument style requires curly braces {} to surround the function arguments.

Using CF.query positional argument syntax
Positional arguments support a subset of CF.query arguments, and you can create more efficient code. The following is the syntax for the positional argument style:

```javascript
// CF.query positional argument syntax
CF.query(datasource, sql);
CF.query(datasource, sql, maxrows);
CF.query(datasource, sql, username, password);
CF.query(datasource, sql, username, password, maxrows);
```

Note: When using positional arguments, do not use curly braces {}.

About the CF.query record set
The CF.query function returns a RecordSet object, which is an instance of the RecordSet class of objects. The RecordSet class provides a wide range of functions for handling record set data.

You use methods in the RecordSet ActionScript class in your client-side ActionScript to change data returned in the CF.query record set.

Currently, the following methods are available in the RecordSet class:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>addItem</td>
<td>Appends a record to the end of the specified RecordSet</td>
</tr>
<tr>
<td>addItemAt</td>
<td>Inserts a record at the specified index</td>
</tr>
<tr>
<td>addView</td>
<td>Requests notification of changes in a RecordSet object's state</td>
</tr>
<tr>
<td>filter</td>
<td>Creates a new RecordSet object that contains selected records from the original RecordSet object</td>
</tr>
<tr>
<td>getColumnNames</td>
<td>Returns the names of all the columns of the RecordSet</td>
</tr>
<tr>
<td>getItemAt</td>
<td>Retrieves a record from a RecordSet object</td>
</tr>
<tr>
<td>getItemID</td>
<td>Gets the unique ID corresponding to a record</td>
</tr>
<tr>
<td>getLength</td>
<td>Returns the total number of records in a RecordSet object</td>
</tr>
<tr>
<td>getNumberAvailable</td>
<td>Returns the number of records that have been downloaded from the server</td>
</tr>
<tr>
<td>isFullyPopulated</td>
<td>Determines whether a RecordSet object can be edited or manipulated</td>
</tr>
<tr>
<td>isLocal</td>
<td>Determines whether a RecordSet object is local or server-associated</td>
</tr>
</tbody>
</table>
These functions are available for every RecordSet object returned by the `CF.query` function to the Flash client. You invoke these functions as follows:

```actionscript
objectName.functionName();
```

For example, in the result function that you create to handle record set data returned by the `CF.query` function, you can reference the database column names returned in the record set using the `getColumnNames` RecordSet function:

```actionscript
function selectData_Result { result }
{
    //result holds the query data; employeesView is a Flash list box
    stringOutput.text = result.getColumnNames();
    _root.employeesView.setDataProvider(result);
}
```

### Building a simple application

The following procedure describes how to build a simple server-side ActionScript application. The example application, a corporate personnel directory, uses the NetServices object to connect to the `personneldirectory` server-side ActionScript. The `personneldirectory` server-side ActionScript retrieves data from a ColdFusion data source and returns the results to the Flash application as a RecordSet object.

**Note:** The server-side ActionScript application that you create provides the back-end services in an application.

This example requires the following:

- A server-side ActionScript file named `personneldirectory.asr` that includes functions that interact with a ColdFusion data source.
- A client-side Flash movie in which the NetServices object is created.

#### Create the application

1. Write server-side ActionScript that performs the database query and returns data to the client through the Flash Remoting service.
2. Create the Flash movie interface. See “Creating the Flash movie interface” on page 715.
3. Define a search function that sends user data to the Flash Remoting service. See “Submitting user data to the Flash Remoting service” on page 716.
4. Define a result function that captures the results returned from the Flash Remoting service. See “” on page 716.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>removeAll</td>
<td>Removes all records from the RecordSet object</td>
</tr>
<tr>
<td>removeItemAt</td>
<td>Removes a specified record</td>
</tr>
<tr>
<td>replaceItemAt</td>
<td>Replaces the entire contents of a record</td>
</tr>
<tr>
<td>setDeliveryMode</td>
<td>Changes the delivery mode of a server-associated record set</td>
</tr>
<tr>
<td>setField</td>
<td>Replaces one field of a record with a new value</td>
</tr>
<tr>
<td>sort</td>
<td>Sorts all records by a specified compare function</td>
</tr>
<tr>
<td>sortItemsBy</td>
<td>Sorts all the records by a selected field</td>
</tr>
</tbody>
</table>

These functions are available for every RecordSet object returned by the `CF.query` function to the Flash client. You invoke these functions as follows:

```actionscript
objectName.functionName();
```
5 Ensure that the Flash movie has established a connection to the Flash Remoting service. See “Checking for a 
Flash Remoting service connection” on page 717.

Writing the server-side ActionScript function

The example in this section creates a search function that performs a simple search operation against a ColdFusion 
data source. This function accepts two arguments, firstName and lastName, and returns any records found that 
match these arguments.

Create a server-side ActionScript function

1 Create a server-side ActionScript file that contains the following code:

```actionscript
//search takes firstName lastName arguments
function search(firstName, lastName)
{
    searchdata = CF.query({datasource: "bigDSN",
        sql:"SELECT * from personnel WHERE fname = firstName AND lname = lastName"});

    if (searchdata)
        return searchdata;
    else
        return null;
}
```

2 Save the file as personneldirectory.asr.

Creating the Flash movie interface

The Flash movie interface example in this section consists of one frame with a variety of text boxes and a submit 
button.

Create the Flash movie interface

1 In the Flash authoring environment, create a new Flash source file, and save it as pDirectory.fla.

2 Create two input text boxes. Name one text box variable lastName and the other firstName.

3 Create a dynamic text box, and name its variable status.

4 Insert a list box component, and name it dataView.

5 Insert a push button component.

6 Save your work.

The following image shows what the pDirectory Flash movie might look like:
**Submitting user data to the Flash Remoting service**

To send data to server-side ActionScript, you must create a function that passes the data from the Flash movie to server-side ActionScript. The `search` function, applied at the frame level, collects the user-entered data from the `firstName` and `lastName` text boxes and passes the data as function arguments to the `directoryService` object, which is created when the Flash movie connects to the Flash Remoting service. For more information, see “Checking for a Flash Remoting service connection” on page 717.

The following is a Flash ActionScript example:

```actionscript
#include "NetServices.as"

function search()
{
    // The search() method is defined in the server-side AS file
directoryService.search(firstName.text, lastName.text);
dataView.setDataProvider(null);
status.text = "waiting...";
}
```

**Reviewing the code**

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>directoryService.search(firstName.text, lastName.text);</td>
<td>Passes the contents of the <code>firstName</code> and <code>lastName</code> text boxes to server-side ActionScript.</td>
</tr>
<tr>
<td>dataView.setDataProvider(null);</td>
<td>Clears the <code>dataView</code> list box component.</td>
</tr>
<tr>
<td>status.text = &quot;waiting...&quot;;</td>
<td>Displays a message in the status text box while the record set is being retrieved from server-side ActionScript.</td>
</tr>
</tbody>
</table>

**Capturing Flash Remoting service results**

When you create a function that calls a server-side ActionScript function, you must also create a function to handle the data returned by server-side ActionScript. Define the function with the same name as the function making the initial call, but append `_Result` to the name.

For example, if you create a function called `basicQuery` to return query data, you also need to define a results function to handle returned data; declare the results function as `basicQuery_Result`.

In the following example, the results function `search_Result` supplies the record set to the `dataView.setDataProvider` function:

```actionscript
function search_Result(resultset)
{
    dataView.setDataProvider(resultset);
    status.text = (0+resultset.getLength())+" names found."
}
```

**Reviewing the code**

The following table describes the code and its function:
Checking for a Flash Remoting service connection

To ensure that the Flash movie is connected to the Flash Remoting service, you use an if statement; for example:

```javascript
if (inited == null)
{
    inited = true;
gateway");
    directoryService = gateway_conn.getService(personneldirectory, this);
    status.text = "Type into the text boxes, then click 'Search';"
}
```

In this example, the `inited` variable is evaluated for a value. If `inited` is null (not connected), the movie connects to the Flash Remoting service using the NetServices object. For more information about connecting to the Flash Remoting service, see "Connecting to the Flash Remoting service" on page 709.

About the CF.http function

You use the `CF.http` ActionScript function to retrieve information from a remote HTTP server using HTTP Get and Post methods, as follows:

- Using the Get method, you send information to the remote server directly in the URL. This is common for a one-way transaction in which the `CF.http` function retrieves an object, such as the contents of a web page.
- The Post method can pass variables to a form or CGI program, and can also create HTTP cookies.

The most basic way to use the `CF.http` function is to use it with the Get method argument to retrieve a page from a specified URL. The Get method is the default for the `CF.http` function.

The following server-side example retrieves file content from the specified URL:

```javascript
function basicGet(url)
{
    // Invoke with just the url argument. This is an HTTP GET.
    result = CF.http(url);
    return result.get("Filecontent");
}
```

The client-side example could look like the following:

```javascript
#include "NetServices.as"
NetServices.setDefaultGatewayUrl("http://mycfserver:8500");
gatewayConnection = NetServices.createGatewayConnection();
myHttp = gatewayConnection.getService("httpFuncs", this);

// This is the server-side function invocation
```
url = "http://anyserver.com";
myHttp.basicGet(url);

// Create the results function
function basicGet_Result()
{
    url = "http://anyserver.com
    ssasFile.basicGet(url)
}

## Using the CF.http function

The CF.http function returns an object that contains properties, also known as attributes. You reference these attributes to access the contents of the file returned, header information, HTTP status codes, and so on. The following table shows the available properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td>A Boolean value indicating whether the specified URL location contains text data.</td>
</tr>
<tr>
<td>Charset</td>
<td>The charset used by the document specified in the URL. HTTP servers normally provide this information, or the charset is specified in the charset parameter of the Content-Type header field of the HTTP protocol. For example, the following HTTP header announces that the character encoding is EUC-JP: Content-Type: text/html; charset=EUC-JP</td>
</tr>
<tr>
<td>Header</td>
<td>Raw response header. The following is an example header: HTTP/1.1 200 OK Date: Mon, 04 Mar 2002 17:27:44 GMT Server: Apache/1.3.22 (Unix) mod_perl/1.26 Set-Cookie: MM_cookie=207.22.48.162.4731015262864476; path=/; expires=Wed, 03-Mar-04 17:27:44 GMT; domain=.adobe.com Connection: close Content-Type: text/html</td>
</tr>
<tr>
<td>Filecontent</td>
<td>File contents, for text and MIME files.</td>
</tr>
<tr>
<td>Mimetype</td>
<td>MIME type. Examples of MIME types include text/html, image/png, image/gif, video/mpeg, text/css, and audio/basic.</td>
</tr>
<tr>
<td>responseHeader</td>
<td>Response header. If there is one instance of a header key, this value can be accessed as a simple type. If there is more than one instance, values are put in an array in the responseHeader structure.</td>
</tr>
<tr>
<td>Statuscode</td>
<td>HTTP error code and associated error string. Common HTTP status codes returned in the response header include the following: 400: Bad Request 401: Unauthorized 403: Forbidden 404: Not Found 405: Method Not Allowed</td>
</tr>
</tbody>
</table>
Referencing HTTP Post parameters in the CF.http function

To pass HTTP Post parameters in the CF.http function, you must construct an array of objects and assign this array to a variable named `params`. The following arguments can only be passed as an array of objects in the `params` argument of the CF.http function:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>The variable name for data that is passed</td>
</tr>
<tr>
<td>type</td>
<td>Transaction type:</td>
</tr>
<tr>
<td></td>
<td>• URL</td>
</tr>
<tr>
<td></td>
<td>• FormField</td>
</tr>
<tr>
<td></td>
<td>• Cookie</td>
</tr>
<tr>
<td></td>
<td>• CGI</td>
</tr>
<tr>
<td></td>
<td>• File</td>
</tr>
<tr>
<td>value</td>
<td>Value of URL, FormField, Cookie, File, or CGI variables that are passed</td>
</tr>
</tbody>
</table>

In the following example, the CF.http function passes HTTP Post parameters in an array of objects:

```coldfusion
function postWithParamsAndUser()
{
    // Set up the array of Post parameters. These are just like cfhttpparam tags.
    params = new Array();
    params[1] = {name:"arg2", type:"URL", value:"value2"};

    url = "http://localhost:8500/";

    // Invoke with the method, url, params, username, and password
    result = CF.http("post", url, params, "karl", "salsa");
    return result.get("Filecontent");
}
```

Using the CF.http Post method

You use the Post method to send cookie, form field, CGI, URL, and file variables to a specified ColdFusion page or CGI program for processing. For POST operations, you must use the `params` argument for each variable that you post. The Post method passes data to a specified ColdFusion page or an executable that interprets the variables being sent, and returns data.

For example, when you build an HTML form using the Post method, you specify the name of the page to which form data is passed. You use the Post method in the CF.http function in a similar way. However, with the CF.http function, the page that receives the Post does not display anything. See the following example:

```coldfusion
function postWithParams()
{
    // Set up the array of Post parameters. These are just like cfhttpparam tags.
    // This example passes formfield data to a specified URL.
    params = new Array();
    params[1] = {name:"Formfield1", type:"FormField", value:"George"};
    params[2] = {name:"Formfield2", type:"FormField", value:"Brown"};

    url = "http://localhost:8500/";

    // Invoke CF.http with the method, url, and params
    result = CF.http("post", url, params);
}
Using the CF.http Get method

You use the `Get` method to retrieve files, including text and binary files, from a specified server. You reference properties of the object returned by the `CF.http` function to access things like file content, header information, MIME type, and so on.

The following example uses the `CF.http` function to show a common approach to retrieving data from the web:

```coldfusion
// Returns content of URL defined in url variable
// This example uses positional argument style
function get()
{
    url = "http://www.adobe.com/software/coldfusion/";

    // Invoke with just the url argument. Get is the default.
    result = CF.http(url);
    return result.get("Filecontent");
}
```

For more information about `CF.http` function properties, see `CF.http` in the CFML Reference.
Part 6: Working with Documents, Charts, and Reports

This part contains the following topics:

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- Assembling PDF Documents ................................................................. 739
- Creating and Manipulating ColdFusion Images ............................................. 763
- Creating Charts and Graphs ................................................................. 785
- Creating Reports and Documents for Printing ................................................ 810
- Creating Reports with Report Builder ........................................................ 818
- Creating Slide Presentations ................................................................. 854
Chapter 40: Manipulating PDF Forms in ColdFusion

You can use Adobe ColdFusion to manipulate PDF forms created in Adobe Acrobat Professional and Adobe LiveCycle Designer.

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- Populating a PDF form with XML data ......................... 724
- Prefilling PDF form fields ...................................... 725
- Embedding a PDF form in a PDF document ................. 728
- Extracting data from a PDF form submission ............... 729
- Application examples that use PDF forms .................. 732

About PDF forms

ColdFusion 8 lets you incorporate interactive PDF forms in your application. You can extract data submitted from the PDF forms, populate form fields from an XML data file or a database, and embed PDF forms in PDF documents created in ColdFusion.

ColdFusion supports interactive forms created with Adobe Acrobat forms and with LiveCycle. In Adobe Acrobat 6.0 or earlier, you can create interactive Acroforms. Using Adobe LiveCycle Designer, which is provided with Adobe Acrobat Professional 7.0 and later, you can generate interactive forms.

The type of form is significant because it affects how you manipulate the data in ColdFusion. For example, you cannot use an XML data file generated from a form created in Acrobat to populate a form created in LiveCycle, and vice versa, because the XML file formats differ between the two types of forms.

Forms created in Acrobat use the XML Forms Data Format (XFDF) file format. Forms created in LiveCycle use the XML Forms Architecture (XFA) format introduced in Acrobat and Adobe Reader 6. For examples, see "Populating a PDF form with XML data" on page 724. The file format also affects how you prefill fields in a form from a data source, because you must map the data structure as well as the field names. For examples, see "Prefilling PDF form fields" on page 725.

The use of JavaScript also differs based on the context. The JavaScript Object Model in a PDF file differs from the HTML JavaScript Object Model. Consequently, scripts written in HTML JavaScript do not apply to PDF files. Also, JavaScript differs between forms created in Acrobat and those created in LiveCycle: scripts written in one format do not work with other.

ColdFusion 8 introduced several tags for manipulating PDF forms:
The following table describes a few of the tasks that you can perform with PDF forms:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfpdfform</td>
<td>Reads data from a form and writes it to a file or populates a form with data from a data source.</td>
</tr>
<tr>
<td>cfpdfformparam</td>
<td>A child tag of the cfpdfform tag or the cfpdfsubform tag; populates individual fields in PDF forms.</td>
</tr>
<tr>
<td>cfpdfsubform</td>
<td>A child tag of the cfpdfform tag; creates the hierarchy of the PDF form so that form fields are filled properly. The cfpdfsubform tag contains one or more cfpdfformparam tags.</td>
</tr>
</tbody>
</table>

The following table describes a few of the tasks that you can perform with PDF forms:

<table>
<thead>
<tr>
<th>Task</th>
<th>Tags and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Populate a PDF form with XML data</td>
<td>populate action of the cfpdf tag</td>
</tr>
<tr>
<td>Prefill individual fields in a PDF form with data from a data source</td>
<td>populate action of the cfpdfform tag with the cfpdfsubform and cfpdfparam tags</td>
</tr>
<tr>
<td>Determine the structure of a PDF form</td>
<td>read action of the cfpdfform tag with the cfdump tag</td>
</tr>
<tr>
<td>Embed an interactive PDF form within a PDF document</td>
<td>populate action of the cfpdfform tag within the cfdocument tag. Note: The cfpdfform tag must be at the same level as the cfdocumentsection tags, not contained within them.</td>
</tr>
<tr>
<td>Write a PDF form directly to the browser</td>
<td>populate action of the cfpdfform tag with the destination attribute not specified</td>
</tr>
<tr>
<td>Write PDF form output to an XML file</td>
<td>read action of the cfpdfform tag</td>
</tr>
<tr>
<td>Print a PDF form from ColdFusion</td>
<td>cfprint tag</td>
</tr>
<tr>
<td>Extract data from a PDF form submission</td>
<td>source=&quot;#PDF.Content#&quot; for the read action of the cfpdfform tag</td>
</tr>
<tr>
<td>Write data extracted from a PDF form submission to a PDF file</td>
<td>source=&quot;#PDF.Content#&quot; for the populate action of the cfpdfform tag, and the destination attribute</td>
</tr>
<tr>
<td>Write data in a form generated in LiveCycle to an XDP file</td>
<td>source=&quot;#PDF.Content#&quot; for the populate action of the cfpdfform tag, and an XDP extension for the output file</td>
</tr>
<tr>
<td>Extract data from an HTTP post submission</td>
<td>cfdump tag determines the structure of the form data; map the form fields to the output fields</td>
</tr>
</tbody>
</table>
| Flatten forms generated in Acrobat (this does not apply to forms generated in LiveCycle) | cfpdf action="write" flatten="yes"  
For more information, see “Flattening forms created in Acrobat” on page 747. |
| Merge forms generated in Acrobat or LiveCycle with other PDF documents | cfpdf action="merge"  
For more information, see “Merging PDF documents” on page 746. |

**Populating a PDF form with XML data**

Some applications submit PDF form data in an XML data file. For example, the e-mail submit option in forms created in LiveCycle generates an XML data file and delivers it as an attachment to the specified e-mail address. This is an efficient way to transmit and archive data because XML data files are smaller than PDF files. However, XML files are not user-friendly: to view the file in its original format, the user has to open the PDF form template in Acrobat and import the XML data file.
ColdFusion automates the process of reuniting XML data with the PDF form that generated it. To do this, you use the `populate` action of the `cfpdfform` tag, specify the source, which is the PDF form used as a template, and specify the XML data file that contains the information submitted by the person who completed the form. You also have the option to save the result to a new file, which lets you save the completed forms in their original format (and not just the form data). In the following example, ColdFusion populates the payslipTemplate.pdf form with data from the formdata.xml data file and writes the form to a new PDF file called employeeid123.pdf:

```xml
cfpdfform source="c:\payslipTemplate.pdf" destination="c:\empPayslips\employeeid123.pdf" action="populate" XMLdata="c:\formdata.xml"/>
```

For forms created in LiveCycle, you have the option to write the output to an XML Data Package (XDP) file rather than a PDF file. For more information, see "Writing LiveCycle form output to an XDP file" on page 730.

**Note:** If you do not specify a destination, the `populate` action displays the populated PDF form in a browser window.

When you populate a form with an XML data file, ensure that the XML data is in the appropriate format. The format of the XML data file differs based on whether it was generated from Acrobat or LiveCycle. Acrobat generates an XML Forms Data Format (XFDF) file format. The following example shows the XFDF format:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xfdf xmlns="http://ns.adobe.com/xfdf/" xml:space="preserve">
  <fields>
    <field name="textname">
      <value>textvalue</value>
    </field>
    <field name="textname1">
      <value>textvalue1</value>
    </field>
  </fields>
</xfdf>
```

Forms created in LiveCycle require an XML Forms Architecture (XFA) format. The following example shows an XFA format:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xfa:form xmlns:xfa="http://www.xfa.org/schema/xfa-data/1.0/">
  <Subform1>
    <SSN>354325426</SSN>
    <fname>coldfusion</fname>
    <num>354325426.00</num>
  </Subform1>
</xfa:form>
```

**Prefilling PDF form fields**

ColdFusion lets you prefill individual form fields with data extracted from a data source. For example, you can run a query to extract returning customer information from a data source based on a user name and password and populate the related fields in an order form. The customer can complete the rest of the fields in the form and submit it for processing. To do this, you must map the field names and the data structure of the PDF form to the fields in the data source.

To determine the structure of the PDF form, use the `read` action of the `cfpdfform` tag, as the following example shows:
<cfpdfform source="c:\forms\timesheet.pdf" result="#resultStruct#" action="read"/>

Then use the cfdump tag to display the structure:
<cfdump var="#resultStruct#"/>

The result structure for a form created in Acrobat form might look something like the following example:

<table>
<thead>
<tr>
<th>struct</th>
</tr>
</thead>
<tbody>
<tr>
<td>firstName</td>
</tr>
<tr>
<td>lastName</td>
</tr>
<tr>
<td>department</td>
</tr>
</tbody>
</table>

To prefill the fields in ColdFusion, you add a cfpdfformparam tag for each of the fields directly under the cfpdfform tag:

```cfm
<cfpdfform action="populate" source="c:\forms\timesheet.PDF">
  <cfpdfformparam name="firstName" value="Boris">
  <cfpdfformparam name="lastName" value="Pasternak">
  <cfpdfformparam name="department" value="Marketing">
  ...
</cfpdfform>
```

Forms created in LiveCycle from the standard blank forms contain a subform called form1. The result structure of a form created in LiveCycle might look like the following example:

<table>
<thead>
<tr>
<th>struct</th>
</tr>
</thead>
<tbody>
<tr>
<td>form1</td>
</tr>
<tr>
<td>struct</td>
</tr>
<tr>
<td>txtfirstName</td>
</tr>
<tr>
<td>txtlastName</td>
</tr>
<tr>
<td>txtdepartment</td>
</tr>
</tbody>
</table>

To prefill the fields in ColdFusion, add a cfpdfsubform tag for form1 and a cfpdfformparam tag for each of the fields to fill directly below the cfpdfsubform tag:

```cfm
<cfpdfform source="c:\forms\timesheetForm.pdf" action="populate">
  <cfpdfsubform name="form1">
    <cfpdfformparam name="txtfirstName" value="Harley">
    <cfpdfformparam name="txtlastName" value="Davidson">
    <cfpdfformparam name="txtDeptName" value="Engineering">
    ...
  </cfpdfsubform>
</cfpdfform>
```

**Note:** In dynamic forms created in LiveCycle forms (forms saved as Dynamic PDF Form Files in LiveCycle Designer), you have the option to mark how many times a record is repeated. Therefore, if no record exists for a subform, the subform does not appear in the structure returned by the read action of the cfpdfform tag. You must view these forms in LiveCycle Designer to see the hierarchy.

**Nesting subforms**

Although Acrobat forms do not contain subforms, some contain complex field names. For example an Acrobat form might contain the following fields: form1.x.f1, form1.x.f2, form1.x.f3, and so on.
Because the cfpdfparam tag does not handle field names with periods in them, ColdFusion treats forms with complex field names created in Acrobat the same way as subforms created in LiveCycle. Therefore, the result structure of an Acrobat form with complex field names might look like the following example:

```
struct
form1 struct
  x struct
    f1 [empty string]
    f2 [empty string]
    ...
```

In ColdFusion, to prefill the fields in forms created in Acrobat, nest the field names as subforms:

```coldfusion
cfpdfformaction="populate" source="acrobatForm.pdf">
  cfpdfsiform subform="form1">
    cfpdfsiform subform="x">
      cfpdfparam name="f1" value="AGuthrie">
      cfpdfparam name="f2" value="123">
      cfpdfparam name="f3" value="456">
    </cfpdfsubform>
  </cfpdfsubform>
</cfpdfform>
```

Often, forms created in LiveCycle contain subforms within the form1 subform. For example, the following grant application contains nested subforms:

```
struct
form1 struct
  grantapplication struct
    page1 struct
      orgAddress [empty string]
      orgCity [empty string]
      orgState [empty string]
      ...
    page2 struct
      description [empty string]
      pageCount [empty string]
      ...
```

To populate the fields in ColdFusion, map the structure by using nested cfpdfsiform tags:

```coldfusion
cfpdfform source="c:\grantForm.pdf" destination="c:\employeidd123.pdf" action="populate">
  cfpdfsiform subform="form1">
    cfpdfsiform subform="grantapplication">
      cfpdfsiform subform="page1">
        cfpdfparam name="orgAddress" value="572 Evergreen Terrace">
        cfpdfparam name="orgCity" value="Springfield">
        cfpdfparam name="orgState" value="Oregon">
      ...
    </cfpdfsubform>
  </cfpdfform>
```

```coldfusion
cfpdfsiform subform="page2">
```
```
<cfpdfformparam name="description" value="Head Start">
<cfpdfformparam name="pageCount" value="2">
...
</cfpdfsubform>
</cfpdfsubform>
</cfpdfsubform>
</cfpdfform>

**Note:** A PDF file can contain only one interactive form. Therefore, if a PDF file contains subforms, a Submit button submits data for all the subforms simultaneously.

## Embedding a PDF form in a PDF document

You can use the `cfpdfform` tag inside the `cfdocument` tag to embed an existing interactive PDF form in a PDF document. This is useful to include additional information with a standard interactive form. For example, a company might have a generic PDF form for maintaining employee information. You could reuse this form in different contexts to ensure the employee information is current.

To create the static PDF pages, use the `cfdocument` tag and `cfdocumentsection` tags. Then use the `cfpdfform` tag in the `cfdocument` tag to create an interactive form in the PDF document. When the user updates the form and prints or submits it, all of the pages in the document, including the static PDF pages, are printed or submitted with the form.

**Note:** You can embed only one interactive form in a PDF document; therefore, include only one `cfpdfform` tag in a `cfdocument` tag. However, each `cfpdfform` tag can include multiple `cfpdfsubform` tags and `cfpdfformparam` tags.

Use at least one `cfdocumentsection` tag with the `cfpdfform` tag, but do not place the `cfpdfform` tag within the `cfdocumentsection` tag. Instead, insure that the `cfpdfform` and `cfdocumentsection` tags are at the same level, the following example shows:

```cfm
<cfdocument format="pdf">
  <cfdocumentitem type="header">
    <font size="+1">This is the Header</font>
  </cfdocumentitem>
  <cfdocumentitem type="footer">
    <font size="+1">This is the Footer</font>
  </cfdocumentitem>

  <cfdocumentsection>
    <p>This is the first document section.</p>
  </cfdocumentsection>

  <cfpdfform source="c:\forms\embed.pdf" action="populate">
    <cfpdfsubform name="form1">
      <cfpdfformparam name="txtManagerName" value="Janis Joplin">
      <cfpdfformparam name="txtDepartment" value="Sales">
    </cfpdfsubform>
  </cfpdfform>

  <cfdocumentsection>
    <p>This is another section</p>
  </cfdocumentsection>
</cfdocument>
```

The contents of the `cfpdfform` tag start on a new page. Any text or code directly after the `cfdocument` tag and before the `cfpdfform` tag applies to the document sections but not to the interactive PDF form in the `cfpdfform` tag.
The headers and footers that are part of the embedded PDF form do not apply to the rest of the PDF document, and the headers and footers that are defined in the `cfdocument` tag do not apply to the interactive form. However, header and footer information defined in the `cfdocumentitem` tags resumes in the sections that follow the embedded form and account for the pages in the embedded form.

**Note:** The `read` action of the `cfpdfform` tag is not valid when you embed a PDF form. Also, you cannot specify a destination in the `cfpdfform` tag. However, you can specify a filename in the `cfdocument` tag to write the PDF document with the PDF form to an output file. If you do not specify a filename, ColdFusion displays the PDF form in the context of the PDF document in the browser.

### Extracting data from a PDF form submission

Data extraction differs based on how the PDF form is submitted. ColdFusion supports two types of PDF form submission: HTTP post, which submits the form data, but not the form itself, and PDF, which submits the entire PDF file.

One use for PDF submission is for archival purpose: because the form is submitted with the data, you can write the output to a file. HTTP post submissions process faster because only the field data is transmitted, which is useful for updating a database or manipulating specific data collected from the form, but you cannot write an HTTP post submission directly to a file.

**Note:** Although forms created in LiveCycle Designer allow several types of submission, including XDP and XML, ColdFusion 8 can extract data from HTTP post and PDF submissions only.

In LiveCycle Designer, the XML code for an HTTP post submission looks like the following example:

```xml
<submit format="formdata" target="http://localhost:8500/pdfforms/pdfreceiver.cfm" textEncoding="UTF-8"/>
```

In LiveCycle Designer, the XML code for a PDF submission looks like the following example:

```xml
<submit format="pdf" target="http://localhost:8500/pdfforms/pdfreceiver.cfm" textEncoding="UTF-16" xdpContent="pdf datasets xfdf"/>
```

**Note:** Acrobat forms are submitted in binary format, not XML format.

### Extracting data from a PDF submission

Use the following code to extract data from a PDF submission and write it to a structure called `fields`:

```cfm
<!--- The following code reads the submitted PDF file and generates a result structure called fields. --->
<cfpdfform source="#PDF.content#" action="read" result="fields"/>
```

Use the `cfdump` tag to display the data structure, as follows:

```cfm
<cfdump var="#fields#"
```

**Note:** When you extract data from a PDF submission, always specify `"#PDF.content#"` as the source.

You can set the form fields to a variable, as the following example shows:

```cfm
<cfset empForm="#fields.form1#"
```

Use the populate action of the `cfpdfform` tag to write the output to a file. Specify `"#PDF.content#"` as the source. In the following example, the unique filename is generated from a field on the PDF form:
Writing LiveCycle form output to an XDP file

For Acrobat forms, you can write the output to a PDF file only. For LiveCycle forms, you have the option to write the output to an XDP file. The file extension determines the file format: to save the output in XDP format, simply use an XDP extension in the destination filename, as the following example shows:

```coldfusion
<cfpdfform action="populate" source="#PDF.content#"
        destination="timesheets\#empForm.txtsheet#.pdf" overwrite="yes"/>
```

An XDP file is an XML representation of a PDF file. In LiveCycle Designer, an XDP file contains the structure, data, annotations, and other relevant data to LiveCycle forms, which renders the form at run time.

ColdFusion XDP files contain the XDP XML code and the PDF image. Therefore, the file size is larger than a PDF file. Only write PDF forms to XDP files if you must incorporate them into the LiveCycle Designer workflow on a LiveCycle server.

Writing PDF output to an XML file

ColdFusion lets you extract data from a PDF form and write the output to an XML data file. To do this, you must save the form output as a PDF file. (The `cfpdfform` tag source must always be a PDF file.)

To write the output of a PDF file to an XML file, use the `read` action of the `cfpdfform` tag, as the following example shows:

```coldfusion
<cfpdfform action="read" source="#empForm.txtsheet#.pdf"
        XMLdata="timesheets\#empForm.txtsheet#.xml"/>
```

To save disk space, you can delete the PDF file and maintain the XML data file. As long as you keep the blank PDF form used as the template, you can use the `populate` action to regenerate the PDF file. For more information on populating forms, see "Populating a PDF form with XML data" on page 724.

Extracting data from an HTTP post submission

For an HTTP post submission, use the `cfdump` tag with the form name as the variable to display the data structure, as follows:

```coldfusion
<cfdump var="#FORM.form1#"/>
```

Note: When you extract data from an HTTP post submission, always specify the form name as the source. For example, specify "#FORM.form1#' for a form generated from a standard template in LiveCycle.

Notice that the structure is not necessarily the same as the structure of the PDF file used as the template (before submission). For example, the structure of a form before submission might look like the following example:

<table>
<thead>
<tr>
<th>struct</th>
</tr>
</thead>
<tbody>
<tr>
<td>form1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>txtDeptName [empty string]</td>
</tr>
<tr>
<td>txtEMail [empty string]</td>
</tr>
<tr>
<td>txtEmpID [empty string]</td>
</tr>
<tr>
<td>txtFirstName [empty string]</td>
</tr>
<tr>
<td>txtLastName [empty string]</td>
</tr>
<tr>
<td>txtPhoneNum [empty string]</td>
</tr>
</tbody>
</table>
After submission by using HTTP post, the resulting structure might look like the following example:

```plaintext
struct
FORM1 struct
    SUBFORM struct
        HEADER struct
            HTTPSUBMITBUTTON1 (empty string)
            TXTDEPTNAME Sales
            TXTFIRSTNAME Carolynn
            TXTLASTNAME Peterson
            TXTPHONENUM (617) 872-9178
            TXTEMDID 1
            TXTEMAIL carolynp@company
```

**Note:** When data extraction using the `cfpdf` tag results in more than one page, instead of returning one structure, the extraction returns one structure per page.

The difference in structure reflects internal rules applied by Acrobat for the HTTP post submission.

To extract the data from the HTTP post submission and update a database with the information, for example, map the database columns to the form fields, as the following code shows:

```cfml
<cfquery name="updateEmpInfo" datasource="cfdocexamples">
    UPDATE EMPLOYEES
    SET FIRSTNAME = "#FORM1.SUBFORM.HEADER.TXTFIRSTNAME#",
        LASTNAME = "#FORM1.SUBFORM.HEADER.TXTLASTNAME#",
        DEPARTMENT = "#FORM1.SUBFORM.HEADER.TXTDEPTNAME#",
        IM_ID = "#FORM1.SUBFORM.TXTEMAIL#",
        PHONE = "#FORM1.SUBFORM.HEADER.TXTPHONENUM#"
    WHERE EMP_ID = <cfqueryparam value="#FORM1.SUBFORM.TXTEMPID#">
</cfquery>
```

You can set a variable to create a shortcut to the field names, as the following code shows:

```cfml
<cfset fields=#form1.subform.header#>
```

Use the `cfoutput` tag to display the form data:

```cfml
<h3>Employee Information</h3>
<cfoutput>
    <table>
        <tr>
            <td>Name:</td>
            <td>#fields.txtfirstname# #fields.txtlastname#</td>
        </tr>
        <tr>
            <td>Department:</td>
            <td>#fields.txtdeptname#</td>
        </tr>
        <tr>
            <td>E-Mail:</td>
            <td>#fields.txtemail#</td>
        </tr>
        <tr>
            <td>Phone:</td>
            <td>#fields.txtponenumber#</td>
        </tr>
    </table>
</cfoutput>
```
Application examples that use PDF forms

The following examples show how you can use PDF forms in your applications.

PDF submission example
The following example shows how to populate fields in a PDF form created in LiveCycle Designer based on an employee's login information. When the employee completes the form and clicks the PDF Submit button, the entire PDF form with the data is submitted to a second processing page where ColdFusion writes the completed form to a file.

On the ColdFusion login page, an employee enters a user name and password:

```cfml
<!--- The following code creates a simple form for entering a user name and password. --->
<h3>Timesheet Login Form</h3>
<p>Please enter your user name and password.</p>
<cfform name="loginform" action="loginform_proc.cfm" method="post">
<table>
<tr>
<td>user name:</td>
<td><cfinput type="text" name="username" required="yes" message="A user name is required."></td>
</tr>
<tr>
<td>password:</td>
<td><cfinput type="password" name="password" required="yes" message="A password is required."/>
</td>
</tr>
<br/>
<cfinput type="submit" name="submit" value="Submit">
</cfform>
```

On the first processing page, a query retrieves all of the information associated with the user name from the cfdocexamples database. The cfpdfform tag populates an associated PDF form created in LiveCycle Designer (called timesheetForm.pdf) with the employee name, phone number, e-mail address, and department. ColdFusion displays the populated form in the browser, where the employee can complete the form and submit it.

```cfml
<!--- The following code retrieves all of the employee information for the user name entered on the login page. --->
<cfquery name="getEmpInfo" datasource="cfdocexamples">
SELECT * FROM EMPLOYEES
WHERE EMAIL = <cfqueryparam value="#FORM.username#"/>
</cfquery>

<!------ The following code populates the template called "timesheetForm.pdf" with data from the query and displays the interactive PDF form in the browser. A field in the PDF form contains the name of the output file to be written. It is a combination of the user name and the current date. --->
```
<!--- Notice the use of the cfpdfsform tag. Forms created from templates in LiveCycle Designer include a subform called form1. Use the cfpdfsform tag to match the structure of the form in ColdFusion. Likewise, the field names in the cfpdfformparam tags must match the field names in the PDF form. If the form structures and field names do not match exactly, ColdFusion does not populate the form fields. --->
<cfpdfform source="c:\forms\timesheetForm.pdf" action="populate">
  <cfpdfsubform name="form1">
    <cfpdfformparam name="txtEmpName" value="#getEmpInfo.FIRSTNAME# #getEmpInfo.LASTNAME#">
    <cfpdfformparam name="txtDeptName" value="#getEmpInfo.DEPARTMENT#">
    <cfpdfformparam name="txtEmail" value="#getEmpInfo.IM_ID#">
    <cfpdfformparam name="txtPhoneNum" value="#getEmpInfo.PHONE#">
    <cfpdfformparam name="txtManagerName" value="Randy Nielsen">
    <cfpdfformparam name="txtSheet" value="#form.username#_#DateFormat(Now())#">
  </cfpdfsubform>
</cfpdfform>

When the user completes the timesheet form (by filling in the time period, projects, and hours for the week) and clicks the Submit button, Acrobat sends the PDF file in binary format to a second ColdFusion processing page.

**Note:** In LiveCycle Designer, use the standard Submit button on the PDF form and specify "submit as: PDF" in the button Object Properties. Also, ensure that you enter the URL to the ColdFusion processing page in the Submit to URL field.

The cfpdfsform tag read action reads the PDF content into a result structure named fields. The cfpdfsform tag populate action writes the completed form to a file in the timesheets subdirectory.

<!--- The following code reads the PDF file submitted in binary format and generates a result structure called fields. The cfpdfsform populate action and the cfoutput tags reference the fields in the structure. --->
<cfpdfform source="#PDF.content#" action="read" result="fields"/>
<cfset empForm="#fields.form1#">
<cfpdfform action="populate" source="#PDF.content#" destination="timesheets\#empForm.txtsheet#.pdf" overwrite="yes"/>

<h3>Timesheet Completed</h3>
<p><cfoutput>#empForm.txtempname#</cfoutput>,</p>
<p>Thank you for submitting your timesheet for the week of #DateFormat(empForm.dtmForPeriodFrom, "long")# through #DateFormat(empForm.dtmForPeriodTo, "long")# Your manager, #empForm.txtManagerName# will notify you upon approval.</p>

**HTTP post example**

The following example shows how to extract data from a PDF form submitted with HTTP post and use it to update an employee database. The form was created in LiveCycle Designer.

On the ColdFusion login page, an employee enters a user name and password:

<!--- The following code creates a simple form for entering a user name and password. The code does not include password verification. --->
<h3>Employee Update Login Form</h3>
<p>Please enter your user name and password.</p>
<cfform name="loginform" action="loginform_procHTTP.cfm" method="post">
  <table>
    <tr>
      <td>user name:</td>
      <td><cfinput type="text" name="username" required="yes"></td>
    </tr>
message="A user name is required."/>
</tr>
<tr>
<td>password:</td>
<td><cfinput type="password" name="password" required="yes"
message="A password is required."/>
</td>
</tr>
</table>
<br/>
<cfinput type="submit" name="submit" value="Submit"/>
</cfform>

On the first processing page, a query retrieves all of the information associated with the user name from the cfdocexamples database. The cfpdfform tag populates an associated PDF form created in LiveCycle Designer (called employeeInfoHTTP.pdf) with the employee name, phone number, e-mail address, and department. The form also includes the employee ID as a hidden field. ColdFusion displays the populated form in the browser where the employee can change personal information in the form and submit it.

<!--- The following code retrieves all of the employee information for the user name entered on the form page. --->
<cfquery name="getEmpInfo" datasource="cfdocexamples">
SELECT * FROM EMPLOYEES
WHERE EMAIL = <cfqueryparam value="#FORM.username#">
</cfquery>

<!--- The following code populates the template called "employeeInfoHTTP.pdf" with data from the query. As in the previous example, notice the use of the cfpdfsubform tag. The txtEmpID field is a hidden field on the PDF form. --->
<cfquery name="getEmpInfo" datasource="cfdocexamples">
SELECT * FROM EMPLOYEES
WHERE EMAIL = <cfqueryparam value="#FORM.username#">
</cfquery>
<cfpdfform source="c:\forms\employeeInfoHTTP.pdf" action="populate">
<cfpdfsubform name="form1">
   <cfpdfformparam name="txtFirstName" value="#getEmpInfo.FIRSTNAME#">
   <cfpdfformparam name="txtLastName" value="#getEmpInfo.LASTNAME#">
   <cfpdfformparam name="txtDeptName" value="#getEmpInfo.DEPARTMENT#">
   <cfpdfformparam name="txtEmail" value="#getEmpInfo.IM_ID#">
   <cfpdfformparam name="txtPhoneNum" value="#getEmpInfo.PHONE#">
   <cfpdfformparam name="txtEmpID" value="#getEmpInfo.Emp_ID#">
</cfpdfsubform>
</cfpdfform>

When the employee updates the information in the form and clicks the HTTP post Submit button, Acrobat sends the form data (but not the form itself) to a second ColdFusion processing page.

Note: In LiveCycle Designer, use the HTTP Submit button on the PDF form. Also, ensure that you enter the URL to the ColdFusion processing page in the URL field of button Object Properties.

You must reproduce the structure, not just the field name, when you reference form data. To determine the structure of the form data, use the cfdump tag.

<!--- The following code reads the form data from the PDF form and uses it to update corresponding fields in the database. --->
<cfquery name="updateEmpInfo" datasource="cfdocexamples">
UPDATE EMPLOYEES
    SET FIRSTNAME = "#FORM1.SUBFORM.HEADER.TXTFIRSTNAME#",
    LASTNAME = "#FORM1.SUBFORM.HEADER.TXTLASTNAME#",
</cfquery>
DEPARTMENT = "#FORM1.SUBFORM.HEADER.TXTDEPTNAME#",
IM_ID = "#FORM1.SUBFORM.HEADER.TXTEMAIL#",
PHONE = "#FORM1.SUBFORM.HEADER.TXTPHONENUM#"
WHERE EMP_ID = <cfqueryparam value="#FORM1.SUBFORM.TXTEMPID#">
</cfquery>
<h3>Employee Information Updated</h3>
<p><cfoutput>#FORM1.SUBFORM.HEADER.TXTFIRSTNAME#</cfoutput>,</p>
<p>Thank you for updating your employee information in the employee database.</p>

Embedded PDF form example

The following example shows how to embed an interactive PDF form in a PDF document created with the <strong>cfdocument</strong> tag.

On the login page, an employee enters a user name and password:

```html
<h3>Employee Login Form</h3>
<p>Please enter your user name and password.</p>
<cfform name="loginform" action="embed2.cfm" method="post">
<table>
<tr>
<td>user name:</td>
<td><cfinput type="text" name="username" required="yes" message="A user name is required."></td>
</tr>
<tr>
<td>password:</td>
<td><cfinput type="password" name="password" required="yes" message="A password is required."></td>
</tr>
</table>
<br/>
<cfinput type="submit" name="submit" value="Submit">
</cfform>
```

On the processing page, a query populates an interactive PDF form from the cfdocexamples database. The interactive PDF form is embedded in a PDF document created with the <strong>cfdocument</strong> tag. The PDF document comprises three sections: the <strong>cfdocumentsection</strong> tags define the first and last sections of the document; the <strong>cfpdfform</strong> tag defines the second section embedded in the PDF document. Each section starts a new page in the PDF document. The Print button on the PDF form prints the entire document, including the pages in the sections before and after the interactive PDF form.

```cfquery name="getEmpInfo" datasource="cfdocexamples" SELECT * FROM EMPLOYEES
WHERE EMAIL = <cfqueryparam value="#FORM.username#">
</cfquery>
```

```html
<!--- The following code creates a PDF document with headers and footers. --->
<cfdocument format="pdf">
<cfdocumentitem type="header">
<font size="-1" align="center">Nondisclosure Agreement</font>
</cfdocumentitem>
<cfdocumentitem type="footer">
<font size="-1">Page <cfoutput>$cfdocument.currentpagenumber$ of $cfdocument.totalpagecount$</cfoutput></font>
</cfdocumentitem>

<!--- The following code creates the first section in the PDF document. --->
<cfdocumentsection>
```
<h3>Employee Nondisclosure Agreement</h3>

Please verify the information in the enclosed form. Make any of the necessary changes in the online form and click the <b>Print</b> button. Sign and date the last page. Staple the pages together and return the completed form to your manager.

---

The following code embeds an interactive PDF form within the PDF document with fields populated by the database query. The cfpdfform tag automatically creates a section in the PDF document. Do not embed the cfpdfform within cfdocumentsection tags. ---

```coldfusion
cfpdfform action="populate" source="c:\forms\embed.pdf">
  <cfpdfsubform name="form1">
    <cfpdfformparam name="txtEmpName" value="#getEmpInfo.FIRSTNAME# #getEmpInfo.LASTNAME#"/>
    <cfpdfformparam name="txtDeptName" value="#getEmpInfo.DEPARTMENT#"/>
    <cfpdfformparam name="txtEmail" value="#getEmpInfo.IM_ID#"/>
    <cfpdfformparam name="txtPhoneNum" value="#getEmpInfo.PHONE#"/>
    <cfpdfformparam name="txtManagerName" value="Randy Nielsen"/>
  </cfpdfsubform>
</cfpdfform>
```

---

The following code creates the last document section. Page numbering resumes in this section. ---

```coldfusion
cfdocumentsection
<p>I, <cfoutput>#getEmpInfo.FIRSTNAME# #getEmpInfo.LASTNAME#</cfoutput>, hereby attest that the information in this document is accurate and complete.</p>
<br/>
<table border="0" cellpadding="20">
  <tr><td width="300">
    <hr/>
    <p><i>Signature</i></p>
  </td><td width="150">
    <hr/>
    <p><i>Today's Date</i></p>
  </td></tr>
</table>
</cfdocumentsection>
```

---

Update PDF form example

The following example shows how ColdFusion lets you update a PDF form while retaining existing data. The application lets a user create an office supply request from a blank form created in LiveCycle or modify an existing supply request. The user has the option to submit the completed form as an e-mail attachment.

```coldfusion
cfpdfform source="SupplyReq.pdf" action="populate" destination="supplyReqs/NewRequest.pdf" overwrite="yes">
  <cfpdfsubform name="form1">
    <cfpdfformparam name="txtContactName" value="Constance Gardner"/>
    <cfpdfformparam name="txtCompanyName" value="Wild Ride Systems"/>
    <cfpdfformparam name="txtAddress" value="18 Melrose Place"/>
    <cfpdfformparam name="txtPhone" value="310-654-3298"/>
    <cfpdfformparam name="txtCity" value="Hollywood"/>
    <cfpdfformparam name="txtStateProv" value="CA"/>
    <cfpdfformparam name="txtZipCode" value="90210"/>
  </cfpdfsubform>
</cfpdfform>
```
<!---- The following code lets users choose an existing supply request form or create a new request from a the NewRequest.pdf form. ---->
<h3>Office Supply Request Form</h3>
<p>Please choose the office supply request form that you would like to open. Choose <b>New Supply Request</b> to create a new request.</p>

<!---- The following code populates a list box in a form with files located in the specified directory. ---->
<cfset thisDir = expandPath(".")>
<cfdirectory directory="#thisDir#/supplyReqs" action="list" name="supplyReqs">
<cfif #supplyReqs.name# is "NewRequest.pdf">
<cfset #supplyReqs.name# = "---New Supply Request---">
</cfif>
<cfform name="fileList" action="supplyReq2.cfm" method="post">
<cfselect name="file" query="supplyReqs" value="name" display="name" required="yes" size="8" multiple="no"/>
<cfinput type="submit" name="submit" value="OK">
</cfform>

<!---- supplyReq2.cfm ---->
<!---- The following code displays the PDF form that the user selected. ---->
<cfif #form.file# is "---New Supply Request---">
<cfset #form.file# = "NewRequest.pdf">
</cfif>
<cfpdfform source="supplyReqs/#form.file#" action="populate"/>

<!---- supplyReq3.cfm ---->
<!---- The following code reads the PDF file content from the submitted PDF form. ---->
<cfpdfform source="#PDF.content#$ action="read" result="fields"/>

<!---- The following code writes the PDF form to a file and overwrites the file if it exists. ---->
<cfpdfform action="populate" source="#PDF.content#$ destination="SupplyReqs/supplyReq_#fields.form1.txtRequestNum#.pdf" overwrite="yes"/>

<!---- The following code customizes the display based on field values extracted from the PDF form. ---->
<p>Your changes have been recorded for supply request #fields.form1.txtRequestNum#.</p>
<p>If the form is complete and you would like to submit it to #fields.form1.txtContactName# for processing, click <b>Submit</b>.</p>

<!---- The following code gives the option to e-mail the submitted form as an attachment or return to the home page. ---->
<cfform name="send" method="post" action="supplyReq4.cfm">
<cfinput type="hidden" value="SupplyReqs/supplyReq_#fields.form1.txtRequestNum#.pdf" name="request">
<cfinput type="hidden" value="#fields.form1.txtRequester#" name="requester">
<cfinput type="submit" value="Submit" name="Submit">
</cfform>
<p>If you would like to modify your request or choose another request, <a href="supplyReq1.cfm">click here</a>.</p>

<!---- supplyReq4.cfm ---->
<!---- The following code sends the completed PDF form as an attachment to the person responsible for processing the form. ---->
<p>Your request has been submitted.</p>
<cfmail from="#form.requester#@wildride.com" to="cgardener@wildride.com"
    subject="see attachment">
    Please review the attached PDF supply request form.
    <cfmailparam file="#form.request#"></cfmailparam>
</cfmail>
Chapter 41: Assembling PDF Documents

You can use Adobe ColdFusion to assemble PDF documents. You create a unified document from multiple source files or pages from multiple files by using the `cfpdf` and `cfpdfparam` tags.

Contents

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- Using shortcuts for common tasks .............................................................. 741
- Using DDX to perform advanced tasks ......................................................... 749
- Application examples ..................................................................................... 756

About assembling PDF documents

You use the `cfpdf` tag to assemble PDF documents in ColdFusion. The tag provides several actions for creating unified output files from multiple sources, as the following table shows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>addWatermark</td>
<td>Adds a watermark image to one or more pages in a PDF document.</td>
</tr>
<tr>
<td>deletePages</td>
<td>Deletes one or more pages from a PDF document.</td>
</tr>
<tr>
<td>getInfo</td>
<td>Extracts information associated with the PDF document, such as the author, title, and creation date.</td>
</tr>
<tr>
<td>merge</td>
<td>Assembles PDF documents or pages from PDF source files into one output file.</td>
</tr>
<tr>
<td>processddx</td>
<td>Extends the <code>cfpdf</code> tag by providing a subset of Adobe® LiveCycle™ Assembler functionality. This is the default action.</td>
</tr>
<tr>
<td>protect</td>
<td>Password-protects and encrypts a PDF document.</td>
</tr>
<tr>
<td>read</td>
<td>Reads a PDF document into a ColdFusion variable.</td>
</tr>
<tr>
<td>removeWatermark</td>
<td>Removes watermarks from specified pages in a PDF document.</td>
</tr>
<tr>
<td>setInfo</td>
<td>Sets the Title, Subject, Author, and Keywords for a PDF document.</td>
</tr>
<tr>
<td>thumbnail</td>
<td>Generates thumbnail images from specified pages in a PDF document.</td>
</tr>
<tr>
<td>write</td>
<td>Writes PDF output to a file. Also use to flatten forms created in Acrobat and linearize documents.</td>
</tr>
</tbody>
</table>

Note: You cannot use the `cfpdf` tag to create a PDF document from scratch. To create a PDF document from HTML content, use the `cfdocument` tag. Also, you can use Report Builder to generate a report in PDF format. Instead of writing a PDF document to file, you can specify a PDF variable generated as the source for the `cfpdf` tag.

All but one of the `cfpdf` tag actions provide shortcuts to common tasks; for example, with one line of code, you can add a watermark image to one or more pages in an output file, merge all the PDF documents in a directory into a single output file, or password-protect a PDF document. ColdFusion provides two ways to extend the functionality of the `cfpdf` tag: the `cfpdfparam` tag and the `processddx` action.

You use the `cfpdfparam` tag only with the `merge` action of the `cfpdf` tag. The `cfpdfparam` tag gives you more control over which files are included in the output file; for example, you can merge pages from multiple files in different directories.
The `processddx` action extends the `cfpdf` tag by providing a subset of Adobe LiveCycle Assembler functionality. You use the `processddx` action to process Document Description XML (DDX) instructions explained in “Using DDX to perform advanced tasks” on page 749. Using DDX instructions requires more coding, but it lets you perform complex tasks, such as generating a table of contents and adding automatic page numbers.

Also, ColdFusion provides three functions for PDF file, DDX file, and PDF variable verification:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>IsDDX</code></td>
<td>Determines whether a DDX file, pathname, and instructions are not null and are valid. Also verifies that the schema used for the DDX instructions is supported by ColdFusion.</td>
</tr>
<tr>
<td><code>IsPDFFile</code></td>
<td>Determines whether a PDF source file, pathname, and version are valid and supported on the server running ColdFusion. Also verifies whether a PDF file is corrupted.</td>
</tr>
<tr>
<td><code>IsPDFObject</code></td>
<td>Determines whether a PDF object stored in memory is valid. Also verifies the contents of PDF variables generated by the <code>cfdocument</code> and <code>cfpdf</code> tags.</td>
</tr>
</tbody>
</table>

The following table describes a few document assembly tasks that you can perform with ColdFusion:

<table>
<thead>
<tr>
<th>Task</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add a generated table of contents to a PDF document</td>
<td><code>cfpdf action=&quot;processddx&quot;</code> with the TableOfContents DDX element</td>
</tr>
<tr>
<td>Add automatic page numbers to a PDF document</td>
<td><code>cfpdf action=&quot;processddx&quot;</code> with the _PageNumber and _LastPageNumber built-in keys. Valid only in the Header and Footer DDX elements.</td>
</tr>
<tr>
<td>Add headers and footers to a PDF document</td>
<td><code>cfpdf action=&quot;processddx&quot;</code> with the Header and Footer DDX elements</td>
</tr>
<tr>
<td>Add or remove watermarks</td>
<td><code>cfpdf action=&quot;processddx&quot;</code> with the Watermark and Background DDX elements</td>
</tr>
<tr>
<td></td>
<td><code>cfpdf action=&quot;addWatermark&quot;</code> and <code>cfpdf action=&quot;removeWatermark&quot;</code></td>
</tr>
<tr>
<td>Change the encryption algorithm for PDF documents</td>
<td><code>cfpdf action=&quot;protect&quot;</code> encrypt=&quot;encryption algorithm&quot;</td>
</tr>
<tr>
<td>Change user permissions on a PDF document</td>
<td><code>cfpdf action=&quot;protect&quot;</code> newOwnerPassword=&quot;xxxxx&quot; permissions=&quot;comma-separated list&quot;</td>
</tr>
<tr>
<td>Delete pages from a PDF document</td>
<td><code>cfpdf action=&quot;deletePages&quot;</code></td>
</tr>
<tr>
<td>Extract text from a PDF document and export it to an XML file</td>
<td><code>cfpdf action=&quot;processddx&quot;</code> with the DocumentText DDX element</td>
</tr>
<tr>
<td>Flatten (remove interactivity from) forms created in Acrobat</td>
<td><code>cfpdf action=&quot;write&quot;</code> flatten=&quot;yes&quot;</td>
</tr>
<tr>
<td>Generate thumbnail images from PDF document pages</td>
<td><code>cfpdf action=&quot;thumbnail&quot;</code> pages=&quot;page numbers&quot;</td>
</tr>
<tr>
<td>Linearize PDF documents for faster web display</td>
<td><code>cfpdf action=&quot;write&quot;</code> saveOption=&quot;linear&quot;</td>
</tr>
<tr>
<td>Merge pages and page ranges from multiple documents in different locations into one PDF document</td>
<td><code>cfpdf action=&quot;merge&quot;</code> with multiple <code>cfpdfparam</code> tags</td>
</tr>
<tr>
<td>Merge PDF documents in a directory into one PDF document</td>
<td><code>cfpdf action=&quot;merge&quot;</code> directory=pathname</td>
</tr>
</tbody>
</table>
Using shortcuts for common tasks

You use the `cfpdf` tag actions to perform shortcuts to common PDF document assembly and manipulation.

Adding and removing watermark images

Use the `addWatermark` and `removeWatermark` actions to add and remove watermarks from PDF documents. You can create a watermark and apply it to a PDF document in one of the following ways:

- Use an image file as a watermark.
- Specify a variable that contains an image file.
- Specify a ColdFusion image.
- Use the first page of a PDF document as a watermark.

**Note:** Also, you can use the `Watermark` or `Background` DDX elements with the `processddx` action to create a text-string watermark. For more information, see "Using DDX to perform advanced tasks" on page 749.

Using an image file as a watermark

The following example shows how to specify an image file as a watermark:

```cfml
<cfpdf action="addWatermark" source="artBook.pdf"
    image="../cfdocs/images/artgallery/raquel05.jpg" destination="output.pdf"
    overwrite="yes">

By default, ColdFusion centers the image on the page, sets the opacity of the image to 3 out of 10 (opaque), and displays the image in the background of each page in the output file. In the following example, ColdFusion displays the watermark in the foreground, offset 100 pixels from the left margin of the page and 100 pixels from the bottom margin of the page. Because the opacity is set to 1, the image does not obscure the page content.

```cfml
<cfpdf action="addWatermark" source="artBook.pdf"
    image="../cfdocs/images/artgallery/raquel05.jpg" destination="output.pdf"
    overwrite="yes" foreground="yes" opacity=1 showOnPrint="no" position="100,100">

For a complete list of attributes and settings, see the `cfpdf` tag in the CFML Reference.

Using a variable that contains an image file

You can specify a variable that contains an image as a watermark. The following example shows how to create a form from which the user can select an image:

```html
<!---- The following code creates a form where you can choose an image to use as a watermark. ---->
<h3>Choosing a Watermark</h3>
<p>Please choose the image you would like to use as a watermark.</p>

<!---- Create the ColdFusion form to select an image. ---->
```
<table>
<cfform action="addWatermark2.cfm" method="post"
 enctype="multipart/form-data">
<tr>
<td><img src="../cfdocs/images/artgallery/maxwell01.jpg"/><br/>
<cfinput type="radio" name="art" value="../cfdocs/images/artgallery/maxwell01.jpg"
 checked="yes">
 Birch Forest</td>
<td><img src="../cfdocs/images/artgallery/raquel05.jpg"/><br/>
<cfinput type="radio" name="art" value="../cfdocs/images/artgallery/raquel05.jpg">
 Lounging Woman</td>
<td><img src="../cfdocs/images/artgallery/jeff01.jpg"/><br/>
<cfinput type="radio" name="art" value="../cfdocs/images/artgallery/jeff01.jpg">Celebration</td>
<td><img src="../cfdocs/images/artgallery/paul01.jpg"/><br/>
<cfinput type="radio" name="art" value="../cfdocs/images/artgallery/paul01.jpg">Guitarist</td>
</tr>
</table>
<br/>
<cfinput type="Submit" name="submit" value="Submit"></p>
</cfform>

The processing page uses the image selected from the form as the watermark for a PDF file:

<!--- ColdFusion applies the image selected from the form as the watermark in a PDF document by using the input variable form.art. --->
<cfpdf action="addwatermark" source="check.pdf" image="#form.art#" destination="output.pdf"
 foreground="yes" overwrite="true">
<p>The watermark has been added to your personalized checks.</p>
</cfpdf>

**Using a ColdFusion image as a watermark**

You can specify a ColdFusion image as a watermark. You can extract an image from a database and manipulate the image in memory, but you don't have to write the manipulated image to a file. Instead, you can apply the manipulated image as a watermark in a PDF document.

In the following example, the first ColdFusion page extracts images from a database and populates a pop-up menu with the titles of the artwork:

<!--- Create a query to extract artwork from the cfartgallery database. --->
<cfquery name="artwork" datasource="cfartgallery">
SELECT ARTID, ARTNAME, LARGEIMAGE
FROM ART
ORDER BY ARTNAME
</cfquery>

<!--- Create a form that lists the artwork titles generated by the query. Set the value to LARGEIMAGE so that the image file is passed to the processing page. --->
<cfform action="addWatermarkB.cfm" method="post">
<p>Please choose a title:</p>
<cfselect name="art" query="artwork" display="ARTNAME" value="LARGEIMAGE" required="yes"
 multiple="no" size="8">
</cfselect>
<br/>
<cfinput type="submit" name="submit" value="OK"></cfform>
The action page generates a ColdFusion image from the selected file by using the `cfimage` tag. The `ImageScaleToFit` function resizes the image and applies the bicubic interpolation method to improve the resolution. To use the manipulated image as a watermark, specify the image variable, as the following example shows:

```coldfusion
<!--- Verify that an image file exists and is in a valid format. --->
<cfif IsImageFile("../cfdocs/images/artgallery/#form.art#")>

<!--- Use the cfimage tag to create a ColdFusion image from the file chosen from the list. --->
<cfimage source="../cfdocs/images/artgallery/#form.art#" action="read" name="myWatermark">

<!--- Use the ImageScaleToFit function to resize the image by using the bicubic interpolation method for better resolution. --->
<cfset ImageScaleToFit(myWatermark,450,450,"bicubic")>

<!--- Use the ColdFusion image variable as the watermark in a PDF document. --->
<cfpdf action="addWatermark" source="title.pdf" image="#myWatermark#" destination="watermarkTitle.pdf" overwrite="yes">
</cfif>

<i>For more information on ColdFusion images, see “Creating and Manipulating ColdFusion Images” on page 763.</i>

**Creating a text image and using it as a watermark**

You can use the `ImageDrawText` function to create a text image in ColdFusion and apply the image as a watermark, as the following example shows:

```coldfusion
<!--- Create a blank image that is 500 pixels square. --->
<cfset myImage=ImageNew("",500,500)>

<!--- Set the background color for the image to white. --->
<cfset ImageSetBackgroundColor(myImage,"white")>

<!--- Clear the rectangle specified on myImage and apply the background color. --->
<cfset ImageClearRect(myImage,0,0,500,500)>

<!--- Turn on antialiasing. --->
<cfset ImageSetAntialiasing(myImage)>

<!--- Draw the text. --->
<cfset attr=StructNew()>
<cfset attr.size=50>
<cfset attr.style="bold"
<cfset attr.font="Verdana">
<cfset ImageSetDrawingColor(myImage,"blue")>
<cfset ImageDrawText(myImage,"PROOF",100,250,attr)>

<!--- Write the text image to a file. --->
<cfimage action="write" source="#myImage#" destination="text.tiff" overwrite="yes">

<!--- Use the text image as a watermark in the PDF document. --->
<cfpdf action="addWatermark" source="c:/book/1.pdf" image="text.tiff" destination="watermarked.pdf" overwrite="yes">
</cfset>

<i>For more information on ColdFusion images, see “Creating and Manipulating ColdFusion Images” on page 763. For an example of using DDX elements to create a text-string watermark, see “Adding text-string watermarks” on page 754.</i>
Using a PDF page as a watermark

Use the `copyFrom` attribute to create a watermark from the first page of a PDF file and apply it to another PDF document. In the following example, ColdFusion creates a watermark from the first page of `image.PDF`, applies the watermark to the second page of `artBook.pdf`, and writes the output to a new file called `output.pdf`:

```<cfpdf action="addWatermark" copyFrom="image.pdf" source="artBook.pdf" pages="2" destination="output.pdf" overwrite="yes">```

In this example, `image.pdf` appears in the background of the second page of `artBook.pdf`. ColdFusion does not change the size of the watermark image to fit the page. The page used as a watermark can contain text, graphics, or both.

Removing watermarks

Use the `removeWatermark` action to remove a watermark from one or more pages in a PDF document. The following example shows how to remove a watermark from the entire PDF document and write the document to a new output file:

```<cfpdf action="removeWatermark" source="artBook.pdf" destination="noWatermark.pdf">```

The following example shows how to remove a watermark from the first two pages of a PDF document and overwrite the source document:

```<cfpdf action="removeWatermark" source="artBook.pdf" destination="artBook.pdf" overwrite="yes" pages="1-2">```

Because the source and the destination are the same and the `overwrite` attribute is set to `yes`, ColdFusion overwrites the source file with the output file.

Deleting pages from a PDF document

Use the `deletePages` action to remove pages from a PDF document and write the result to a file. You can specify a single page, a page range (for example, “81–97”), or a comma-separated list of pages to delete, as the following example shows:

```<cfpdf action="deletePages" source="myBook.pdf" pages="10-15,21,89" destination="abridged.pdf" overwrite="yes">```

Protecting PDF files

Use the `protect` action to password-protect, set permissions, and encrypt PDF documents for security.

Setting passwords

ColdFusion supports two types of passwords: an `owner password` and a `user password`. An owner password controls the ability to change the permissions on a document. When you specify an owner password, you set permissions to restrict the operations users can perform, such as the ability to print a document, make changes to its content, and extract content. The following code creates an owner password for a document:

```<cfpdf action="protect" newOwnerPassword="splunge" source="timesheet.pdf" destination="timesheet.pdf" overwrite="yes" permissions="AllowPrinting">```

To password-protect a document, set the user password. A user password controls the ability to open a document. If you set a user password for a document, any person attempting to open the file is prompted to enter a password. The following example sets the user password for a document:

```<cfpdf action="protect" newUserPassword="openSesame" source="timesheet.pdf" destination="myTimesheet.pdf">```
In the previous example, no restrictions apply to the PDF document after the user enters the correct password. To restrict usage and password-protect a document, add a user password and an owner password. Use the owner password to set the permissions, as the following example shows:

```cfpdf
<cfpdf action="protect" newUserPassword="openSesame" newOwnerPassword="topSecret"
    source="timesheet.pdf" destination="myTimesheet.pdf" overwrite="yes"
    permissions="AllowPrinting">
```

In the previous example, a person who enters the user password (openSesame) can print the document only. A person who enters the owner password (topSecret) is considered the owner of the document, has full access to the file, and can change the user permissions for that file.

**Setting permissions on a PDF document**

To set permissions on a PDF document, you must specify a `newOwnerPassword`. Conversely, you cannot set the `newOwnerPassword` without also setting the `permissions` attribute. Only an owner can change permissions or add passwords. For a list of permissions that an owner can set for PDF documents, see `cfpdf` in the CFML Reference.

Except for `all` or `none`, owners can specify a comma-separated list of permissions on a document, as the following example shows:

```cfpdf
<cfpdf action="protect" permissions="AllowInPrinting,AllowDegradedPrinting,AllowSecure"
    source="timesheet.pdf" newOwnerPassword="private" newUserPassword="openSesame"
    destination="myTimesheet.pdf">
```

In this example, a user must enter the password openSesame before opening the PDF form. All users can print the document at any resolution, but only the owner can modify the document or change the permissions.

**Encrypting PDF files**

When you specify the `protect` action for a PDF file, ColdFusion encrypts the file with the RC4 128-bit algorithm by default. Depending on the version of Acrobat running on the ColdFusion server, you can set the encryption to protect the document contents and prevent search engines from accessing the PDF file metadata.

You can change the encryption algorithm by using the `encrypt` attribute. For a list of supported encryption algorithms, see `cfpdf` in the CFML Reference.

The following example changes the password encryption algorithm to RC4 40-bit encryption:

```cfpdf
<cfpdf action="protect" source="confidential.pdf" destination="confidential.pdf"
    overwrite="yes" newOwnerPassword="paSSword1" newUserPassword="openSesame"
    encrypt="RC4_40">
```

To prevent ColdFusion from encrypting the PDF document, set the encryption algorithm to `none`, as the following example shows:

```cfpdf
<cfpdf action="protect" source="confidential.pdf" encrypt="none" destination="public.pdf">
```

To decrypt a file, provide the owner or user password and write the output to another file. The following code decrypts the confidential.pdf file and writes it to a new file called myDocument.pdf:

```cfpdf
<cfpdf action="write" source="confidential.pdf" password="paSSword1"
    destination="myDocument.pdf">
```

**Managing PDF document information**

To retrieve information stored with a source PDF document, such as the creation date, the application used to create the PDF document, and the name of the person who created the document, use the `getInfo` action. For a list of data elements, see "PDF file information elements" on page 440 in the CFML Reference.
Use the `setInfo` action to specify information, such as the author, subject, title, and keywords associated with the output file. This information is useful for archiving and searching PDF documents. PDF document information is not displayed or printed with the document.

The following example shows how to set keywords for tax documents. The information is useful for assembling the documents based on the tax filing requirements for different business types (Sole Proprietor, Partnership, and S Corporation). Some business types share the same forms and documents. By setting the business type keywords for each document, you can store the documents in one directory and search them based on keyword values. The following code sets three keywords for the p535.pdf tax booklet:

```coldfusion
<cfset taxKeys=StructNew()>
<cfset taxKeys.keywords="Sole Proprietor, Partnership, S Corporation">
<cfpdf action="setInfo" source="taxes\p535.pdf" info="#taxKeys#" destination="taxes\p535.pdf" overwrite="yes">
When you use the `setInfo` action, ColdFusion overwrites any existing information for that key-value pair. In the previous example, if the p535.pdf document contained a keyword of “tax reference”, ColdFusion overwrites that keyword with “Sole Proprietor, Partnership, S Corporation”.

To retrieve all of the information associated with the tax file, use the `cfdump` tag with the `getInfo` action, as the following example shows:

```coldfusion
<cfpdf action="getInfo" source="taxes\p535.pdf" name="taxInfo">
<cfdump var="#taxInfo#">
To retrieve just the keywords for the PDF document, use this code:

```coldfusion
<cfpdf action="getInfo" source="taxes\p535.pdf" name="taxInfo">
<cfoutput>#taxInfo.keywords#</cfoutput>

### Merging PDF documents

ColdFusion lets you merge PDF documents in the following ways:

- Merge all of the PDF files in a specified directory.
- Merge a comma-separated list of PDF files.
- Merge individual PDF files, and pages within those files, explicitly, even if the source files are stored in different locations.
- Merge the contents of a PDF variable generated by the `cfdocument` tag or a `cfpdf` tag.

To merge the contents of a directory, use the `merge` action and specify the directory where the source PDF files are located, as the following example shows:

```coldfusion<cfpdf action="merge" directory="c:/BookFiles" destination="myBook.pdf" overwrite="yes">
By default, ColdFusion merges the source files in descending order by timestamp. You can control the order in which the PDF files are added to the book by setting the `order` and `ascending` attributes. The following code merges the files in ascending order according to the timestamp on the files:

```coldfusion<cfpdf action="merge" directory="c:/BookFiles" destination="myBook.pdf" order="name" ascending="yes" overwrite="yes">
By default, ColdFusion continues the merge process even if it encounters a file that is not a valid PDF document in the specified directory. To override this setting, set the `stopOnError` attribute to `yes`, as the following example shows:

```coldfusion<cfpdf action="merge" directory="c:/BookFiles" destination="myBook.pdf" order="time" ascending="yes" overwrite="yes" stopOnError="yes"}>
You can merge a comma-separated list of PDF files. To do this, you must specify the absolute pathname for each file, as the following example shows:

```cfpdf action="merge"
  source="c:\coldfusion\wwwroot\lion\Chap1.pdf,c:\coldfusion\wwwroot\lion\Chap2.pdf"
  destination="twoChaps.pdf" overwrite="yes">
</cfpdf>
```

For more control over which files are added to the merged document, use the `cfpdfparam` tag with the `cfpdf` tag. The `cfpdfparam` tag merges documents or pages from documents located in different directories into a single output file. When you use the `cfpdfparam` tag, the PDF files are added to the output file in the order they appear in the code. In the following example, the cover, title, and copyright pages are followed by the first five pages of the introduction, then all of the pages in Chapter 1, and then the first page followed by pages 80–95 in Chapter 2:

```cfpdf param action="merge" destination="myBook.pdf" overwrite="yes" keepBookmark="yes">
<cfpdfparam source="coverPage">
<cfpdfparam source="title.pdf">
<cfpdfparam source="e:\legal\copyright.pdf">
<cfpdfparam source="boilerplate\intro.pdf" pages="1-5">
<cfpdfparam source="bookfiles\chap1.pdf">
<cfpdfparam source="bookfiles\chap2.pdf" pages="1,80-95">
</cfpdfparam>
</cfpdfparam>
</cfpdfparam>
</cfpdfparam>
</cfpdf>
```

Because the `keepbookmark` attribute is set to `yes`, ColdFusion retains the bookmarks from the source documents in the output file.

**Note:** You cannot use the `cfpdf` tag to create bookmarks in a PDF document.

### Flattening forms created in Acrobat

Flattening forms involves removing the interactivity from the form fields. This is useful for displaying form data and presenting it without allowing it to be altered. Use the `write` action to flatten PDF forms, as the following example shows:

```cfpdf action="write" flatten="yes" source="taxForms\f1040.pdf"
  destination=taxForms\flatForm.pdf" overwrite="yes">
<a href="http://localhost:8500/Lion/taxforms/flatForm.pdf">1040 form</a>
```

**Note:** If you flatten a prefilled form created in Acrobat, ColdFusion flattens the form and removes the data from the form fields. When you specify a form created in Acrobat as a source file for `merge` action of the `cfpdf` tag, ColdFusion automatically flattens the form and removes data from the form fields, if the fields are filled in. ColdFusion does not support flattening forms created in LiveCycle.
Linearizing PDF documents for faster web display

For efficient access of PDF files over the web, linearize PDF documents. A linearized PDF file is structured in a way that displays the first page of the PDF file in the browser before the entire file is downloaded from the web server. This means that linear PDF documents open almost instantly.

To linearize PDF documents, specify the saveOption attribute of the write action. The following example saves the output file in linear format:

```cfpdf action="write" saveOption="linear" source="myBook.pdf" destination="fastBook.pdf" overwrite="yes">
```

*Note:* Linearization can decrease performance when handling very large documents.

Generating thumbnail images from PDF pages

Use the thumbnail action to generate thumbnail images from PDF pages. If you specify only the source attribute with the thumbnail action, ColdFusion automatically creates a directory relative to the CFM page called thumbnails where it stores a generated JPEG image for each page in the document. The filenames are in the following format:

`PDFdocumentName_page_n.JPG`

For example, assume that the source file in the following example has 100 pages:

```cfpdf action="thumbnail" source="myBook.pdf">
```

ColdFusion generates the following files and stores them in the thumbnails directory:

- `myBook_page_1.jpg`
- `myBook_page_2.jpg`
- `myBook_page_3.jpg`
  ...
- `myBook_page_100.jpg`

If you specify a destination, ColdFusion does not create the thumbnails directory and stores the files in the specified directory instead. The following code generates a thumbnail image called `myBook_page_1.jpg` from the first page of `myBook.pdf` and stores it in a directory called images, which is relative to the CFM page:

```cfpdf action="thumbnail" source="myBook.pdf" pages="1" destination="images">
```

You change the prefix for the thumbnail filename and the change image file format to PNG or TIFF by specifying the imagePrefix and format attributes. The following code generates a file called `TOC_page_2.PNG` from the second page of `myBook.pdf`:

```cfpdf action="thumbnail" source="myBook.pdf" pages="2" imagePrefix="TOC" format="PNG" destination="images">
```

The following code generates thumbnails from a range of pages and changes the image background to transparent (the default is opaque):

```cfpdf action="thumbnail" source="myBook.pdf" pages="1-10,15,8-16,59" transparent="yes" destination="\myBook\subset" imagePrefix="abridged">
```

For an example of how to generate thumbnail images and link them to pages in the source PDF document, see the cfpdf tag in the CFML Reference.
Using the Duplicate function to create versions of a PDF document

You can use the `Duplicate` function to clone PDF variables, which is an efficient way to create different versions of a PDF document from a single source file. For example, you can customize PDF output based on your audience by creating clones of a PDF variable and performing different actions on each clone. The following example shows how to create a clone of a PDF document in memory, and create one version of the document with a watermark and another version of the document where permissions are restricted:

```coldfusion
<cfset filename="coldfusion.pdf">
<!--- This code reads a PDF document into a PDF variable called pdfVar1. --->
<cfpdf action="read" source="#filename#" name="pdfVar1">
<!--- This code uses the Duplicate function to create a clone of pdfVar1 called pdfVar2. --->
<cfset pdfVar2=Duplicate(pdfVar1)>
<!--- This code creates a watermarked version of the source PDF document from the pdfVar1 variable. --->
<cfpdf action="addwatermark" source="pdfVar1" rotation="45" image="watermark.jpg" destination="watermark_coldfusion.pdf" overwrite="yes">
<!--- This code creates a protected version of the source PDF document from the pdfVar2 variable. --->
<cfpdf action="protect" source="pdfVar2" encrypt="RC4_128" permissions="none" newownerpassword="owner1" destination="restricted_coldfusion.pdf" overwrite="yes">
```

Using DDX to perform advanced tasks

LiveCycle Assembler is a server-based application that processes DDX, a declarative markup language used to define PDF output files.

The `processddx` action lets you process DDX instructions without installing LiveCycle Assembler. In addition to all of the functionality available with the other `cfpdf` actions, you can use DDX instructions to perform advanced tasks, such as adding a generated table of contents to a PDF document, adding headers and footers with automatic page numbers, and creating groups of PDF documents to which you can apply formatting instructions.

ColdFusion does not provide complete LiveCycle Assembler functionality. For a list of DDX elements that you can access from ColdFusion, see “Supported DDX elements” on page 442 in the CFML Reference.

For complete DDX syntax, see the Adobe LiveCycle Assembler Document Description XML Reference.

Using DDX instructions with ColdFusion

Although you can type DDX instructions directly in ColdFusion, typically you refer to an external DDX file. A DDX file is basically an XML file with a DDX extension (for example, merge.ddx). You can use any text editor to create a DDX file. The DDX syntax requires that you enclose the instructions within DDX start and end tags. In the following example, the `PDF` element provides instructions for merging two PDF source files (Doc1 and Doc2) into a result file (Out1):

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
<PDF result="Out1">
    <PDF source="Doc1"/>
    <PDF source="Doc2"/>
</PDF>
</DDX>
```
In ColdFusion, you verify the source DDX file with the `IsDDX` function:

```coldfusion
<!--- The following code verifies that the DDX file exists and the DDX instructions are valid. --->
<cfif IsDDX("merge.ddx")>
```

To implement the DDX instructions in ColdFusion, you create two structures: an input structure that maps the DDX input instructions to the PDF source files, and an output structure that maps the DDX output instructions to a PDF output file.

The following code maps two files called Chap1.pdf and Chap2.pdf to the Doc1 and Doc2 sources that you defined in the DDX file:

```coldfusion
<!--- This code creates a structure for the input files. --->
<cfset inputStruct=StructNew()>
<cfset inputStruct.Doc1="Chap1.pdf">
<cfset inputStruct.Doc2="Chap2.pdf">
```

The following code maps the output file called twoChaps.pdf to the Out1 result instruction that you defined in the DDX file:

```coldfusion
<!--- This code creates a structure for the output file. --->
<cfset outputStruct=StructNew()>
<cfset outputStruct.Out1="twoChaps.pdf">
```

To process the DDX instructions, you use the `processddx` action of the `cfpdf` tag, in which you reference the DDX file, the input structure, and the output structure, as the following example shows:

```coldfusion
<cfpdf action="processddx" ddxfile="merge.ddx" inputfiles="#inputStruct#" outputfiles="#outputStruct#" name="myBook">
```

The `name` attribute creates a variable that you can use to test the success or failure of the action. If the action is successful, ColdFusion generates an output file with the name and location specified in the output structure. The following code returns a structure that displays a success, reason for failure, or failure message (if the reason is unknown) for each output file, depending on the result:

```coldfusion
<cfdump var="#myBook#">
```

The previous example performs the same task as the `merge` action in ColdFusion, as the following example shows:

```coldfusion
<cfpdf action="merge" destination="twoChaps.pdf" overwrite="yes">
    <cfpdfparam source="Chap1.pdf">
    <cfpdfparam source="Chap2.pdf">
</cfpdf>
</cfif>
```

In this situation, it makes more sense to use the `merge` action because it is easier. DDX is useful when you have to perform tasks that you can’t perform with other actions in the `cfpdf` tag, or you require more control over specific elements.

### Adding a table of contents

You use DDX instructions to add a generated table of contents page to the PDF output file. Generating a table of contents is useful if you are assembling documents from multiple sources. You can generate a table of contents that contains active links to pages in the assembled PDF document. The following code shows how to create DDX instructions to merge two documents and add a table of contents:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
    <!--- This code creates a structure for the input files. --->
    <cfset inputStruct=StructNew()>
    <cfset inputStruct.Doc1="Chap1.pdf">
    <cfset inputStruct.Doc2="Chap2.pdf">
```

```xml
    <!--- This code creates a structure for the output file. --->
    <cfset outputStruct=StructNew()>
    <cfset outputStruct.Out1="twoChaps.pdf">
```

```xml
    To process the DDX instructions, you use the `processddx` action of the `cfpdf` tag, in which you reference the DDX file, the input structure, and the output structure, as the following example shows:

```xml
    <cfpdf action="processddx" ddxfile="merge.ddx" inputfiles="#inputStruct#" outputfiles="#outputStruct#" name="myBook">
```

```xml
    The `name` attribute creates a variable that you can use to test the success or failure of the action. If the action is successful, ColdFusion generates an output file with the name and location specified in the output structure. The following code returns a structure that displays a success, reason for failure, or failure message (if the reason is unknown) for each output file, depending on the result:

```xml
    <cfdump var="#myBook#">
```

```xml
    The previous example performs the same task as the `merge` action in ColdFusion, as the following example shows:

```xml
    <cfpdf action="merge" destination="twoChaps.pdf" overwrite="yes">
        <cfpdfparam source="Chap1.pdf">
        <cfpdfparam source="Chap2.pdf">
    </cfpdf>
    </cfif>
```

```xml
    In this situation, it makes more sense to use the `merge` action because it is easier. DDX is useful when you have to perform tasks that you can’t perform with other actions in the `cfpdf` tag, or you require more control over specific elements.

```xml
    <!--- Adding a table of contents --->
    <cfset toc=StructNew()>
    <cfset toc.Toc1="Chapter 1"
```
The TableOfContents element generates a table of contents from the PDF source elements that follow it. Order is important: in the previous example, the table of contents appears on a separate page after the Title and before Doc1 and Doc2. The table of contents contains entries from Doc1 and 2, but not from the title page, because the title page precedes the table of contents in the order of instructions.

You do not reference the TableOfContents element on the corresponding ColdFusion page, as the following example shows:

```cfml
<cfif IsDDX("makeBook.ddx")>

<!---- The following code verifies that the DDX file exists and the DDX instructions are valid. --->
<cfif IsDDX("makeBook.ddx")>

<!---- This code creates a structure for the input files. --->
<cfset inputStruct=StructNew()>
<cfset inputStruct.Title="Title.pdf">
<cfset inputStruct.Doc1="Chap1.pdf">
<cfset inputStruct.Doc2="Chap2.pdf">

<!---- This code creates a structure for the output file. --->
<cfset outputStruct=StructNew()>
<cfset outputStruct.Out1="Book.pdf">

<!---- This code processes the DDX instructions and generates the book. --->
<cfpdf action="processddx" ddxfile="makeBook.ddx" inputfiles="#inputStruct#" outputfiles="#outputStruct#" name="myBook">
</cfif>

ColdFusion generates a table of contents from the DDX instructions and inserts it in the PDF document in the location that you provided in the DDX file. By default, the table of contents contains active links to the top-level bookmarks in the merged PDF document.

You can change the default TableOfContents settings in the DDX file, as the following example shows:

```xml
<TableOfContents maxBookmarkLevel="infinite" bookmarkTitle="Table of Contents" includeInTOC="false">
</TableOfContents>
```

Use the maxBookmarkLevel attribute to specify the level of bookmarks included on the table of contents page. Valid values are infinite or an integer. Use the bookmarkTitle attribute to add a bookmark to the table of contents page in the output file. The includeInTOC attribute specifies whether the bookmark title is included on the table of contents page.

For more information on the TableOfContents element, see the Adobe LiveCycle Assembler Document Description XML Reference.

### Adding headers and footers

To add headers and footers to a PDF document, specify the Header and Footer elements in the DDX file. The following example specifies headers and footers for the PDF source called Doc2:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"...>
In this example, the `Header` and `Footer` elements apply only to `Doc2` because they are contained within that PDF source start and end tags; they do not apply to the table of contents or to the title page, which precede the `Header` and `Footer` elements.

**Formatting headers and footers**

You use DDX instructions to perform the following tasks:

- Add automatic page numbers to headers and footers
- Use style profiles
- Group documents in the PDF output file

**Adding automatic page numbers**

To add automatic page numbers, use the `_PageNumber` and `_LastPageNumber` built-in keys within the `Header` or `Footer` elements. The following code shows how to create footers with right-justified automatic page numbers:

```xml
<Footer>
  <Right>
    <StyledText>
      <p>Page <_PageNumber/> of <_LastPageNumber/></p>
    </StyledText>
  </Right>
</Footer>
```

The first page of the output file is numbered "Page 1 of n", and so on.

For more information on built-in keys, see the *Adobe LiveCycle Assembler Document Description XML Reference*.

**Using style profiles**

The previous example uses the `StyledText` element to define inline text formatting. To define styles that you can apply by reference, use the `StyleProfile` element. Style profiles let you apply a set of styles to different elements in the PDF output file. The following code shows how to define a style profile for the table of contents `Header`:

```xml
<StyleProfile name="TOCheaderStyle">
  <Header>
    <Center>
```
To apply the style profile, refer to the StyleProfile name by using the styleReference attribute of the Header element, as the following example shows:

```xml
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
    <PDF result="Out1">
        <PDF source="Title"/>
        <TableOfContents>
            <Header styleReference="TOCheaderStyle"/>
        </TableOfContents>
        <PDF source="Doc1"/>
        <PDF source="Doc2"/>
        <PDF source="Doc3"/>
        <PDF source="Doc4"/>
    </PDF>
    <StyleProfile name="TOCheaderStyle">
        <Header>
            <Center>
                <StyledText color="red" font-weight="bold" font="Arial">Table of Contents</StyledText>
            </Center>
        </Header>
    </StyleProfile>
</DDX>
```

Grouping PDF documents
To apply a style profile to a group of documents in the output PDF file, use the PDFGroup element. The following example shows how to create a group of chapters in the output file and apply a style profile to the Footer element for all of the documents in the group:

```xml
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
    <PDF result="Out1">
        <PDF source="Title"/>
        <PageLabel prefix="page " format="Decimal"/>
        <TableOfContents>
            ...
        </TableOfContents>
        <PDFGroup>
            <Footer styleReference="FooterStyle" />
            <PDF source="Doc1"/>
            <PDF source="Doc2"/>
            <PDF source="Doc3"/>
            <PDF source="Doc4"/>
        </PDFGroup>
    </PDF>
    <StyleProfile name="FooterStyle">
       ...
    </StyleProfile>
</DDX>
```
For a complete example, see “Using DDX instructions to create a book” on page 758.

Setting the initial view of a PDF document

To set the initial view of a PDF document, use the InitialViewProfile DDX element. Setting the initial view determines how the PDF output file is displayed on the screen when it is first opened in Adobe Acrobat Reader. You reference the InitialViewProfile by using the InitialView attribute of the PDF result element, as the following example shows:

```xml
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:pdf="http://ns.adobe.com/PDF/1.1/"
xmlns:xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
  <PDF result="Out1"
    initialView="firstView">
    ...
    <InitialViewProfile name="firstView"
      show="BookmarksPanel"
      magnification="FitPage"
      openToPage="2"/>
    ...
  </PDF>
</DDX>
```

In this example, the first time the PDF document is displayed in Acrobat Reader, the document is opened to page two and the bookmark panel is displayed. The magnification of the document is adjusted to fit the page.

For more information on InitialViewProfile settings, see the Adobe LiveCycle Assembler Document Description XML Reference.

Adding text-string watermarks

You use the processddx action with the Background or Watermark DDX elements to create a text-string watermark. Background elements appear in the background (behind the contents of the page); Watermark elements display in the foreground (over the contents of the page). The syntax for both the elements is the same.

The following example shows the DDX page for using the text string "DRAFT" as a watermark. The watermark appears on every page of the output file. By default, the watermark appears in the middle of the page. In this example, the watermark is rotated 30 degrees:

```xml
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:pdf="http://ns.adobe.com/PDF/1.1/"
xmlns:xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
  <PDF result="Out1">
    <Watermark rotation="30" opacity="65%">
      <StyledText><p font-size="50pt" font-weight="bold" color="lightgray"
        font="Arial">DRAFT</p></StyledText>
    </Watermark>
  </PDF>
</DDX>
```
The following example shows how to add different backgrounds on alternating pages. The `verticalAnchor` attribute displays the background text at the top of the page:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
    <PDF result="Out1">
        <Background alternation="EvenPages" verticalAnchor="Top">
            <StyledText><p font-size="20pt" font-weight="bold" color="gray" font="Arial">DRAFT</p></StyledText>
        </Background>
        <Background alternation="OddPages" verticalAnchor="Top">
            <StyledText><p font-size="20pt" font-weight="bold" color="gray" font="Arial"><i>Beta 1</i></p></StyledText>
        </Background>
    </PDF>
</DDX>
```

Instead of applying watermarks to the entire output file, you can apply them to individual source files. The following example applies a different background to the first three chapters of a book. The fourth chapter has no background:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
    <PDF result="Out1">
        <PDF source="Doc1">
            <Background>
                <StyledText><p font-size="20pt" font-weight="bold" color="lightgray" font="Arial">CHAPTER 1</p></StyledText>
            </Background>
        </PDF>
        <PDF source="Doc2">
            <Background>
                <StyledText><p font-size="20pt" font-weight="bold" color="lightgray" font="Arial">CHAPTER 2</p></StyledText>
            </Background>
        </PDF>
        <PDF source="Doc3">
            <Background>
                <StyledText><p font-size="20pt" font-weight="bold" color="lightgray" font="Arial">CHAPTER 3</p></StyledText>
            </Background>
        </PDF>
        <PDF source="Doc4"/>
    </PDF>
</DDX>
```

For more information on using DDX instructions to create watermarks, see the *Adobe LiveCycle Assembler Document Description XML Reference*. 
Extracting text from a PDF document

You can use the DocumentText DDX element to return an XML file that contains the text in one or more PDF documents. As with the PDF element, you specify a result attribute to the DocumentText element and enclose one or more PDF source elements within the start and end tags, as the following example shows:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
  <DocumentText result="Out1">
    <PDF source="doc1"/>
  </DocumentText>
</DDX>
```

The following code shows the CFM page that calls the DDX file. Instead of writing the output to a PDF file, you specify an XML file for the output:

```cfml
<cfif IsDDX("documentText.ddx")>
  <cfset ddxfile = ExpandPath("documentText.ddx")>
  <cfset sourcefile1 = ExpandPath("book1.pdf")>
  <cfset destinationfile = ExpandPath("textDoc.xml")>

  <cffile action="read" variable="myVar" file="#ddxfile#"/>
  <cfset inputStruct=StructNew()>
  <cfset inputStruct.Doc1="#sourcefile1#">
  <cfset outputStruct=StructNew()>
  <cfset outputStruct.Out1="#destinationfile#">

  <cfpdf action="processddx" ddxfile="#myVar#" inputfiles="#inputStruct#"
         outputfiles="#outputStruct#" name="ddxVar">

  <!-- Use the cfdump tag to verify that the PDF files processed successfully. -->
  <cfdump var="#ddxVar#">
</cfif>
```

The XML file conforms to a schema specified in doctext.xsd. For more information, see [http://ns.adobe.com/DDX/DocText/1.0](http://ns.adobe.com/DDX/DocText/1.0)

When you specify more than one source document, ColdFusion aggregates the pages into one file. The following example shows the DDX code for combining a subset of pages from two documents into one output file:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
  <DocumentText result="Out1">
    <PDF source="doc1" pages="1-10"/>
    <PDF source="doc2" pages="3-5"/>
  </DocumentText>
</DDX>
```

Application examples

The following examples show you how to use the cfpdf tag to perform PDF document operations in simple applications.
Merging documents based on a keyword search

The following example shows how to use the `getInfo` and `merge` actions to assemble a PDF document from multiple tax files based on business type (Sole Proprietor, Partnership, or S Corporation). The application assembles the tax forms and information booklets based on a radio button selection. Some tax forms and booklets apply to more than one business type (for example, Partnership and S Corporations both use the tax form f8825.pdf). For instructions on setting keywords for PDF documents, see "Managing PDF document information" on page 745.

This example shows how to perform the following tasks:

- Use the `getInfo` action to perform a keyword search on PDF files in a directory.
- Create a comma-separated list of files that match the search criteria.
- Use the `merge` action to merge the PDF documents in the comma-separated list into an output file.

The first CFM page creates a form for selecting the tax documents based on the business type:

```
<h3>Downloading Federal Tax Documents</h3>
<p>Please choose the type of your business.</p>
<!--- Create the ColdFusion form to determine which PDF documents to merge. --->
<table>
  <cfform action="cfpdfMergeActionTest.cfm" method="post">
    <tr><td><cfinput type="radio" name="businessType" Value="Sole Proprieter">Sole Proprietor</td></tr>
    <tr><td><cfinput type="radio" name="businessType" Value="Partnership">Partnership</td></tr>
    <tr><td><cfinput type="radio" name="businessType" Value="S Corporation">S Corporation</td></tr>
  </cfform>
</table>
```

The action page loops through the files in the taxes subdirectory and uses the `getInfo` action to retrieve the keywords for each file. If the PDF file contains the business type keyword (Sole Proprietor, Partnership, or S Corporation), ColdFusion adds the absolute pathname of the file to a comma-separated list. The `merge` action assembles the files in the list into an output PDF file:

```
<!--- Create a variable for the business type selected from the form. --->
<cfset bizType=#form.businessType#>
<!--- Create a variable for the pathname of the current directory. --->
<cfset thisPath=ExpandPath(".")>

<!--- List the files in the taxes subdirectory. --->
<cfdirectory action="list" directory="#thisPath#\taxes" name="filelist">
  <!- The following code loops through the files in the taxes subdirectory. The getInfo action retrieves the keywords for each file and determines whether the business type matches one of the keywords in the file. If the file contains the business type keyword, ColdFusion adds the file to a comma-separated list. --->
  <cfset tempPath="">
  <cfloop query="filelist">
    <cfset fPath="#thisPath#\taxes\#filelist.name#">
    <cfpdf action="GetInfo" source="#fPath#" name="kInfo"></cfpdf>
    <cfif #kInfo.keywords# contains "#bizType#">
      <cfset tempPath=#tempPath# & #fPath# & ","/>
    </cfif>
  </cfloop>
</cfloop>
Using DDX instructions to create a book

The following example shows how to create a book using DDX instructions with the `processddx` action. Specifically, it shows how to perform the following tasks:

- Merge several PDF documents into an output file.
- Add a generated table of contents page.
- Add headers and footers.
- Add automatic page numbers.
- Apply different styles to the table of contents and the body of the book.

The following code shows the DDX file:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<DDX xmlns="http://ns.adobe.com/DDX/1.0/
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://ns.adobe.com/DDX/1.0/ coldfusion_ddx.xsd">
  <PDF result="Out1">
    <PDF source="Doc0"/>
    <TableOfContents maxBookmarkLevel="3" bookmarkTitle="Table of Contents"
      includeInTOC="false">
      <Header styleReference="TOCheaderStyle"/>
      <Footer styleReference="TOCFooterStyle"/>
    </TableOfContents>
    <PDFGroup>
      <Footer styleReference="FooterStyle"/>
      <PDF source="Doc1"/>
      <PDF source="Doc2"/>
      <PDF source="Doc3"/>
      <PDF source="Doc4"/>
    </PDFGroup>
  </PDF>
  <StyleProfile name="TOCheaderStyle">
    <Header>
      <Center>
        <StyledText>
          <p color="red" font-weight="bold" font="Arial">Table of Contents</p>
        </StyledText>
      </Center>
    </Header>
  </StyleProfile>
  <StyleProfile name="TOCFooterStyle">
    <Footer>
      <Right>
        <StyledText>
          <p font-size="9pt">Page <_PageNumber/> of <_LastPageNumber/></p>
        </StyledText>
      </Right>
    </Footer>
  </StyleProfile>
</DDX>
```
The following code shows the ColdFusion page that processes the DDX instructions:

```cfml
<cfif IsDDX("Book.ddx")>
  <cfset inputStruct=StructNew()>
  <cfset inputStruct.Doc0="Title.pdf">
  <cfset inputStruct.Doc1="Chap1.pdf">
  <cfset inputStruct.Doc2="Chap2.pdf">
  <cfset inputStruct.Doc3="Chap3.pdf">
  <cfset inputStruct.Doc4="Chap4.pdf">

  <cfset outputStruct=StructNew()>
  <cfset outputStruct.Out1="myBook.pdf">

  <cfpdf action="processddx" ddxfile="book.ddx" inputfiles="#inputStruct#" outputfiles="#outputStruct#" name="ddxVar">
    <cfoutput>#ddxVar.Out1#</cfoutput>
  </cfpdf>
</cfif>
```

Applying a watermark to a form created in Acrobat

The following example shows how to prefill an interactive Acrobat tax form and apply a text-string watermark to the completed form that the user posted. Specifically, this example shows how to perform the following tasks:

- Use the `cfpdfform` and `cfpdfiformparam` tags to populate a form created in Acrobat.
- Use the `cfpdfform` tag to write the output of a PDF post submission to a file.
- Use the `cfpdf processddx` action to apply a text-string watermark to the completed form.

**Note:** This example uses the `cfdocexamples` database and the 1040 and 1040ez Federal tax forms. A valid user name is "cpeterson." To download the 1040 and 1040ez IRS tax forms used in this example, go to the IRS website. Open the forms in Acrobat (not LiveCycle Designer) and add a submit button that points to the URL for the ColdFusion processing page. Also, add a hidden field with a variable that contains a unique filename used for the completed tax form.

The first ColdFusion page creates a login form that prompts for the user name and the user's Social Security Number:

<!--- The following code creates a simple form for entering a user name and password. The code does not include password verification. --->

```cfml```
<h3>Tax Login Form</h3>
<p>Please enter your user name and your social security number.</p>
<cfform name="loginform" action="TaxFile2.cfm" method="post">
<table>
<tr>
<td>User name:</td>
<td><cfinput type="text" name="username" required="yes" message="A user name is required."/></td>
</tr>
<tr>
<td>SSN#:</td>
<td><cfinput type="text" name="SS1" maxLength="3" size="3" required="yes" mask="999"> -
<cfinput type="text" name="SS2" maxLength="2" size="2" required="yes" mask="99"> -
<cfinput type="text" name="SS3" maxLength="4" size="4" required="yes" mask="9999"/></td>
</tr>
</table>
<br/>
<cfinput type="submit" name="submit" value="Submit"/>
</cfform>

The second ColdFusion page retrieves the user information from the cfdocexamples database. Also, it creates a pop-up menu with a list of available tax forms:

<!---- The following code retrieves all of the employee information for the user name entered on the login page. ---->
<cfquery name="getEmpInfo" datasource="cfdocexamples">
SELECT * FROM EMPLOYEES
WHERE EMAIL = <cfqueryparam value="#FORM.username#">
</cfquery>

<h3>Choose a tax form</h3>
<p>Hello <cfoutput>#getEmpInfo.firstname#</cfoutput>,</p>
<p>Please choose a tax form from the list:</p>
<!---- Create a pop-up menu with a list of tax forms. ---->
<cfset thisPath=ExpandPath(".")>
<!---- Create a variable called filerID that is a combination of the username and the last three digits of the Social Security number. ---->
<cfset filerID="#form.username#_#form.SS3#">
<cfdirectory action="list" name="taxForms" directory="#thisPath#/taxforms">
<cfselect query="taxForms" value="name" size="10" required="yes" multiple="no" name="myTaxForm"/>
<br/>br/>
<cfinput type="Submit" name="OK" label="OK"/>
<!---- Use hidden fields to pass the user's first name, last name, and the three parts of their SSN# to the tax form. Also, create a hidden field for the filerID variable. ---->
<cfinput type="hidden" name="FirstName" value="#getEmpInfo.FirstName#">
<cfinput type="hidden" name="LastName" value="#getEmpInfo.LastName#">
<cfinput type="hidden" name="Phone" value="#getEmpInfo.Phone#">
<cfinput type="hidden" name="SS1" value="#form.SS1#">
<cfinput type="hidden" name="SS2" value="#form.SS2#">
<cfinput type="hidden" name="SS3" value="#form.SS3#">
<cfinput type="hidden" name="taxFiler" value="#filerID#">
</cfselect>
</cfdirectory>
The third ColdFusion page uses the `cfpdfform` and `cfpdfformparam` tags to populate the tax form with the user's information. ColdFusion displays the tax prefilled tax form in the browser window where the user can complete the rest of the form fields. When the user clicks the submit button, Acrobat sends the completed PDF form to the ColdFusion processing page.

**Note:** To prefill forms, you must map each PDF form field name to the corresponding data element in a `cfpdfformparam` tag. To view the form fields, open the form in Acrobat Professional and select Forms > Edit Forms in Acrobat. For more information about prefilling forms, see "Manipulating PDF Forms in ColdFusion" on page 723.

<!--- The following code populates the tax form template chosen from the list with information from the database query and the login form. Because no destination is specified, ColdFusion displays the interactive PDF form in the browser. A hidden field in the PDF form contains the name of the output file to write. It is a combination of the user name and the last three numerals of the user's SSN#. The submit button added to the form created in Acrobat contains a URL to the ColdFusion processing page. --->

```coldfusion```
<cfpdfform source="taxForms/#form.myTaxForm#" action="populate">
  <cfif "taxForms/#form.myTaxForm#" is "taxForms/f1040.pdf">
    <cfpdfformparam name="f1_04(0)" value="#form.Firstname#">
    <cfpdfformparam name="f1_05(0)" value="#form.Lastname#">
    <cfpdfformparam name="f2_115(0)" value="#form.Phone#">
    <cfpdfformparam name="f1_06(0)" value="#form.SS1#">
    <cfpdfformparam name="f1_07(0)" value="#form.SS2#">
    <cfpdfformparam name="f1_08(0)" value="#form.SS3#">
    <cfpdfformparam name="filerID" value="#form.taxFiler#_1040">
  </cfif>
  <cfelseif "taxForms/#form.myTaxForm#" is "taxForms/f1040ez.pdf">
    <cfpdfformparam name="f1_001(0)" value="#form.Firstname#">
    <cfpdfformparam name="f1_002(0)" value="#form.Lastname#">
    <cfpdfformparam name="f1_070(0)" value="#form.Phone#">
    <cfpdfformparam name="f1_003(0)" value="#form.SS1#">
    <cfpdfformparam name="f1_004(0)" value="#form.SS2#">
    <cfpdfformparam name="f1_005(0)" value="#form.SS3#">
    <cfpdfformparam name="filerID" value="#form.taxFiler#_1040ez">
  </cfelseif>
</cfpdfform>
```

The fourth ColdFusion page uses the `cfpdfform` tag to process the PDF post submission and generate an output file. The filename is generated from the value of the hidden field in the tax form. The `procesddx` action of the `cfpdf` tag uses the DDX instructions in the watermark.ddx file to generate a text-string watermark and apply it to the form.

The following code shows the contents of the watermark.ddx file:

```xml```
<?xml version="1.0" encoding="UTF-8"?>
    <PDF result="Out1">
        <PDF source="Doc1">
            <Watermark rotation="30" opacity="65%">
                <StyledText><p font-size="85pt" font-weight="bold" color="gray" font="Arial">FINAL</p></StyledText>
            </Watermark>
        </PDF>
    </PDF>
</DDX>
```

<!--- The following code reads the PDF file submitted in binary format and generates a result structure called fields. The `cfpdfform` populate action and the `cfoutput` tags reference the fields in the structure. --->

```coldfusion```
<cfpdfform source="#PDF.content#" action="read" result="fields"/>
```
<cfpdf action="populate" source="#PDF.content#"
   destination="FiledForms\#fields.filerID#.pdf" overwrite="yes"/>

<cfif IsDDX("watermark.ddx")>
   <!--- The following code verifies that the DDX file exists and the DDX instructions are valid. --->
   <!--- The following code uses the processddx action of the cfpdf tag to create a text-string watermark. --->
   <!--- This code creates a structure for the input files. --->
   <cfset inputStruct=StructNew()>
   <cfset inputStruct.Doc1="FiledForms\#fields.filerID#.pdf">
   <!--- This code creates a structure for the output file. --->
   <cfset outputStruct=StructNew()>
   <cfset outputStruct.Out1="FiledForms\#fields.filerID#.pdf">
   <!--- This code processes the DDX instructions and applies the watermark to the form. --->
   <cfpdf action="processddx" ddxfile="watermark.ddx" inputfiles="#inputStruct#" outputfiles="#outputStruct#" name="Final">
</cfif>

<h3>Tax Form Completed</h3>

<p>Thank you for filing your tax form on line. Copy this URL to view or download your filed tax form:</p>

<cfoutput>
<a href="http://localhost:8500/Lion/FiledForms/#fields.filerID#.pdf">
    Link to your completed tax form</a>
</cfoutput>
Chapter 42: Creating and Manipulating ColdFusion Images

You can use Adobe ColdFusion to create and manipulate images, retrieve and store images in a database, retrieve image information for indexes and searches, convert images from one format to another, and write images to the hard drive.

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About ColdFusion images

ColdFusion lets you create and manipulate images dynamically. With ColdFusion, you can automate many image effects and drawing functions that you perform manually in Adobe Photoshop® or other imaging software packages and integrate the images in your application. For example, contributors to a website can upload photos in different formats. You can add a few lines of code to your ColdFusion application to verify the images, reformat the images to a standard size and appearance, write the modified images to a database, and display the images in a browser.

The following table describes a few of the tasks you can perform with ColdFusion images:

<table>
<thead>
<tr>
<th>Task</th>
<th>Functions and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify whether a ColdFusion variable returns an image</td>
<td>IsImage function</td>
</tr>
<tr>
<td>Verify whether a file is a valid image</td>
<td>IsImageFile function</td>
</tr>
<tr>
<td>Create thumbnail images</td>
<td>ImageScaleToFit function, the ImageResize function, or the resize action of the cfimage tag</td>
</tr>
<tr>
<td>Create a watermark</td>
<td>ImageSetDrawingTransparency function with any of the ImageDraw functions and the ImagePaste function</td>
</tr>
<tr>
<td>Get information about an image (for example, so you can enforce size restrictions)</td>
<td>ImageGetHeight and the ImageGetWidth functions or the ImageInfo function</td>
</tr>
<tr>
<td>Enforce compression on JPEG images</td>
<td>quality attribute of the write action of the cfimage tag or the ImageWrite function</td>
</tr>
<tr>
<td>Convert an image from one image file format to another (for example, convert a BMP file to a JPEG)</td>
<td>cfimage tag or ImageRead and ImageWrite functions</td>
</tr>
</tbody>
</table>
The ColdFusion image

A ColdFusion image is a construct that is native to ColdFusion. The ColdFusion image contains image data that it reads from a source. The source can be an image file or another ColdFusion image, which is expressed as a ColdFusion image variable. The ColdFusion image variable lets you manipulate information dynamically in memory. Optionally, you can write a ColdFusion image to a file, to a database column, or to a browser.

The cfimage tag

You use the cfimage tag to create a ColdFusion image and as a shortcut to commonly performed image functions, such as resizing an image, adding a border to an image, and converting an image to a different file format. You can use the cfimage tag independently or in conjunction with Image functions. You can pass a ColdFusion image created with the cfimage tag to one or more Image functions to perform complex image manipulation operations.

The following table summarizes the cfimage tag actions:

<table>
<thead>
<tr>
<th>Task</th>
<th>Functions and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert an image file to a Base64 string</td>
<td>cfimage tag or the ImageWriteBase64 function</td>
</tr>
<tr>
<td>Create a ColdFusion image from a Base64 string</td>
<td>ImageReadBase64 function</td>
</tr>
<tr>
<td>Insert a ColdFusion image as a Binary Large Object Bitmap (BLOB) in a database</td>
<td>ImageGetBlob function within a cfquery statement</td>
</tr>
<tr>
<td>Create an image from a BLOB in a database</td>
<td>cfimage tag or the ImageNew function with a cfquery statement</td>
</tr>
<tr>
<td>Create an image from a binary object</td>
<td>cfimage tag to convert an image file to a binary object and then pass the binary object to the ImageNew function</td>
</tr>
<tr>
<td>Create a Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA) image</td>
<td>captcha action of the cfimage tag</td>
</tr>
</tbody>
</table>

For more information, see the cfimage tag in the CFML Reference.
Image functions
ColdFusion provides more than fifty Image functions that expand on the functionality of the cfimage tag. You can pass images created with the cfimage tag to Image functions or create images with the ImageNew function. The following table groups the Image functions by category:

<table>
<thead>
<tr>
<th>Category</th>
<th>Image functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verifying images and supported image formats</td>
<td>IsImage, IsImageFile, GetReadableImageFormats, GetWriteableImageFormats</td>
</tr>
<tr>
<td>Retrieving image information</td>
<td>ImageSetEXIFTag, ImageGetHeight, ImageGetIPTCTag, ImageGetWidth, ImageInfo</td>
</tr>
<tr>
<td>Reading, writing, and converting images</td>
<td>ImageGetBlob, ImageGetBufferedImage, ImageNew, ImageRead, ImageReadBase64,</td>
</tr>
<tr>
<td></td>
<td>ImageWrite, ImageWriteBase64</td>
</tr>
<tr>
<td>Manipulating images</td>
<td>ImageAddBorder, ImageBlur, ImageCopy, ImageCrop, ImageFlip, ImageGrayscale,</td>
</tr>
<tr>
<td></td>
<td>ImageNegative, ImageOverlay, ImagePaste, ImageResize, ImageRotate, ImageScaleToFit,</td>
</tr>
<tr>
<td></td>
<td>ImageSharpen, ImageShear, ImageTranslate</td>
</tr>
<tr>
<td>Drawing lines, shapes, and text</td>
<td>ImageDrawArc, ImageDrawBeveledRect, ImageDrawCubicCurve, ImageDrawLine,</td>
</tr>
<tr>
<td></td>
<td>ImageDrawLines, ImageDrawOval, ImageDrawPoint, ImageDrawQuadraticCurve,</td>
</tr>
<tr>
<td></td>
<td>ImageDrawRect, ImageDrawRoundRect, ImageDrawText</td>
</tr>
<tr>
<td>Setting drawing controls</td>
<td>ImageClearRect, ImageRotateDrawingAxis, ImageSetAntialiasing,</td>
</tr>
<tr>
<td></td>
<td>ImageSetBackgroundColor, ImageSetDrawingColor, ImageSetDrawingStroke,</td>
</tr>
<tr>
<td></td>
<td>ImageSetDrawingTransparency, ImageShearDrawingAxis, ImageTranslateDrawingAxis,</td>
</tr>
<tr>
<td></td>
<td>ImageXORDrawingMode</td>
</tr>
</tbody>
</table>

Creating ColdFusion images
The ColdFusion image contains image data in memory. Before you can manipulate images in ColdFusion, you create a ColdFusion image. The following table shows the ways to create a ColdFusion image:

<table>
<thead>
<tr>
<th>Task</th>
<th>Functions and tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a ColdFusion image from an existing image file.</td>
<td>cfimage tag or the ImageNew function</td>
</tr>
<tr>
<td>Create a blank image from scratch.</td>
<td>ImageNew function</td>
</tr>
<tr>
<td>Create a ColdFusion image from BLOB data in a database.</td>
<td>ImageNew function with the cfquery tag</td>
</tr>
<tr>
<td>Create a ColdFusion image from a binary object.</td>
<td>cffile tag with the ImageNew function</td>
</tr>
<tr>
<td>Create a ColdFusion image from a Base64 string.</td>
<td>ImageReadBase64 function and the ImageNew function or the cfimage tag</td>
</tr>
<tr>
<td>Create a ColdFusion image from another ColdFusion image.</td>
<td>ImageCopy function with the ImageWrite function or the Duplicate function, or by passing the image to the ImageNew function or the cfimage tag</td>
</tr>
</tbody>
</table>

Using the cfimage tag
The simplest way to create a ColdFusion image with the cfimage tag is to specify the source attribute, which is the file that is read by the ColdFusion image, and the name attribute, which is the variable that defines the image in memory:

```xml
<cfimage source="../cfdocs/images/artgallery/jeff01.jpg" name="myImage"/>
```
You do not have to specify the read action because it is the default action. You must specify the name attribute for the read action, which creates a variable that contains the ColdFusion image, for example, myImage.

You can pass the myImage variable to another cfimage tag or to Image functions. The following example shows how to specify a ColdFusion image variable as the source:

```cfimage source="#myImage#" action="write" destination="test_myImage.jpg">
```

The write action writes the file to the specified destination, which can be an absolute or relative pathname. The following example shows how to create a ColdFusion image from a URL and write it to a file on the local drive:

```cfimage source="http://www.google.com/images/logo_sm.gif" action="write" destination="c:\images\logo_sm.gif">
```

You must specify the destination for the write action.

When you specify a destination, set the overwrite attribute to "yes" to write to the same file more than once. Otherwise, ColdFusion generates an error:

```cfimage source="#myImage#" action="write" destination="images/jeff01.jpg" overwrite="yes">
```

### Using the ImageNew function

You create a ColdFusion image with the ImageNew function the same way you define a ColdFusion variable. The following example creates a ColdFusion image variable named “myImage” from the jeff01.jpg source file:

```cfset myImage=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")>
```

This produces the same result as the following code:

```cfimage source="../cfdocs/images/artgallery/jeff01.jpg" name="myImage">
```

As with the cfimage tag, you can specify an absolute or relative pathname, a URL, or another ColdFusion image as the source. In the following example, ColdFusion reads a file from the local drive and passes it to the ImageWrite function, which writes the image to a new file:

```cfset myImage=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")>
<cfset ImageWrite(myImage,"myImageTest.png")>
```

The following code produces the same result:

```cfimage source="../cfdocs/images/artgallery/jeff01.jpg" name="myImage">
<cfimage source="#myImage#" action="write" destination="#myImageTest.png">
```

Also, you can create a blank image. When using the ImageNew function, you do not specify the source to create a blank image. However, you can specify the width and height, respectively. The following example shows how to create a blank canvas that is 300 pixels wide and 200 pixels high:

```cfset myImage=ImageNew("",300,200)>
```

Optionally, you can specify the image type, as in the following example:

```cfset myImage=ImageNew("",200,300,"rgb")>
```

Other valid image types are argb and grayscale. You can use blank images as canvases for drawing functions in ColdFusion. For examples, see “Creating watermarks” on page 777.

Also, you can use the ImageNew function to create ColdFusion images from other sources, such as Bas64 byte arrays, file paths, and URLs. The following example creates a ColdFusion image from a JPEG file (x), and then creates another ColdFusion image (y) from the image in memory:

```cfset x = ImageNew("c:\abc.jpg")>
<cfset y = ImageNew(x)>
```
For more information about the `ImageNew` function, see the CFML Reference.

Creating an image from a binary object

You can use the `cffile` tag to write an image file to ColdFusion variable. Then, you can pass the variable to the `ImageNew` function to create a ColdFusion image from the binary object, as the following example shows:

```coldfusion
<!--- Use the cffile tag to read an image file, convert it to binary format, and write the result to a variable. --->
<cffile action = "readBinary" file = "jeff05.jpg" variable = "aBinaryObj">
<!--- Use the ImageNew function to create a ColdFusion image from the variable. --->
<cfset myImage=ImageNew(aBinaryObj)>
```

Creating images from BLOB data

Many databases store images as BLOB data. To extract BLOB data from a database, create a query with the `cfquery` tag. The following example shows how to extract BLOB data and use the `cfimage` tag to write them to files in PNG format:

```coldfusion
<!--- Use the cfquery tag to retrieve employee photos and last names from the database. --->
<cfquery name="GetBLOBs" datasource="myblobdata">
  SELECT LastName, Image
  FROM Employees
</cfquery>
<cfset i = 0>
<table border=1>
  <cfoutput query="GetBLOBs">
    <tr>
      <td> #LastName# </td>
      <td> #GetBLOBs.Image# </td>
    </tr>
  </cfoutput>
</table>
```

The following example shows how to use the `ImageNew` function to generate ColdFusion images from BLOB data:

```coldfusion
<!--- Use the cfquery tag to retrieve all employee photos and employee IDs from a database. --->
<cfquery name="GetBLOBs" datasource="myBlobData">
  SELECT EMLPOYEEID, PHOTO FROM Employees
</cfquery>
<!--- Use the ImageNew function to create a ColdFusion image from the BLOB data that was retrieved from the database. --->
<cfset myImage = ImageNew(GetBLOBs.PHOTO)>
<!--- Create thumbnail versions of the images by resizing them to fit in a 100-pixel square, while maintaining the aspect ratio of the source image. --->
<cfset ImageScaleToFit(myImage,100,100)>
<!--- Convert the images to JPEG format and save them to files in the thumbnails subdirectory, using the employee ID as the filename. --->
<cfimage source="#myImage#" action="write" destination="images/thumbnails/#GetBLOBs.EMPLOYEID#.jpg"/>
For information on converting a ColdFusion image to a BLOB, see “Inserting an image as a BLOB in a database” on page 770.

Creating an image from a Base64 string

Base64 is a way to describe binary data as a string of ASCII characters. Some databases store images in Base64 format rather than as BLOB data. You can use the cfimage tag or the ImageReadBase64 function to read Base64 data directly from a database. This eliminates the intermediary steps of binary encoding and decoding.

The following examples show how to use the cfimage tag to create a ColdFusion image from a Base64 string:

<!--- This example shows how to create a ColdFusion image from a Base64 string with headers (used for display in HTML). --->
<cfimage source="data:image/jpg;base64,/9j/4AAQSkZJRgABAQA.............." destination="test_my64.jpeg" action="write" isBase64="yes">

<!--- This example shows how to use the cfimage tag to write a Base64 string without headers. --->
<cfimage source="/9j/4AAQSkZJRgABAQA.............." destination="test_my64.jpeg" action="write" isBase64="yes">

The following examples show how to use the ImageReadBase64 function to create a ColdFusion image from a Base64 string:

<!--- This example shows how to use the ImageReadBase64 function to read a Base64 string with headers. --->
<cfset myImage=ImageReadBase64("data:image/jpg;base64,/9j/4AAQSkZJRgABAQA..............")>

<!--- This example shows how to read a Base64 string without headers. --->
<cfset myImage=ImageReadBase64("/9j/4AAQSkZJRgABAQA..............")>

For more information on Base64 strings, see “Converting an image to a Base64 string” on page 770.

Copying an image

You use the ImageCopy function to copy a rectangular area of an existing image and generate a new ColdFusion image from it. You can paste the new ColdFusion image onto another image, or write it to a file, as the following example shows:

<!--- Use the cfimage tag to create a ColdFusion image from a JPEG file. --->
<cfimage source="../cfdocs/images/artgallery/lori05.jpg" name="myImage">

<!--- Turn on antialiasing to improve image quality. --->
<cfset ImageSetAntialiasing(myImage)>

<!--- Copy the rectangular area specified by the coordinates (25,25,50,50) in the image to the rectangle beginning at (75,75), and return this copied rectangle as a new ColdFusion image. --->
<cfset dupArea = ImageCopy(myImage,25,25,50,50,75,75)>

<!--- Write the new ColdFusion image (dupArea) to a PNG file. --->
<cfimage source="#dupArea#" action="write" destination="test_myImage.png" overwrite="yes">
Duplicating an image

Another way to create a ColdFusion image is to duplicate it. Duplicating an image creates a clone, which is a copy of an image that is independent of it: if the original image changes, those changes do not affect the clone, and vice versa. This is useful if you want to create several versions of the same image. Duplicating an image can improve processing time because you retrieve image data from a database or a file once to create the ColdFusion image. Then you can create several clones and manipulate them in memory before writing them to files. For example, you might want to create a thumbnail version, a grayscale version, and an enlarged version of an image uploaded to a server. To do this, you use the `cfimage` tag or the `ImageNew` function to create a ColdFusion image from the uploaded file. You use the `Duplicate` function to create three clones of the ColdFusion image.

To create a clone, you can pass a ColdFusion image variable to the `Duplicate` function:

```cfml
<!--- Use the ImageNew function to create a ColdFusion image from a JPEG file. --->
<cfset myImage=ImageNew("../cfdocs/images/artgallery/paul01.jpg")>
<!--- Turn on antialiasing to improve image quality. --->
<cfset ImageSetAntialiasing(myImage)>
<!--- Use the Duplicate function to create three clones of the ColdFusion image. --->
<cfset cloneA=Duplicate(myImage)>
<cfset cloneB=Duplicate(myImage)>
<cfset cloneC=Duplicate(myImage)>
<!--- Create a grayscale version of the image. --->
<cfset ImageGrayscale(cloneA)>
<!--- Create a thumbnail version of the image. --->
<cfset ImageScaleToFit(cloneB,50,"")>
<!--- Create an enlarged version of the image. --->
<cfset ImageResize(cloneC,"150%","")>
<!--- Write the images to files. --->
<cfset ImageWrite(myImage,"paul01.jpg","yes")>
<cfset ImageWrite(cloneA,"paul01_bw.jpg","yes")>
<cfset ImageWrite(cloneB,"paul01_sm.jpg","yes")>
<cfset ImageWrite(cloneC,"paul01_lg.jpg","yes")>
<!--- Display the images. --->
<img src="paul01.jpg">
<img src="paul01_bw.jpg">
<img src="paul01_sm.jpg">
<img src="paul01_lg.jpg">
```

Also, you can use the `cfimage` tag and the `ImageNew` function to duplicate images, as the following example shows:

```cfml
<!--- Use the cfimage tag to create a ColdFusion image (myImage) and make a copy of it (myImageCopy). --->
<cfimage source="../cfdocs/images/artgallery/paul01.jpg" name="myImage">
<cfimage source="#myImage#" name="myImageCopy">
<!-- Use the ImageNew function to make a copy of myImage called myImageCopy2. --->
<cfset myImageCopy2 = ImageNew(myImage)>
```

Converting images

ColdFusion makes it easy to convert images from one file format to another. Also, you can convert an image file to a binary object, BLOB data, or a Base64 string.

Converting an image file

The extension of the destination file determines the file format of the image. Therefore, to convert an image, simply change the file extension in the destination file. The following example shows how to convert a JPEG file to a GIF file:
Similarly, you can use the ImageWrite function with the ImageNew function:

```cfset myImage=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")
<cfset ImageWrite(myImage,"jeff01.gif")>
```

In both examples, the convert action is implied.

The write action does not create a ColdFusion image; it simply writes an image to a file. To convert an image and generate a ColdFusion image variable, use the convert action:

```cfimage source="../cfdocs/images/artgallery/jeff01.jpg" action="convert" destination="jeff01.gif" name="myImage">
```

ColdFusion reads and writes most standard image formats. For more information, see "Supported image file formats" on page 304 in the CFML Reference.

### Converting an image to a Base64 string

To convert a ColdFusion image to a Base64 string, use the ImageWriteBase64 function. In the following example, the yes value determines that the output includes the headers required for display in HTML:

```cfset ImageWriteBase64(myImage,"jeffBase64.txt","bmp","yes")>
```

**Note:** Microsoft Internet Explorer does not support Base64 strings.

### Inserting an image as a BLOB in a database

Many databases store images as BLOB data. To insert a ColdFusion image into a BLOB column of a database, use the ImageGetBlob function within a cfquery statement, as the following example shows:

```<cfquery name="InsertBlobImage" datasource="myBlobData">
INSERT into EMPLOYEES (FirstName,LastName,Photo)
VALUES ("Aiden","Quinn",<cfqueryparam value="#ImageGetBlob(myImage)#" cfsqltype="cf_sql_blob">
</cfquery>
```

### Verifying images

Use the IsImage function to test whether an image variable represents a valid ColdFusion image. This function takes a variable name as its only parameter and returns a Boolean value.

**Note:** You cannot use the IsImage function to verify whether files are valid images. Instead, use the IsImageFile function.

Also, ColdFusion provides two tags for determining which image file formats are supported on the server where the ColdFusion application is deployed: GetReadableImageFormats and GetWriteableImageFormats. For more information, see the CFML Reference.
Enforcing size restrictions

ColdFusion provides several functions for retrieving information associated with images, including the height and width of an image. For example, you can use the `ImageGetWidth` and `ImageGetHeight` functions to determine whether an image is too large to upload to a website or database.

The following example shows how to prevent users from uploading images that are greater than 300 pixels wide or 300 pixels high:

```cfml
<!--- Create a ColdFusion image named "myImage" from a file uploaded to the server. --->
<cfimage action="read" source="#fileUpload.serverFile#" name="myImage">
<!--- Determine whether the file is greater than 300 pixels in width or height. --->
<cfif ImageGetHeight(myImage) gt 300 or ImageGetWidth(myImage) gt 300>
    <!--- If the file exceeds the size limits, delete it from the server. --->
    <cffile action="delete" file="#fileUpload.serverDirectory#/#fileUpload.serverFile#">
    <cfoutput>
        <!--- Display the following message. --->
        <p>
        The image you uploaded was too big. It must be less than 300 pixels wide and 300 pixels high. Your image was #imageGetWidth(myImage)# pixels wide and #imageGetHeight(myImage)# pixels high.
        </p>
    </cfoutput>
</cfif>
```

For information about retrieving image metadata, see the `ImageGetEXIFTag`, `ImageGetIPTCTag`, and `ImageInfo` functions in the CFML Reference.

Compressing JPEG images

To reduce the size of large files, you can convert a JPEG file to a lower quality image by using the `write` action of the `cfimage` tag. Specify a value between 0 (low) and 1 (high) for the `quality` attribute, as the following example shows:

```cfml
<cfimage source="../cfdocs/images/artgallery/jeff05.jpg" action="write"
    destination="jeff05_lq.jpg" quality="0.5" overwrite="yes">
```

You can perform the same operation by using the `ImageWrite` function:

```cfml
<cfset myImage=ImageNew("jeff05.jpg")>
<cfset ImageWrite(myImage, "jeff05_lq.jpg", "0.5")>
```

Manipulating ColdFusion images

You can perform a few common manipulation operations on ColdFusion images. For more information on manipulating ColdFusion images, see the CFML Reference.

Adding borders to images

To create a simple border, use the `cfimage` tag. The following example creates a ColdFusion image with a 5-pixel blue border:

```cfml
<cfimage source="../cfdocs/images/artgallery/jeff01.jpg" action="border" thickness="5"
    color="blue" destination="testMyImage.jpg" overwrite="yes">
```

```html
<img src="testMyImage.jpg">
```
The border is added to the outside edge of the source image. This increases the area of the image.

To create complex borders, use the `ImageAddBorder` function. The following example shows how to nest borders:

```cfml
<!--- Create a ColdFusion image from a JPEG file. --->
<cfset myImage=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")>
<!--- Add a 5-pixel blue border around the outside edge of the image. --->
<cfset ImageAddBorder(myImage,5,"blue")>
<!--- Add a 10-pixel magenta border around the blue border. --->
<cfset ImageAddBorder(myImage,10,"magenta")>
<!--- Add a 5-pixel green border around the magenta border. --->
<cfset ImageAddBorder(myImage,20,"green")>
<!--- Write the ColdFusion image to a file. --->
<cfset ImageWrite(myImage,"testMyImage.jpg")>
<img src="testMyImage.jpg"/>

Also, with the `ImageAddBorder` function, you can add a border that is an image effect. For example, you can use the `wrap` parameter to create a tiled border from the source image. The `wrap` parameter creates a tiled border by adding the specified number of pixels to each side of the image, as though the image were tiled.

In the following example, 20 pixels from the outside edge of the source image are tiled to create the border:

```cfml
<cfset myImage=ImageNew("../cfdocs/images/artgallery/jeff03.jpg")>
<cfset ImageAddBorder(myImage,20,"","wrap")>
<cfset ImageWrite(myImage,"testMyImage.jpg")>
<img src="testMyImage.jpg"/>

The following images show the source image on the left and image with the tiled border on the right:

![Source Image](image-source.png) ![Tiled Border](image-tiled.png)

For examples of other border types, see the `ImageAddBorder` function in the CFML Reference.

### Creating text images

You can create two types of text images:

- A CAPTCHA image, in which ColdFusion randomly distorts the text
- A text image, in which you control the text attributes

#### Creating a CAPTCHA image

You use the `captcha` action of the `cfimage` tag to create a distorted text image that is human-readable but not machine-readable. When you create a CAPTCHA image, you specify the text that is displayed in the CAPTCHA image; ColdFusion randomly distorts the text. You can specify the height and width of the text area, which affects the spacing between letters, the font size, the fonts to use for the CAPTCHA text, and the level of difficulty, which affects readability. Do not use spaces in the text string specified for the `text` attribute; users cannot detect the spaces as part of the CAPTCHA image.
The following example shows how to write a CAPTCHA image directly to the browser.

```coldfusion
<!--- This example shows how to create a CAPTCHA image with the text "rEadMe" and write the image directly to the browser. --->
<cfimage action="captcha" fontSize="25" width="162" height="75" text="rEadMe"
    fonts="Verdana,Arial,Courier New,Courier">

**Note:** For the CAPTCHA image to display, the width value must be greater than: fontSize times the number of characters specified in text times 1.08. In this example, the minimum width is 162.

ColdFusion 8 supports CAPTCHA images in PNG format only.

**Note:** If you specify the destination attribute to write CAPTCHA images to files, use unique names for the CAPTCHA image files so that when multiple users access the CAPTCHA images, the files are not overwritten.

The following example shows how to create CAPTCHA images with a high level of text distortion.

```coldfusion
<cfset tc = GetTickCount()>

<!--- Use the GetTickCount function to generate unique names for the CAPTCHA files. --->
<cfset tc = GetTickCount()>

<!--- Set the difficulty to "high" for a higher level of text distortion. --->
<cfimage action="captcha" fontSize="15" width="180" height="50" text="rEadMe"
    destination="readme#tc#.png" difficulty="high">

For a detailed example, see “Using CAPTCHA to verify membership” on page 782.

The following image shows three CAPTCHA images with low, medium, and high levels of difficulty, respectively:

![CAPTCHA images with different levels of difficulty](image1.png) ![CAPTCHA images with different levels of difficulty](image2.png) ![CAPTCHA images with different levels of difficulty](image3.png)

### Using the ImageDrawText function

To create a text image by using the `ImageDrawText` function, you must specify the text string and the x and y coordinates for the location of the beginning of the text string. You can draw the text on an existing image or on a blank image, as the following examples show:

```coldfusion
<!--- This example shows how to draw a text string on a blank image. --->
<cfset myImage=ImageNew("",200,100)>
<cfset ImageDrawText(myImage, "Congratulations!",10,50)>
<cfimage source="#myImage#" action="write" destination="myImage.png" overwrite="yes">

<!--- This example shows how to draw a text string on an existing image. --->
<cfset myImage2=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")>
<cfset ImageDrawText(myImage2,"Congratulations!",10,50)>
<cfimage source="#myImage2#" action="write" destination="myImage2.png" overwrite="yes">

In the previous examples, the text is displayed in the default system font and font size. To control the appearance of the text, you specify a collection of text attributes, as the following example shows:

```coldfusion
<cfset attr = StructNew()>
<cfset attr.style="bolditalic">
<cfset attr.size=20>
<cfset attr.font="verdana">
<cfset attr.underline="yes">

To apply the text attributes to the text string, include the attribute collection name in the `ImageDrawText` definition.

In the following examples, the "attr" text attribute collection applies the text string "Congratulations!":

```coldfusion
<!--- This example shows how to draw a text string on a blank image. --->
<cfset myImage=ImageNew("",200,100)>
<cfset ImageDrawText(myImage, "Congratulations!",10,50,attr)>
<cfimage source="#myImage#" action="write" destination="myImage.png" overwrite="yes">

<!--- This example shows how to draw a text string on an existing image. --->
<cfset myImage2=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")>
<cfset ImageDrawText(myImage2,"Congratulations!",10,50,attr)>
<cfimage source="#myImage2#" action="write" destination="myImage2.png" overwrite="yes">

```
...<br/>
<cfset ImageDrawText(myImage,"Congratulations!",10,50,attr)>

To change the color of the text, use the ImageSetDrawingColor function. This function controls the color of all subsequent drawing objects on an image. In the following example, two lines of text, "Congratulations!" and "Gabriella", inherit the color magenta.

<!--[--- This example shows how to draw a text string on a blank image. --]><br/>
<cfset myImage=ImageNew("../cfdocs/images/artgallery/jeff01.jpg")><br/>
<cfset ImageSetDrawingColor(myImage,"magenta")><br/>
<cfset attr = StructNew()><br/>
<cfset attr.style="bolditalic"><br/>
<cfset attr.size=20><br/>
<cfset attr.underline="yes"><br/>
<cfset ImageDrawText(myImage,"Congratulations!",10,50,attr)><br/>
<cfset ImageDrawText(myImage,"Gabriella",50,125,attr)><br/>
<cfimage source="#myImage#" action="write" destination="myImage.jpg" overwrite="yes"><br/>
<img src="myImage.jpg" />

For a list of valid named colors, see the cfimage tag in the CFML Reference.

**Drawing lines and shapes**

ColdFusion provides several functions for drawing lines and shapes. For shapes, the first two values represent the x and y coordinates, respectively, of the upper-left corner of the shape. For simple ovals and rectangles, the two numbers following the coordinates represent the width and height of the shape in pixels. For a line, the values represent the x and y coordinates of the start point and end point of the line, respectively. To create filled shapes, set the filled attribute to true. The following example shows how to create an image with several drawing objects:

<!--[--- Create an image that is 200-pixels square. ---]><br/>
<cfset myImage=ImageNew("",200,200)><br/>
<!--[--- Draw a circle that is 100 pixels in diameter. ---]><br/>
<cfset ImageDrawOval(myImage,40,20,100,100)><br/>
<!--[--- Draw a filled rectangle that is 40 pixels wide and 20 pixels high. ---]><br/>
<cfset ImageDrawRect(myImage,70,50,40,20,true)><br/>
<!--[--- Draw a 100-pixel square. ---]><br/>
<cfset ImageDrawRect(myImage,40,40,100,100)><br/>
<!--[--- Draw two lines. ---]><br/>
<cfset ImageDrawLine(myImage,130,40,100,200)><br/>
<cfset ImageDrawLine(myImage,50,40,100,200)><br/>
<!--[--- Write the ColdFusion image to a file. ---]><br/>
<cfimage source="#myImage#" action="write" destination="testMyImage.gif" overwrite="yes"><br/>
<img src="testMyImage.gif" />

*Note: To draw a sequence of connected lines, use the ImageDrawLines function. For more information, see the CFML Reference.*

**Setting drawing controls**

ColdFusion provides several functions for controlling the appearance of drawing objects. As shown in the ImageDrawText example, you use the ImageSetDrawingColor function to define the color of text in an image. This function also controls the color of lines and shapes. To control line attributes (other than color), use the ImageSetDrawingStroke function. The ImageSetDrawingStroke function uses a collection to define the line attributes.
Drawing controls apply to all subsequent drawing functions in an image; therefore, order is important. In the following example, the drawing stroke attributes defined in the attribute collection apply to the square and the two lines. Similarly, the color green applies to the rectangle and the square, while the color red applies only to the two lines. You can reset a drawing control as many times as necessary within an image to achieve the desired effect.

<!--- Create an attribute collection for the drawing stroke. --->
<cfset attr=StructNew()>
<cfset attr.width="4">
<cfset attr.endcaps="round">
<cfset attr.dashPattern=ArrayNew(1)>
<cfset dashPattern[1]=8>
<cfset dashPattern[2]=6>
<cfset attr.dashArray=dashPattern>
<cfset myImage=ImageNew("",200,200)>
<cfset ImageDrawOval(myImage,40,20,100,100)>
<!--- Set the drawing color to green for all subsequent drawing functions. --->
<cfset ImageSetDrawingColor(myImage,"green")>
<cfset ImageDrawRect(myImage,70,50,40,20,true)>
<!--- Apply the attribute collection to all subsequent shapes and lines in the image. --->
<cfset ImageSetDrawingStroke(myImage,attr)>
<cfset ImageDrawRect(myImage,40,40,100,100)>
<!--- Set the drawing color to red for all subsequent drawing functions. --->
<cfset ImageSetDrawingColor(myImage,"red")>
<cfset ImageDrawLine(myImage,130,40,100,200)>
<cfset ImageDrawLine(myImage,50,40,100,200)>
<cfimage source="#myImage#" action="write" destination="testMyImage.gif" overwrite="yes">
<img src="testMyImage.gif"/>

Resizing images

ColdFusion makes it easy to resize images. You can reduce the file size of an image by changing its dimensions, enforce uniform sizes on images, and create thumbnail images. The following table describes the ways to resize images in ColdFusion:

<table>
<thead>
<tr>
<th>Task</th>
<th>Functions and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resize an image</td>
<td>ImageResize function, or the resize action of the cfimage tag</td>
</tr>
<tr>
<td>Resize images so that they fit in a defined square or rectangle and control the interpolation method</td>
<td>ImageScaleToFit function</td>
</tr>
<tr>
<td>Resize an image and control the interpolation method</td>
<td>ImageResize function</td>
</tr>
</tbody>
</table>

Using the cfimage tag resize action

Use the cfimage tag resize action to resize an image to the specified height and width. You can specify the height and width in pixels or as a percentage of the image's original dimensions. To specify a percentage, include the percent symbol (%) in the height and width definitions.

<!--- This example shows how to specify the height and width of an image in pixels. --->
<cfimage source="../cfdocs/images/artgallery/jeff01.jpg" action="resize" width="100" height="100" destination="jeff01_sm.jpg">
<!--- This example shows how to specify the height and width of an image as percentages. --->
<cfimage source="../cfdocs/images/artgallery/jeff02.jpg" action="resize" width="50%" height="50%" destination="jeff02_sm.jpg">
<!--- This example shows how to specify the height of an image in pixels and its width as a percentage. Notice that this can distort the image. --->
<cfimage source="../cfdocs/images/artgallery/jeff03.jpg" action="resize" width="50%" height="100" destination="jeff03_sm.jpg">
The `cfimage` tag requires that you specify both the height and the width for the `resize` action. The `cfimage` tag `resize` action uses the `highestQuality` interpolation method for the best quality image (at the cost of performance). For faster display, use the `ImageResize` function or the `ImageScaleToFit` function.

**Using the `ImageResize` function**

The `ImageResize` function is similar to the `cfimage` tag `resize` action. To ensure that the resized image is proportional, specify a value for the either the height or width and enter a blank value for the other dimension:

<!--- This example shows how to resize an image to 50% of original size and resize it proportionately to the new width. Note that the height value is blank. --->
<cfset myImage=ImageNew("http://www.google.com/images/logo_sm.gif")>
<cfset ImageResize(myImage,"50%","")>

<!--- Save the modified image to a file. --->
<cfimage source="#myImage#" action="write" destination="test_myImage.jpeg" overwrite="yes">

<!--- Display the source image and the resized image. --->
<img src="http://www.google.com/images/logo_sm.gif" />
<img src="test_myImage.jpeg" />

The `ImageResize` function also lets you specify the type of interpolation used to resize the image. Interpolation lets you control the trade-off between performance and image quality. By default, the `ImageResize` function uses the `highestQuality` interpolation method. To improve performance (at the cost of image quality), change the interpolation method. Also, you can set the blur factor for the image. The default value is 1 (not blurred). The highest blur factor is 10 (very blurry). The following example shows how to resize an image using the `highPerformance` form of interpolation with a blur factor of 10:

<cfset myImage=ImageNew("../cfdocs/images/artgallery/aiden01.jpg")>
<cfset ImageResize(myImage,"","200%","highPerformance", 10)>
<cfimage action="writeToBrowser" source="#myImage#">

**Note:** Increasing the blur factor reduces performance.

For a complete list of interpolation methods, see `ImageResize` in the CFML Reference.

**Using the `ImageScaleToFit` function**

To create images of a uniform size, such as thumbnail images or images displayed in a photo gallery, use the `ImageScaleToFit` function. You specify the area of the image in pixels. ColdFusion resizes the image to fit the square or rectangle and maintains the source image's aspect ratio. Like the `ImageResize` function, you can specify the interpolation, as the following example shows:

<!--- This example shows how to resize an image to a 100-pixel square, while maintaining the aspect ratio of the source image. --->
<cfimage source="../cfdocs/images/artgallery/jeff05.jpg" name="myImage" action="read">
<cfset ImageSetAntialiasing(myImage)>
<cfset ImageScaleToFit(myImage,100,100,"mediumQuality")>

<!--- Display the modified image in a browser. --->
<cfimage action="writeToBrowser" source="#myImage#">

To fit an image in a defined rectangular area, specify the width and height of the rectangle, as the following example shows:

<!--- This example shows how to resize an image to fit in a rectangle that is 200 pixels wide and 100 pixels high, while maintaining the aspect ratio of the source image. --->
<cfimage source="../cfdocs/images/artgallery/jeff05.jpg" name="myImage" action="read">
<cfset ImageSetAntialiasing(myImage)>

<!--- Turn on antialiasing. --->
<cfset ImageSetAntialiasing(myImage)>

<!--- Display the modified image in a browser. --->
<cfimage action="writeToBrowser" source="#myImage#"
<cfset ImageScaleToFit(myImage,200,100)>
<!---- Display the modified image in a browser. ---->
<cfimage source="#myImage#" action="writeToBrowser">

In this example, the width of the resulting image is less than or equal to 200 pixels and the height of the image is less than or equal to 100 pixels.

Also, you can specify just the height or just the width of the rectangle. To do this, specify an empty string for the undefined dimension. The following example resizes the image so that the width is exactly 200 pixels and the height of the image is proportional to the width:

<!--- This example shows how to resize an image so that it is 200 pixels wide, while maintaining the aspect ratio of the source image. The interpolation method is set to maximize performance (which reduces image quality). --->
<cfimage source="../cfdocs/images/artgallery/jeff05.jpg" name="myImage">

<!--- Turn on antialiasing. --->
<cfset ImageSetAntialiasing(myImage)>
<cfset ImageScaleToFit(myImage,200,"","highestPerformance")>

<!--- Display the modified image in a browser. --->
<cfimage source="#myImage#" action="writeToBrowser">

For more information, see ImageScaleToFit in the CFML Reference.

Creating watermarks

A watermark is a semitransparent image that is superimposed on another image. One use for a watermark is for protecting copyrighted images. To create a watermark in ColdFusion, you use the ImageSetDrawingTransparency function with the ImagePaste function. You can create a watermark image in one of three ways:

• Create a watermark from an existing image file. For example, you can use a company logo as a watermark.

• Create a text image in ColdFusion and apply the image as a watermark. For example, you can create a text string, such as Copyright or PROOF and apply it to all the images in a photo gallery.

• Create a drawing image in ColdFusion and use it as a watermark. For example, you can use the drawing functions to create a green check mark and apply it to images that have been approved.

Creating a watermark from an image file

The following example shows how to create a watermark from an existing GIF image located on a website:

<!--- This example shows how to create a watermark from an existing image. --->
<!--- Create two ColdFusion images from existing JPEG files. --->
<cfimage source="../cfdocs/images/artgallery/raquel05.jpg" name="myImage">
<cfimage source="http://www.google.com/images/logo_sm.gif" name="myImage2">

<cfimage source="#myImage#" action="write" destination="logo.jpg" overwrite="yes">
<cfset ImageSetDrawingTransparency(myImage,50)>

<!--- Paste myImage2 on myImage at the coordinates (0,0). --->
<cfset ImagePaste(myImage,myImage2,0,0)>

<!--- Write the result to a file. --->
<cfimage source="#myImage#" destination="watermark.jpg" action="write" overwrite="yes">
<!---- Display the the result. ---->
<img src="watermark.jpg"/>

Creating a watermark from a text image

The following example shows how to create a text image in ColdFusion and use it as a watermark:

<!--- Create a ColdFusion image from an existing JPG file. --->
<cfset myImage=ImageNew("../cfdocs/images/artgallery/raquel05.jpg")>
<!---- Scale the image to fit in a 200-pixel square, maintaining the aspect ratio of the source image. --->
<!---- Display the modified image in a browser. --->
<cfimage source="#myImage#" action="writeToBrowser"/>
<cfset ImageScaleToFit(myImage,200,200)>

<!--- Set the drawing transparency to 75%. --->
<cfset ImageSetDrawingTransparency(myImage,75)>

<!--- Create a ColdFusion image from scratch. --->
<cfset textImage=ImageNew("",150,140)>

<!--- Set the drawing color to white. --->
<cfset ImageSetDrawingColor(textImage,"white")>

<!--- Create a collection of text attributes. --->
<cfset attr=StructNew()>
<cfset attr.size=40>
<cfset attr.style="bold">
<cfset attr.font="Arial">

<!--- Turn on antialiasing. --->
<cfset ImageSetAntialiasing(textImage)>

<!--- Draw the text string "PROOF" on the ColdFusion image. Apply the text attributes that you specified. --->
<cfset ImageDrawText(textImage,"PROOF",1,75,attr)>

<!--- Rotate the text image by 30 degrees. --->
<cfset ImageRotate(textImage,30)>

<!--- Scale the image to fit in a 200-pixel square, maintaining the aspect ratio of the source image. --->
<cfset ImageScaleToFit(textImage,200,200)>

<!--- Paste the text image onto myImage. --->
<cfset ImagePaste(myImage,textImage,0,0)>

<!--- Write the combined image to a file. --->
<cfimage source="#myImage#" action="write" destination="test_watermark.jpg" overwrite="yes">

<!--- Display the image. --->
<img src="test_watermark.jpg"/>

Creating a watermark from a ColdFusion drawing

The following example shows how to draw an image in ColdFusion and use it as a watermark. You use the ImageSetDrawingStroke function to define the attributes of lines and shapes you create with drawing functions and the ImageSetDrawingColor function to define the color.

<!--- This example shows how to draw a red circle with a line through it and use it as a watermark. --->
<cfset myImage=ImageNew("",201,201)>

<!--- Set the drawing transparency of the image to 30%. --->
<cfset ImageSetDrawingTransparency(myImage,30)>

<!--- Set the drawing color to red. --->
<cfset ImageSetDrawingColor(myImage,"red")>

<!--- Create an attribute collection that sets the line width to 10 pixels. --->
<cfset attr=StructNew()>
<cfset attr.width = 10>

<!--- Apply the attribute collection to the ImageSetDrawingStroke function. --->
<cfset ImageSetDrawingStroke(myImage,attr)>

<!--- Draw a diagonal line starting at (40,40) and ending at (165,165) on myImage. The drawing attributes you specified are applied to the line. --->
<cfset ImageDrawLine(myImage,40,40,165,165)>

<!--- Draw a circle starting at (5,5) and is 190 pixels high and 190 pixels wide. The drawing attributes you specified are applied to the oval. --->
<cfset ImageDrawOval(myImage,5,5,190,190)>

<!--- Create a ColdFusion image from a JPEG file. --->
<cfimage source="../cfdocs/images/artgallery/raquel05.jpg" name="myImage2">

<!--- Scale the image to fit in a 200-pixel square, maintaining the aspect ratio of the source image. --->
<cfset ImageScaleToFit(myImage2,200,200)>

<!--- Paste the myImage2 directly over the myImage. --->

Writing images to the browser

Use the writeToBrowser action of the cfimage tag to display a images directly in the browser without writing them to files. This is useful for testing the appearance of a ColdFusion image. The following example shows how to test the display of two effects applied to an image:

```coldfusion
<cfset myImage=ImageNew("../cfdocs/images/artgallery/paul01.jpg")>
<cfset ImageBlur(myImage,5)>
<cfset ImageNegative(myImage)>
<cfimage source="#myImage#" action="writeToBrowser">
```

The writeToBrowser action displays images in PNG format.

Also, you can write multiple images to the browser which is useful if you want to manipulate images in memory and display them without writing them to files. For example, you can duplicate several versions of the same image, display the versions in a browser, and allow the user to choose one of the images to write to a file. Or, you can extract images from a database, add a watermark to the images that appear in the browser, such as Proof or Draft, without having to write the modified images to files first. This way you can maintain one set of image files and change them on-the-fly. For an example of writing multiple images to the browser, see “Generating a gallery of watermarked images” on page 781.

Application examples that use ColdFusion images

You can create simple applications that automate image processes by using ColdFusion images.

Generating thumbnail images

The following example shows how to create a form for uploading images. A visitor to the site can use the form to upload an image file and generate a thumbnail image from it. You use ColdFusion image operations to perform the following tasks:

- Verify that the uploaded file is a valid image.
- Ensure that the height or the width of the image does not exceed 800 pixels.
- If the image is valid and within the size limits, generate a thumbnail version of the source image and save it to a file.

Enter the following code on the form page:

```coldfusion
<!--- This code creates a form with one field where the user enters the image file to upload. --->
<cfform action="makeThumbnail.cfm" method="post" enctype="multipart/form-data">
  Please upload an image: <cfinput type="file" name="image">
  <cfinput type="submit" value="Send Image" name="Submit">
</cfform>
```
Enter the following code on the action page:

```cfml
<cfset thisDir = expandPath(".")>
<!---- Determine whether the form is uploaded with the image. ---->
<cfif structKeyExists(form,"image") and len(trim(form.image))>
  <!---- Use the cffile tag to upload the image file. ---->
  <cffile action="upload" fileField="image" destination="#thisDir#" result="fileUpload" nameconflict="overwrite">
  <!---- Determine whether the image file is saved. ---->
  <cfif fileUpload.fileWasSaved>
    <!---- Determine whether the saved file is a valid image file. ---->
    <cfif IsImageFile("#fileUpload.serverfile#")>
      <!---- Read the image file into a variable called myImage. ---->
      <cfimage action="read" source="#fileUpload.serverfile#" name="myImage">
      <!---- Determine whether the image file exceeds the size limits. ---->
      <cfif ImageGetHeight(myImage) gt 800 or ImageGetWidth(myImage) gt 800>
        <!---- If the file is too large, delete it from the server. ---->
        <cffile action="delete"
          file="#fileUpload.serverDirectory#/" & fileUpload.serverFilename & "_thumbnail." & fileUpload.serverFileExt">
        <cfoutput>
          <p>The image you uploaded was too large. It must be less than 800 pixels wide and 800 pixels high. Your image was #imageGetWidth(myImage)# pixels wide and #imageGetHeight(myImage)# pixels high.</p>
        </cfoutput>
      </cfif>
      <!---- If the image is valid and does not exceed the size limits, create a thumbnail image from the source file that is 75-pixels square, while maintaining the aspect ratio of the source image. Use the bilinear interpolation method to improve performance. ---->
      <cfelse>
        <cfset ImageScaleToFit(myImage,75,75,"bilinear")>
        <!---- Specify the new filename as the source filename with "_thumbnail" appended to it. ---->
        <cfset newImageName = fileUpload.serverDirectory & "/" & fileUpload.serverFilename & "_thumbnail." & fileUpload.serverFileExt>
        <!---- Save the thumbnail image to a file with the new filename. ---->
        <cfimage source="#myImage#" action="write"
          destination="#newImageName#" overwrite="yes">
        <cfoutput>
          <p>Thank you for uploading the image. We have created a thumbnail for your picture.</p>
        </cfoutput>
      </cfif>
    </cfif>
  </cfif>
</cfif>
<!---- If it is not a valid image file, delete it from the server. ---->
<cfelse>
  <cffile action="delete"
    file="#fileUpload.serverDirectory#/" & fileUpload.serverFile#">
  <cfoutput>
    <p>The file you uploaded, #fileUpload.clientFile#, was not a valid image.</p>
  </cfoutput>
</cfelse>
```
Generating a gallery of watermarked images

The following example extracts images and information from the cfartgallery database. You use ColdFusion image operations to perform the following tasks:

- Verify that an image exists for records returned from the database.
- Display the text, SOLD! on images that have been sold.
- Resize images to 100 pixels, maintaining the aspect ratio of the source image.
- Add a 5-pixel border to the images.
- Display the modified images directly in the browser without writing them to files.

Example

<!--- Create a query to extract artwork and associated information from the cfartgallery database. --->
<cfquery name="artwork" datasource="cfartgallery">
SELECT FIRSTNAME, LASTNAME, ARTNAME, DESCRIPTION, PRICE, LARGEIMAGE, ISSOLD, MEDIATYPE
FROM ARTISTS, ART, MEDIA
WHERE ARTISTS.ARTISTID = ART.ARTISTID
AND ART.MEDIAID = MEDIA.MEDIAID
ORDER BY ARTNAME
</cfquery>
<cfset xctr = 1>
<table border="0" cellpadding="15" cellspacing="0" bgcolor="#FFFFFF">
<cfoutput query="artwork">
<cfif xctr mod 3 eq 1>
<tr>
</cfif>
<!--- Use the IsImageFile function to verify that the image files extracted from the database are valid. Use the ImageNew function to create a ColdFusion image from valid image files. --->
<cfif IsImageFile("../cfdocs/images/artgallery/"#artwork.largeImage#")>
<cfset myImage=ImageNew("../cfdocs/images/artgallery/"#artwork.largeImage#")>
<td valign="top" align="center" width="200">
<cfset xctr = xctr + 1>
<!--- For artwork that has been sold, display the text string "SOLD!" in white on the image. --->
<cfif artwork.isSold>
    <cfset ImageSetDrawingColor(myImage,"white")>
    <cfset attr=StructNew()>
    <cfset attr.size=45>
    <cfset attr.style="bold">
    <cfset ImageDrawText(myImage,"SOLD!",35,195, attr)>
</cfif>
<!--- Resize myImage to fit in a 110-pixel square, scaled proportionately. --->
<cfset ImageScaleToFit(myImage,110,"","bicubic")>
<!--- Add a 5-pixel black border to myImage. --->
<cfset ImageAddBorder(myImage,"5")>
<!--- Write the images directly to the browser without saving them to the hard drive. --->
<cfimage source="#myImage#" action="writeToBrowser"><br>
</cfoutput>
Using CAPTCHA to verify membership

The following example shows how to create a simple form to verify whether a person (rather than a computer generating spam) is registering to receive an online newsletter. You generate the CAPTCHA image from a random text string on the form page and verify the person’s response on the action page.

Example

Enter the following code on the form page:

```coldfusion
<!--- Set the length of the text string for the CAPTCHA image. --->
<cfset stringLength=6>

<!--- Specify the list of characters used for the random text string. The following list limits the confusion between upper- and lowercase letters as well as between numbers and letters. --->
<cfset stringList="2,3,4,5,6,7,8,9,a,b,d,e,f,g,h,j,n,q,r,t,y,A,B,C,D,E,F,G,H,K,L,M,N,P,Q,R,S,T,U,V,W,X,Y,Z">
<cfset rndString="">

<!--- Create a loop that builds the string from the random characters. --->
<cfloop from="1" to="#stringLength#" index="i">
  <cfset rndNum=RandRange(1,listLen(stringList))>
  <cfset rndString=rndString & listGetAt(stringList,rndNum)>
</cfloop>

<!--- Hash the random string. --->
<cfset rndHash=Hash(rndString)>

<!--- Create the user entry form. --->
<cfform action="captcha2.cfm" method="post">
<p>Please enter your first name:</p>
<cfinput type="text" name="firstName" required="yes">
<p>Please enter your last name:</p>
<cfinput type="text" name="lastName" required="yes">
<p>Please enter your e-mail address:</p>
<cfinput type="text" name="mailTo" required="yes" validate="email">
<p><cfimage action="captcha" fontSize="24" fonts="Times New Roman" width="200" height="50" text="#rndString#"></p>
<p>Please type what you see: </p>
<cfinput type="text" name="userInput" required="yes" maxlength=6>
<cfinput type="hidden" name="hashVal" value="#rndHash#">
<p><cfinput type="Submit" name ="OK" value="OK"></p>
</cfform>
```

Enter the following code on the action page:

```coldfusion
<!--- Verify whether the text entered by the user matches the CAPTCHA string. --->
<cfif #form.hashval# eq Hash(#form.userInput#)>
  <cfoutput>
```

Artist: #artwork.firstName# #artwork.lastName#<br>
Price: #dollarFormat(artwork.price)#<br>
#artwork.mediaType# - #artwork.description#<br>
</cfif>
<cfif xctr-1 mod 3 eq 0>
</tr>
</cfif>
<cfoutput>
</table>
Creating versions of an image

The following example shows how to create an application that lets you generate four versions of the same image, display the versions in a form, and choose which one to save. The application comprises three ColdFusion pages that perform the following tasks:

- Dynamically populate a drop-down list box from a database query.
- Use the `cfimage` tag to create a ColdFusion image from the title selected from the list. Use the `ImageNew` function to create three clones of the ColdFusion image. Use the `ImageSharpen` function to change the sharpness setting for each clone.
- Save the file chosen from the form to a new location.

Example

On the first form page, create a query that selects the artwork from the `cfartgallery` database and displays the titles in a pop-up menu:

```coldfusion
<!--- Create a query to extract artwork from the cfartgallery database. --->
<cfquery name="artwork" datasource="cfartgallery">
    SELECT ARTID, ARTNAME, LARGEIMAGE
    FROM ART
    ORDER BY ARTNAME
</cfquery>

<!--- Create a form that lists the artwork titles generated by the query. Set the value to LARGEIMAGE so that the image file is passed to the action page. --->
<br />
<cfform action="dupImage2.cfm" method="post">
    Please choose a title:
    <cfselect name="art" query="artwork" display="ARTNAME" value="LARGEIMAGE" required="yes" multiple="no" size="8">
    </cfselect>
    <cfinput type="submit" name="submit" value="OK">
</cfform>
```

On the first action page, clone the original image three times, change the sharpness setting for each clone, and display the results:

```coldfusion
<!--- Determine whether a valid image file exists. --->
<cfif IsImageFile("../cfdocs/images/artgallery/#form.art#")>
    <cfset original=ImageNew("../cfdocs/images/artgallery/#form.art#")>
    <!--- Use the ImageNew function to create a clone of the ColdFusion image. --->
    <cfset clone1=ImageNew(original)>
    <!--- Use the ImageSharpen function to blur the cloned image. --->
    <cfset ImageSharpen(clone1,-1)>
    <!--- Use the ImageNew function to create a second clone of the original image. --->
    <cfset clone2=ImageNew(original)>
    <!--- Use the ImageSharpen function to blur the cloned image. --->
    <cfset ImageSharpen(clone2,-1)>
    <!--- Use the ImageNew function to create a third clone of the original image. --->
    <cfset clone3=ImageNew(original)>
    <!--- Use the ImageSharpen function to blur the cloned image. --->
    <cfset ImageSharpen(clone3,-1)>
</cfif>
```
<cfset clone2=ImageNew(original)>  
<!-- Use the ImageSharpen function to sharpen the cloned image. -->  
<cfset ImageSharpen(clone2,1)>  
<!-- Use the ImageNew function to create a third clone for the original image. -->  
<cfset clone3=ImageNew(original)>  
<!-- Use the ImageSharpen function to sharpen the cloned image to the maximum setting. -->  
<cfset ImageSharpen(clone3,2)>  
<!-- Create a form with a radio button for each selection. The value of the hidden field is the relative pathname of the original image file. -->  
<p>Please choose an image:</p>  
<table>  
<tr>  
<td><cfform action="dupImage3.cfm" method="post">  
<cfimage source="#original#" action="writeToBrowser">  
<br />
<cfinput type="radio" name="foo" value="original">Original Image</td>  
<td><cfimage source="#clone1#" action="writeToBrowser">  
<br />
<cfinput type="radio" name="foo" value="blurred">Blurred Image</td>  
<td><cfimage source="#clone2#" action="writeToBrowser">  
<br />
<cfinput type="radio" name="foo" value="sharper">Sharper Image</td>  
<td><cfimage source="#clone3#" action="writeToBrowser">  
<br />
<cfinput type="radio" name="foo" value="sharpest">Sharpest Image</td>  
<tr><td><cfinput type="Submit" name="OK">  
</td></tr>  
</cfform>  
</tr>  
</table>  
</cfform>  
</tr>  
</cfif>  
<p>There is no image associated with the title you selected. Please click the Back button and try again.</p>  
</cfif>  

On the second action page, save the selected image to the C drive:  
<p>The image you have chosen has been saved.</p>  
<cfswitch expression="#form.foo#">  
<cfcase value="blurred">  
<cfset ImageSharpen(img,-1)>  
</cfcase>  
<cfcase value="sharper">  
<cfset ImageSharpen(img,1)>  
</cfcase>  
<cfcase value="sharpest">  
<cfset ImageSharpen(img,2)>  
</cfcase>  
</cfswitch>  
<!-- Use the cfimage tag to write the image selected from the form to a file in the C drive. Use the value of the form's hidden field as the source file for the image. -->  
<cfimage source="#img#" action="write" destination="c:/myImage.jpg" overwrite="yes">  
<img src="c:/myImage.jpg" />
Chapter 43: Creating Charts and Graphs

You can use the `cfchart` tag to display charts and graphs.

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**About charts**

The ability to display data in a chart or graph can make data interpretation much easier. Rather than present a simple table of numeric data, you can display a bar, pie, line, or other applicable type of chart using colors, captions, and a two-dimensional or three-dimensional representation of your data.

The `cfchart` tag, along with the `cfchartseries` and `cfchartdata` tags, provide many different chart types. The attributes to these tags let you customize your chart appearance.

You can create 11 types of charts in ColdFusion in two and three dimensions. The following figure shows a sample of each type of chart.

*Note: In two dimensions, bar and cylinder charts appear the same, as do cone and pyramid charts.*
Creating a basic chart

You can create a chart in either of the following ways:

- Using the cfchart, cfchartseries, and cfchartdata tags in a ColdFusion page.
- Using the chart wizard that is included with the ColdFusion Report Builder. For more information, see “Creating Reports and Documents for Printing” on page 810.

Creating a chart with ColdFusion tags

To create a chart with ColdFusion tags, you use the cfchart tag along with at least one cfchartseries tag. You can optionally include one or more cfchartdata tags within a cfchartseries tag. The following table describes these tags:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfchart</td>
<td>Specifies the container in which the chart appears. This container defines the height, width, background color, labels, fonts, and other characteristics of the chart. You must include at least one cfchartseries tag within the cfchart tag.</td>
</tr>
<tr>
<td>cfchartseries</td>
<td>Specifies a database query that supplies the data to the chart and one or more cfchartdata tags that specify individual data points. Specifies the chart type, colors for the chart, and other optional attributes.</td>
</tr>
<tr>
<td>cfchartdata</td>
<td>Optionally specifies an individual data point to the cfchartseries tag.</td>
</tr>
</tbody>
</table>

The following example shows an outline of the basic code that you use to create a chart:

```coldfusion
<cfchart>
  <cfchartseries type="type">
```
The following example displays a simple pie chart that shows four values:

```cfc
<cfchart>
  <cfchartseries type="pie">
    <cfchartdata item="New car sales" value="50000">
    <cfchartdata item="Used car sales" value="25000">
    <cfchartdata item="Leasing" value="30000">
    <cfchartdata item="Service" value="40000">
  </cfchartseries>
</cfchart>
```

The following image shows the resulting chart:

Creating a chart with the Report Builder wizard

The ColdFusion Report Builder includes a wizard that lets you create charts easily. The wizard lets you specify all of the chart characteristics that you can specify using the `cfchart`, `cfchartseries`, and `cfchartdata` tags. For information about using the Report Builder chart wizard, see “Creating Reports and Documents for Printing” on page 810.

Charting data

One of the most important considerations when you chart data is the way that you supply the data to the `cfchart` tag. You can supply data in the following ways:

- Specify individual data points by using `cfchartdata` tags.
- Provide all the data in a single query by using `cfchartseries` tags.
- Combine data from a query with additional data points from `cfchartdata` tags.
- Provide all the data in a report created with Report Builder. For more information, see “Creating Reports and Documents for Printing” on page 810.

Note: The `cfchart` tag charts numeric data only. As a result, you must convert any dates, times, or preformatted currency values, such as $3,000.53, to integers or real numbers.
Charting individual data points

When you chart individual data points, you specify each data point by inserting a `<cfchartdata>` tag in the `<cfchartseries>` tag body. For example, the following code creates a simple pie chart:

```xml
<cfchart>
  <cfchartseries type="pie">
    <cfchartdata item="New Vehicle Sales" value=500000>
    <cfchartdata item="Used Vehicle Sales" value=250000>
    <cfchartdata item="Leasing" value=300000>
    <cfchartdata item="Service" value=400000>
  </cfchartseries>
</cfchart>
```

This pie chart displays four types of revenue for a car dealership. Each `<cfchartdata>` tag specifies a department's income and a description for the legend.

**Note:** If two data points have the same item name, ColdFusion creates a graph of the value for the last one specified within the `<cfchart>` tag.

The `<cfchartdata>` tag lets you specify the following information about a data point:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>value</td>
<td>The data value to be charted. This attribute is required.</td>
</tr>
<tr>
<td>item</td>
<td>(Optional) The description for this data point. The item appears on the horizontal axis of bar and line charts, on the vertical axis of horizontal bar charts, and in the legend of pie charts.</td>
</tr>
</tbody>
</table>

Charting a query

Each bar, dot, line, or slice of a chart represents data from one row/column coordinate in your result set. A related group of data is called a chart series.

Because each bar, dot, line, or slice represents the intersection of two axes, you must craft the query result set such that the row and column values have meaning when displayed in a chart. This often requires that you aggregate data in the query. You typically aggregate data in a query using one of the following:

- Specify a SQL aggregate function (SUM, AVG, MAX, and so on) using a GROUP BY clause in the SELECT statement.
- Use a Query of Queries.
- Retrieve data from a view, instead of a table.

When you chart a query, you specify the query name using the `query` attribute of the `<cfchartseries>` tag. For example, the code for a simple bar chart might be as follows:

```xml
<cfchart>
  <cfchartseries type="bar" query="DataTable" valueColumn="AvgByDept" itemColumn="Dept_Name"/>
</cfchart>
```
This example displays the values in the AvgByDept column of the DataTable query. It displays the Dept_Name column value as the item label by each bar.

The following table lists the attributes of the \texttt{cfchartseries} tag that you use when working with queries:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>query</td>
<td>The query that contains the data. You must also specify the valueColumn and itemColumn.</td>
</tr>
<tr>
<td>valueColumn</td>
<td>The query column that contains the values to be charted.</td>
</tr>
<tr>
<td>itemColumn</td>
<td>The query column that contains the description for this data point. The item normally appears on the horizontal axis of bar and line charts, on the vertical axis of horizontalbar charts, and in the legend in pie charts.</td>
</tr>
</tbody>
</table>

### Charting a query of queries

In addition to charting the results of a query, you can also chart the results of a queries of queries. For more information about using query of queries, see "Using Query of Queries" on page 413. Query of queries provides significant power in generating the data for the chart. For example, you can use aggregating functions such as SUM, AVG, and GROUP BY to create a query of queries with statistical data based on a raw database query. For more information, see "Using Query of Queries" on page 413.

You can also take advantage of the ability to dynamically reference and modify query data. For example, you can loop through the entries in a query column and reformat the data to show whole dollar values.

The example in the following procedure analyzes the salary data in the cfdocexamples database using a query of queries, and displays the data as a bar chart.

1. Create a new ColdFusion page with the following content:

```coldfusion
<!--- Get the raw data from the database. --->
<cfquery name="GetSalaries" datasource="cfdocexamples">
    SELECT Departmt.Dept_Name,
           Employee.Salary
    FROM Departmt, Employee
    WHERE Departmt.Dept_ID = Employee.Dept_ID
</cfquery>

<!--- Generate a query with statistical data for each department. --->
<cfquery dbtype = "query" name = "DeptSalaries">
    SELECT Dept_Name,
           AVG(Salary) AS AvgByDept
    FROM GetSalaries
    GROUP BY Dept_Name
</cfquery>

<!--- Reformat the generated numbers to show only thousands. --->
<cfloop index="i" from="1" to="#DeptSalaries.RecordCount#">
    <cfset DeptSalaries.AvgByDept[i]=Round(DeptSalaries.AvgByDept[i]/1000)*1000>
</cfloop>

<html>
    <head>
        <title>Employee Salary Analysis</title>
    </head>

    <body>
        <h1>Employee Salary Analysis</h1>
    </body>
```
<!---- Bar chart, from DeptSalaries Query of Queries. --->
<cfchart
    xAxisTitle="Department"
    yAxisTitle="Salary Average"
    font="Arial"
    gridlines=6
    showXGridlines="yes"
    showYGridlines="yes"
    showborder="yes"
    show3d="yes"
>
    <cfchartseries
        type="bar"
        query="DeptSalaries"
        valueColumn="AvgByDept"
        itemColumn="Dept_Name"
        seriesColor="olive"
        paintStyle="plain"
    />
</cfchart>

<br/>
</body>
</html>

2 Save the page as chartdata.cfm in the myapps directory under the web root directory. For example, the directory path in Windows might be C:\Inetpub\wwwroot\myapps.

3 Return to your browser and enter the following URL to view the chartdata.cfm page:

   http://localhost/myapps/chartdata.cfm

   The following figure appears:

   ![Bar chart]

   **Note:** If a query contains two rows with the same value for the itemColumn attribute, ColdFusion graphs the last row in the query for that value. For the preceding example, if the query contains two rows for the Sales department, ColdFusion graphs the value for the last row in the query for Sales.

**Reviewing the code**

The following table describes the code and its function:
You can also rewrite this example to use the `cfoutput` and `cfchartdata` tags within the `cfchartseries` tag, instead of using the loop, to round the salary data, as the following code shows:

```cfchartseries
    <cfchartseries type="bar" seriesColor="olive" paintStyle="plain">
        <cfoutput query="deptSalaries">
            <cfchartdata item="#dept_name#" value=#Round(AvgByDept/1000)*1000#>
        </cfoutput>
    </cfchartseries>
```

You can use the `cfdocexamples` database to get the Dept_Name and Salary for each employee. Because the Dept_Name is in the Departmt table and the Salary is in the Employee table, you need a table join in the WHERE clause. You can use the raw results of this query elsewhere on the page.

```cfquery
    <cfquery name="GetSalaries" datasource="cfdocexamples">
        SELECT Departmt.Dept_Name, Employee.Salary
        FROM Departmt, Employee
        WHERE Departmt.Dept_ID = Employee.Dept_ID
    </cfquery>
```

```cfquery
    <cfquery dbtype = "query" name = "DeptSalaries">
        SELECT Dept_Name,
               AVG(Salary) AS AvgByDept
        FROM GetSalaries
        GROUP BY Dept_Name
    </cfquery>
```

```cfloop
    <cfloop index="i" from="1" to="#DeptSalaries.RecordCount#">
        <cfset DeptSalaries.AvgByDept[i]=Round(DeptSalaries.AvgByDept[i]/1000)*1000>
    </cfloop>
```

```cfchart
    <cfchart xAxisTitle="Department" yAxisTitle="Salary Average" font="Arial" gridlines=6 showXGridlines="yes" showYGridlines="yes" showborder="yes" type="bar" query="DeptSalaries" valueColumn="AvgByDept" itemColumn="Dept_Name" seriesColor="olive" paintStyle="plain" />
</cfchart>
```

Combining a query and data points

To chart data from both query and individual data values, you specify the query name and related attributes in the `cfchartseries` tag, and provide additional data points by using the `cfchartdata` tag.

ColdFusion displays the chart data specified by a `cfchartdata` tag before the data from a query, for example, to the left on a bar chart. You can use the `sortXAxis` attribute of the `cfchart` tag to sort data alphabetically along the x axis.
One use of combining queries and data points is to provide data that is missing from the database; for example, to provide the data for one department if the data for that department is missing. The example in the following procedure adds data for the Facilities and Documentation departments to the salary data obtained from the query shown in the previous section:

1. Open the chartdata.cfm file in your editor.
2. Edit the cfchart tag so that it appears as follows:

   ```cfml
   <cfchart chartwidth="600">
     <cfchartseries type="bar" query="DeptSalaries" itemColumn="Dept_Name" valueColumn="AvgByDept">
       <cfchartdata item="Facilities" value="35000">
       <cfchartdata item="Documentation" value="45000">
     </cfchartseries>
   </cfchart>
   ```

3. Save the page as chartqueryanddata.cfm in the myapps directory under the web root directory. For example, the directory path in Windows might be C:\inetpub\wwwroot\myapps.
4. Return to your browser and enter the following URL to view the chartqueryanddata.cfm page:

   `http://localhost/myapps/chartqueryanddata.cfm`

**Charting multiple data collections**

Sometimes, you might have more than one series of data to display on a single chart, or you want to compare two sets of data on the same chart. In some cases, you might want to use different charting types on the same chart. For example, you might want to include a line chart on a bar chart.

To combine multiple data series into a single chart, insert multiple cfchartseries tags within a single cfchart tag. You control how the multiple data collections are charted using the seriesPlacement attribute of the cfchart tag. Using this attribute, you can specify the following options:

- **default**: Let ColdFusion determine the best method for combining the data.
- **cluster**: Place corresponding chart elements from each series next to each other.
- **stacked**: Combine the corresponding elements of each series.
- **percent**: Show the elements of each series as a percentage of the total of all corresponding elements.

The following image shows these options for combining two bar charts:

You can also combine chart types. The following is a combination bar and line chart:
The only chart type that you cannot mix with others is the pie chart. If you define one of the data series to use a pie chart, no other chart appears.

The example in the following procedure creates the chart in the previous figure, which shows a bar chart with a line chart added to it. In this example, you chart the salary of permanent employees (bar) against contract employees (line).

**Note:** The layering of multiple series depends on the order that you specify the `cfchartseries` tags. For example, if you specify a bar chart first and a line chart second, the bar chart appears in front of the line chart in the final chart.

### Create a combination bar chart and line chart

1. Open the `chartdata.cfm` file in your editor.
2. Edit the `cfchart` tag so that it appears as follows:

   ```cfml
   <cfchart
     backgroundColor="white"
     xAxisTitle="Department"
     yAxisTitle="Salary Average"
     font="Arial"
     gridlines=6
     showXGridlines="yes"
     showYGridlines="yes"
     showborder="yes"
   >
     <cfchartseries
       type="line"
       seriesColor="blue"
       paintStyle="plain"
       seriesLabel="Contract Salaries"
     >
       <cfchartdata item="HR" value=70000>
       <cfchartdata item="Marketing" value=95000>
       <cfchartdata item="Sales" value=80000>
       <cfchartdata item="Training" value=93000>
     </cfchartseries>
     <cfchartseries
       type="bar"
       query="DeptSalaries"
       valueColumn="AvgByDept"
       itemColumn="Dept_Name"
       seriesColor="gray"
       paintStyle="plain"
       seriesLabel="Dept. Average Salaries"
     />
   </cfchart>
   ```

3. Save the file as `chart2queries.cfm` in the `myapps` directory under the web root directory.
4. Return to your browser and view the `chart2queries.cfm` page.
Controlling chart appearance

You can control the appearance of charts by doing any of the following:

• Using the default chart styles included with ColdFusion
• Using the attributes of the cfchart and cfchartseries tags
• Creating your own chart styles

Using the default chart styles included with ColdFusion
ColdFusion supplies the following chart styles:

• beige
• blue
• default
• red
• silver
• yellow

To use any of these styles, specify the style using the style attribute of the cfchart tag. The following example illustrates using the beige style:

```xml
<cfchart style="beige">
  <cfchartseries type="pie">
    <cfchartdata item="New car sales" value="50000">
    <cfchartdata item="Used car sales" value="25000">
    <cfchartdata item="Leasing" value="30000">
    <cfchartdata item="Service" value="40000">
  </cfchartseries>
</cfchart>
```

Using the attributes of the cfchart and cfchartseries tags
You can specify the appearance of charts by using the attributes of the cfchart and cfchartseries tags.

You can optionally specify the following characteristics to the cfchart tag on the types of charts indicated:
<table>
<thead>
<tr>
<th>Chart characteristic</th>
<th>Attributes used</th>
<th>Description</th>
<th>Chart type</th>
</tr>
</thead>
<tbody>
<tr>
<td>File type</td>
<td>format</td>
<td>Whether to send the chart to the user as a JPEG, PNG, or SWF file.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The SWF file is the default format.</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>chartWidth chartHeight</td>
<td>The width and height, in pixels, of the chart. This size defines the entire chart area, including the legend and background area around the chart.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The default height is 240 pixels; the default width is 320 pixels.</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>foregroundColor dataBackgroundColor backgroundColor</td>
<td>The colors used for foreground and background objects. The default foreground color is black; the default background colors are white. You can specify 16 color names, use any valid HTML color format, or specify an 8-digit hexadecimal value to specify the RGB value and transparency. If you use numeric format, you must use double number signs; for example, blue or #FF33CC. To specify the color and transparency, use the format #xxFF33CC, where xx indicates the transparency. Opaque is indicated by the value FF; transparent is indicated by the value 00. For the complete list of colors, see Configuring and Administering ColdFusion.</td>
<td>All</td>
</tr>
<tr>
<td>Labels</td>
<td>font fontSize fontBold fontItalic labelFormat xAxisTitle yAxisTitle</td>
<td>The font attribute specifies the font for all text. The default value is Arial. If you are using a double-byte character set on UNIX, or using a double-byte character set in Windows with a file type of Flash, you must specify ArialUnicodeMs as the font. <strong>Note:</strong> If a chart attempts to use a font that is not installed on the ColdFusion server, it uses a different font that is available. Also, if you do not specify the font, characters that are not ASCII, such as Japanese, Chinese, Korean and so on, may not display properly. The fontSize specifies an integer font size used for all text. The default value is 11. The fontBold attribute specifies to display all text as bold. The default value is no. The fontItalic attribute specifies to display all text as italic. The default value is no. The labelFormat attribute specifies the format of the y-axis labels, number, currency, percent, or date. The default value is number. The xAxisTitle and yAxisTitle attributes specify the title for each axis.</td>
<td>All</td>
</tr>
<tr>
<td>Border</td>
<td>showBorder</td>
<td>Use the showBorder attribute to draw a border around the chart. The border color is specified by the foregroundColor attribute. The default value is no.</td>
<td>All</td>
</tr>
<tr>
<td>Chart characteristic</td>
<td>Attributes used</td>
<td>Description</td>
<td>Chart type</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------</td>
<td>-------------</td>
<td>------------</td>
</tr>
</tbody>
</table>
| Grid lines           | showXGridlines | Use the showXGridlines and showYGridlines attributes to display x-axis and y-axis grid lines. The default value no for x-axis gridlines, and yes for y-axis gridlines. The gridLines attribute specifies the total number of grid lines on the value axis, including the axis itself. The value of each grid line appears along the value axis. The cfchart tag displays horizontal grid lines only. The default value is 0, which means no grid lines. | Area
Bar
Cone
Curve
Cylinder
Horizontalbar
Line
Pyramid
Scatter
Step |
|                      | showYGridlines |                         |            |
|                      | gridLines     |                         |            |
| Slice style          | pieSliceStyle | Displays the pie chart as solid or sliced. The default value is sliced. | Pie |
| Markers              | showMarkers   | The showMarkers attribute displays markers at the data points for two dimensional line, curve, and scatter charts. The default value is yes. The markerSize attribute specifies an integer number of pixels for the marker size. ColdFusion determines the default value. | All |
|                      | markerSize    |                         |            |
| Value axis           | scaleFrom     | The minimum and maximum points on the data axis. By default, the minimum is 0 or the lowest negative chart data value, and the maximum is the largest data value. Note: If you specify a scaleFrom or scaleTo attribute that would result in cropping the chart, cfchart uses a value that shows the entire chart without cropping. | Area
Bar
Cone
Curve
Cylinder
Horizontalbar
Line
Pyramid
Scatter
Step |
|                      | scaleTo       |                         |            |
| Axis type            | XAxisType     | Whether the x-axis corresponds to a numeric scale or identifies different categories, and how to sort the items on the axis. If the XAxisType attribute value is scale, the x-axis is numeric. All cfchartData item attribute values must be numeric, and the axis is automatically sorted numerically. The scale value lets you create graphs of numeric relationships, such as population against age. If the attribute value is category (the default), the axis indicates the data category. The sortXAxis attribute determines the order of items when you specify the cfchartData item attribute, whose values are treated as text. By default, the items are displayed in the order in which they are entered in the first chart series. | Area
Bar
Cone
Curve
Cylinder
Horizontalbar
Line
Pyramid
Scatter
Step |
|                      | sortXAxis     |                         |            |
You can also use the `cfchartseries` tag to specify attributes of chart appearance. The following table describes these attributes:

<table>
<thead>
<tr>
<th>Chart characteristic</th>
<th>Attributes used</th>
<th>Description</th>
<th>Chart type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3D appearance</strong></td>
<td>show3D</td>
<td>The <code>show3D</code> attribute displays the chart in three dimensions. The default value is <code>no</code>. The <code>xOffset</code> and <code>yOffset</code> attributes specify the amount to which the chart should be rotated on a horizontal axis (<code>xOffset</code>) or vertical axis (<code>yOffset</code>). The value 0 is flat (no rotation), -1 and 1 are for a full 90 degree rotation left (-1) or right (1). The default value is 1.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>xAxis</td>
<td>Specifies the direction in which the chart will be rotated (left or right). The default value is <code>left</code>.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>yAxis</td>
<td>Specifies the direction in which the chart will be rotated (up or down). The default value is <code>up</code>.</td>
<td>All</td>
</tr>
<tr>
<td><strong>Multiple series</strong></td>
<td>showLegend</td>
<td>The <code>showLegend</code> attribute lets you display the chart's legend when the chart contains more than one series of data. The default value is <code>Yes</code>.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>seriesPlacement</td>
<td>The <code>seriesPlacement</code> attribute specifies the location of each series relative to the others. By default, ColdFusion determines the best placement based on the graph type of each series.</td>
<td>All</td>
</tr>
<tr>
<td><strong>Tips</strong></td>
<td>tipStyle</td>
<td>The <code>tipStyle</code> attribute lets you display a small pop-up window that shows information about the chart element pointed to by the mouse pointer. Options are <code>none</code>, <code>mousedown</code>, or <code>mouseover</code>. The default value is <code>mouseover</code>.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>tipBGColor</td>
<td>The <code>tipBGColor</code> attribute specifies the background color of the tip window for Flash format only. The default value is <code>white</code>.</td>
<td>All</td>
</tr>
</tbody>
</table>

You can also use the `cfchartseries` tag to specify attributes of chart appearance. The following table describes these attributes:

<table>
<thead>
<tr>
<th>Chart characteristic</th>
<th>Attributes used</th>
<th>Description</th>
<th>Chart type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple series</strong></td>
<td>seriesLabel</td>
<td>The <code>seriesLabel</code> attribute specifies the text that displays for the series label.</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>seriesColor</td>
<td>The <code>seriesColor</code> attribute specifies a single color of the bar, line, pyramid, and so on. For pie charts, this is the first slice's color. Subsequent slices are automatically colored based on the specified initial color, or use the colorList attribute.</td>
<td>All</td>
</tr>
<tr>
<td><strong>Paint</strong></td>
<td>paintStyle</td>
<td>Specifies the way color is applied to a data series. You can specify solid color, buttonized look, linear gradient fill with a light center and darker outer edge, and gradient fill on lighter version of color. The default value is <code>solid</code>.</td>
<td>All</td>
</tr>
</tbody>
</table>
Creating your own chart styles

You can create your own chart styles by doing either of the following:

- Modifying the chart style XML files
- Using WebCharts3D to create chart styles

Modifying the chart style XML files

You can modify the chart styles included with ColdFusion to create your own chart styles. The files that contain the style information are XML files located in the cf_root/charting/styles directory. You should only modify attributes specified in the file. To specify additional attributes, follow the instructions in the section "Using WebCharts3D to create chart styles" on page 798.

Note: There are two XML files for each default chart style. For example, the beige style for pie charts is defined in the beige_pie.xml file; the beige style for all other types of charts is defined in the beige.xml file.

1. Open the XML file that you want to modify, for example beige.xml.
2. Modify the file contents.
3. Save the file with a different name; for example myBeige.xml.

Using WebCharts3D to create chart styles

Starting with ColdFusion MX 7, ColdFusion includes the WebCharts3D utility, which you can use to create chart style files.

1. Start WebCharts3D by double-clicking the webcharts.bat file in the CFusion/charting directory.
2. (Optional) Open an existing chart.
3. Make the changes you want to the chart’s appearance.

Note: To use the chart style file in the cfchart tag, you can only make the modifications indicated in the table that follows this procedure.
4 Click the XML style tab.
5 Click the Save button in the bottom right corner.
6 Specify the name of the file; for example, mystyle.xml.
7 Specify the directory in which you want to save the chart style file.

   **Note:** ColdFusion uses the same rules to look for the chart style XML files as it does for files included using the `cfinclude` tag. For more information, see `cfinclude`.

8 Click Save.

The following table lists the attributes of the `cfchart` and `cfchartseries` tags and the associated WebCharts3D commands:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>WebCharts3D command</th>
</tr>
</thead>
<tbody>
<tr>
<td>chartHeight</td>
<td>Drag the chart by handles.</td>
</tr>
<tr>
<td>chartWidth</td>
<td>Drag the chart by handles.</td>
</tr>
<tr>
<td>dataBackgroundColor</td>
<td>Background: minColor (type must be PlainColor)</td>
</tr>
<tr>
<td>font</td>
<td>font: Family (specify only supported fonts)</td>
</tr>
<tr>
<td>fontBold</td>
<td>font: check Bold</td>
</tr>
<tr>
<td>fontItalic</td>
<td>font: check Italic</td>
</tr>
<tr>
<td>fontSize</td>
<td>font: Size</td>
</tr>
<tr>
<td>foregroundColor</td>
<td>foreground</td>
</tr>
<tr>
<td>gridlines</td>
<td>XAxis: labelcount</td>
</tr>
<tr>
<td>labelFormat</td>
<td>YAxis: LabelFormat: Number</td>
</tr>
<tr>
<td>markerSize</td>
<td>Elements: markerSize</td>
</tr>
<tr>
<td>pieSliceStyle</td>
<td>style: solid</td>
</tr>
<tr>
<td>rotated</td>
<td>Type Frame chart: Elements: Shape:</td>
</tr>
<tr>
<td>scaleFrom</td>
<td>YAxis: isAbsolute; scaleMin(int)</td>
</tr>
<tr>
<td>scaleTo</td>
<td>YAxis: isAbsolute; scaleMax(int)</td>
</tr>
<tr>
<td>seriesPlacement</td>
<td>Elements: place</td>
</tr>
<tr>
<td>show3D</td>
<td>is3D</td>
</tr>
<tr>
<td>showBorder</td>
<td>Decoration: style (none or simple)?</td>
</tr>
<tr>
<td>showLegend</td>
<td>Legend: isVisible</td>
</tr>
<tr>
<td>showMarkers</td>
<td>Elements: showMarkers</td>
</tr>
<tr>
<td>showXGridlines</td>
<td>Frame: isVGridVisible</td>
</tr>
<tr>
<td>showYGridlines</td>
<td>Frame: isHGridVisible</td>
</tr>
<tr>
<td>tipbgColor</td>
<td>Popup: background</td>
</tr>
<tr>
<td>tipStyle</td>
<td>Popup: showOn: MouseOver</td>
</tr>
<tr>
<td>url</td>
<td>Elements: action</td>
</tr>
</tbody>
</table>
Creating charts: examples

Creating a bar chart

The example in the following procedure adds a title to the bar chart, specifies that the chart is three dimensional, adds grid lines, sets the minimum and maximum y-axis values, and uses a custom set of colors.

1. Open the chartdata.cfm file in your editor.
2. Edit the cfchart tag so that it appears as follows:

```cfml
<!--- Bar chart, from Query of Queries --->
<cfchart scaleFrom=40000 scaleTo=100000 font="arial" fontSize=16 gridLines=4 show3D="yes" foregroundcolor="#000066" databackgroundcolor="#FFFFCC" chartwidth="450"

<cfchartseries type="bar" query="DeptSalaries"
```
valueColumn="AvgByDept"
itemColumn="Dept_Name"
seriescolor="#33CC99"
paintstyle="shade"

</cfchart>

3 Save the file as chartdatastyle1.cfm.
4 View the chartdatastyle1.cfm page in your browser.

Reviewing the code
The following table describes the code in the preceding example.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>scaleFrom=40000</td>
<td>Set the minimum value of the vertical axis to 40000.</td>
</tr>
<tr>
<td>scaleTo=100000</td>
<td>Set the maximum value of the vertical axis to 100000. The minimum value is the default, 0.</td>
</tr>
<tr>
<td>font=&quot;arial&quot;</td>
<td>Displays text using the Arial font.</td>
</tr>
<tr>
<td>fontSize=16</td>
<td>Makes the point size of the labels 16 points.</td>
</tr>
<tr>
<td>gridLines = 4</td>
<td>Displays four grid lines between the top and bottom of the chart.</td>
</tr>
<tr>
<td>show3D = &quot;yes&quot;</td>
<td>Shows the chart in 3D.</td>
</tr>
<tr>
<td>foregroundcolor=&quot;#000066&quot;</td>
<td>Sets the color of the text, gridlines, and labels.</td>
</tr>
<tr>
<td>databackgroundColor=&quot;#FFFFCC&quot;</td>
<td>Sets the color of the background behind the bars.</td>
</tr>
<tr>
<td>seriescolor=&quot;#33CC99&quot;</td>
<td>Sets the color of the bars.</td>
</tr>
<tr>
<td>paintstyle=&quot;shade&quot;</td>
<td>Sets the paint display style.</td>
</tr>
</tbody>
</table>

Creating a pie chart
The example in the following procedure adds a pie chart to the page.

1 Open the chartdata.cfm file in your editor.
2 Edit the DeptSalaries query and the cfloop code so that it appears as follows:

```cfml
<!--- A query to get statistical data for each department. --->
<cfquery dbtype = "query" name = "DeptSalaries">
    SELECT
        Dept_Name,
        SUM(Salary) AS SumByDept,
        AVG(Salary) AS AvgByDept
    FROM GetSalaries
    GROUP BY Dept_Name
</cfquery>

<!--- Reformat the generated numbers to show only thousands. --->
<cfloop index="i" from="1" to="#DeptSalaries.RecordCount#">
    <cfset DeptSalaries.SumByDept[i]=Round(DeptSalaries.SumByDept[i]/1000)*1000>
    <cfset DeptSalaries.AvgByDept[i]=Round(DeptSalaries.AvgByDept[i]/1000)*1000>
</cfloop>
```
3 Add the following cfchart tag:

```html
<!--- Pie chart, from DeptSalaries Query of Queries. --->
<cfchart
  tipStyle="mousedown"
  font="Times"
  fontsize=14
  fontBold="yes"
  backgroundColor="#CCFFFF"
  show3D="yes"
>
  <cfchartseries
    type="pie"
    query="DeptSalaries"
    valueColumn="SumByDept"
    itemColumn="Dept_Name"
    colorlist="#6666FF,#66FF66,#FF6666,#66CCCC"
  />
</cfchart>
<br>
```

4 Save the file as chartdatapie1.cfm.

5 View the chartdatapie1.cfm page in your browser:

### Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUM(Salary) AS SumByDept,</td>
<td>In the DeptSalaries query, add a SUM aggregation function to get the sum of all salaries per department.</td>
</tr>
<tr>
<td>&lt;cfset DeptSalaries.SumByDept[i]=Round(DeptSalaries.SumByDept[i]/1000)*1000&gt;</td>
<td>In the cfloop tag, round the salary sums to the nearest thousand.</td>
</tr>
</tbody>
</table>
| <cfchart
  tipStyle="mousedown"
  font="Times"
  fontBold="yes"
  backgroundColor="#CCFFFF"
  show3D="yes"
>
  <cfchartseries
    type="pie"
    query="DeptSalaries"
    valueColumn="SumByDept"
    itemColumn="Dept_Name"
    colorlist="#6666FF,#66FF66,#FF6666,#66CCCC"
  />
</cfchart> | Show a tip only when a user clicks on the chart, display text in Times bold font, set the background color to light blue, and display the chart in three dimensions. |
| <cfchartseries
  type="pie"
  query="DeptSalaries"
  valueColumn="SumByDept"
  itemColumn="Dept_Name"
  colorlist="#6666FF,#66FF66,#FF6666,#66CCCC" />
```

Create a pie chart using the SumByDept salary sum values from the DeptSalaries query.

- Use the contents of the Dept_Name column for the item labels displayed in the chart legend.
- Get the pie slice colors from a custom list, which uses hexadecimal color numbers. The double number signs prevent ColdFusion from trying to interpret the color data as variable names.

### Creating an area chart

The example in the following procedure adds an area chart to the salaries analysis page. The chart shows the average salary by start date to the salaries analysis page. It shows the use of a second query of queries to generate a new analysis of the raw data from the GetSalaries query. It also shows the use of additional cfchart attributes.

1 Open the chartdata.cfm file in your editor.
2 Edit the GetSalaries query so that it appears as follows:

```coldfusion
<!-- Get the raw data from the database. -->
<cfquery name="GetSalaries" datasource="cfdocexamples">
    SELECT Departmt.Dept_Name,
    Employee.StartDate,
    Employee.Salary
    FROM Departmt, Employee
    WHERE Departmt.Dept_ID = Employee.Dept_ID
</cfquery>
```

3 Add the following code before the `html` tag:

```
<!--- Convert start date to start year. --->
<!--- You must convert the date to a number for the query to work --->
<cfloop index="i" from="1" to="#GetSalaries.RecordCount#">
    <cfset GetSalaries.StartDate[i]=NumberFormat(DatePart("yyyy", GetSalaries.StartDate[i]),9999)>
</cfloop>

<!--- Query of Queries for average salary by start year. --->
<cfquery dbtype = "query" name = "HireSalaries">
    SELECT
        StartDate,
        AVG(Salary) AS AvgByStart
    FROM GetSalaries
    GROUP BY StartDate
</cfquery>

<!--- Round average salaries to thousands. --->
<cfloop index="i" from="1" to="#HireSalaries.RecordCount#">
    <cfset HireSalaries.AvgByStart[i]=Round(HireSalaries.AvgByStart[i]/1000)*1000>
</cfloop>
```

4 Add the following `cfchart` tag before the end of the `body` tag block:

```
<!--- Area-style Line chart, from HireSalaries Query of Queries. --->
<cfchart
    chartWidth=400
    BackgroundColor="#FFFF00"
    show3D="yes"
>
    <cfchartseries
        type="area"
        query="HireSalaries"
        valueColumn="AvgByStart"
        itemColumn="StartDate"
    />
</cfchart>
<br>
```

5 Save the page.

6 View the chartdata.cfm page in your browser.

**Reviewing the code**

The following table describes the code and its function:
Setting curve chart characteristics

Curves charts use the attributes already discussed. However, you should be aware that curve charts require a large amount of processing to render. For fastest performance, create them offline, write them to a file or variable, and then reference them in your application pages. For information on creating offline charts, see “Writing a chart to a variable” on page 805.

Administering charts

Use the ColdFusion Administrator to administer charts. In the Administrator, you can choose to save cached charts in memory or to disk. You can also specify the number of charts to cache, the number of charting threads, and the disk file for caching images to disk.

ColdFusion caches charts as they are created. In that way, repeated requests of the same chart load the chart from the cache rather than having ColdFusion render the chart over and over again.

**Note:** You do not have to perform any special coding to reference a cached chart. Whenever you use the `cfchart` tag, ColdFusion inspects the cache to see if the chart has already been rendered. If so, ColdFusion loads the chart from the cache.

The following table describes the settings for the ColdFusion charting and graphing engine:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Employee.StartDate,</code></td>
<td>Add the employee start date to the data in the GetSalaries query.</td>
</tr>
<tr>
<td><code>&lt;cfloop index=&quot;i&quot; from=&quot;1&quot; to=&quot;#GetSalaries.RecordCount#&quot;&gt;</code></td>
<td>Use a <code>cfloop</code> tag to extract the year of hire from each employee's hire data, and convert the result to a four-digit number.</td>
</tr>
<tr>
<td><code>&lt;/cfloop&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfquery dbtype = &quot;query&quot; name = &quot;HireSalaries&quot;&gt;</code></td>
<td>Create a second query from the GetSalaries query. This query contains the average salary for each start year.</td>
</tr>
<tr>
<td><code>SELECT StartDate, AVG(Salary) AS AvgByStart FROM GetSalaries GROUP BY StartDate</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfquery&gt;</code></td>
<td>Round the salaries to the nearest thousand.</td>
</tr>
<tr>
<td><code>&lt;cfloop index=&quot;i&quot; from=&quot;1&quot; to=&quot;#HireSalaries.RecordCount#&quot;&gt;</code></td>
<td>Create a line chart using the HireSalaries query. Chart the average salaries against the start date.</td>
</tr>
<tr>
<td><code>&lt;/cfloop&gt;</code></td>
<td>Limit the chart width to 400 pixels, show the chart in three dimensions, and set the background color to white.</td>
</tr>
<tr>
<td><code>&lt;cfchart chartWidth=400 BackgroundColor=&quot;##FFFF00&quot; show3D=&quot;yes&quot; &gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;cfchartseries type=&quot;area&quot; query=&quot;HireSalaries&quot; valueColumn=&quot;AvgByStart&quot; itemColumn=&quot;StartDate&quot;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfchartseries&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfchart&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>
Writing a chart to a variable

In some cases, your application might have charts that are static or charts that, because of the nature of the data input, take a long time to render. In this scenario, you can create a chart and write it to a variable.

Once written to a variable, other ColdFusion pages can access the variable to display the chart, or you can write the variable to disk to save the chart to a file. This lets you create or update charts only as needed, rather than every time someone requests a page that contains a chart.

You use the name attribute of the `cfchart` tag to write a chart to a variable. If you specify the name attribute, the chart is not rendered in the browser but is written to the variable.

You can save the chart as an Adobe Flash SWF file, or as a JPEG or PNG image file. If you save the image as a SWF file, you can pass the variable back to a Flash client using ColdFusion Flash Remoting. For more information, see “Using the Flash Remoting Service” on page 674.

**Note:** If you write the chart to a JPEG or PNG file, mouseover tips and URLs embedded in the chart for data drill-down do not work when you redisplay the image from the file. However, if you save the image as a SWF file, both tips and drill-down URLs work. For more information on data drill-down, see “Linking charts to URLs” on page 806.

### Write a chart to a variable and a file

1. Create a ColdFusion page with the following content:

   ```coldfusion
   <cfchart name="myChart" format="jpg">
   <cfchartseries type="pie">
   <cfchartdata item="New Vehicle Sales" value=500000>
   <cfchartdata item="Used Vehicle Sales" value=250000>
   <cfchartdata item="Leasing" value=300000>
   <cfchartdata item="Service" value=400000>
   </cfchartseries>
   </cfchart>

   <cffile action="WRITE" file="c:\inetpub\wwwroot\charts\vehicle.jpg" output="#myChart#">
   <img src="/charts/vehicle.jpg" height=240 width=320>
   </cffile>
   ```

2. Save the page as chartToFile.cfm in myapps under the web root directory.

3. View the chartToFile.cfm page in your browser.
Reviewing the code
The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfchart name=&quot;myChart&quot; format=&quot;jpg&quot;&gt;</code></td>
<td>Define a chart written to the myChart variable by using the JPEG format.</td>
</tr>
<tr>
<td><code>&lt;cfchartseries seriesLabel=&quot;Department Salaries&quot; ... /&gt;</code></td>
<td>Use the <code>cfchart</code> tag to write the chart to a file.</td>
</tr>
<tr>
<td><code>&lt;img src=&quot;/chartsvehicle.jpg&quot; height=240 width=320&gt;</code></td>
<td>Use the HTML <code>img</code> tag to display the chart.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfchart</code></td>
<td>Use the following variables in the <code>url</code> attribute to pass additional information to the target page:</td>
</tr>
<tr>
<td><code>name=&quot;myChart&quot;</code></td>
<td>• <code>$VALUES$</code>: The value of the selected item, or an empty string</td>
</tr>
<tr>
<td><code>yAxisTitle=&quot;Salary Average&quot;</code></td>
<td>• <code>$ITEMLABELS$</code>: The label of the selected item, or an empty string</td>
</tr>
<tr>
<td><code>url=&quot;moreinfo.cfm&quot;</code></td>
<td>• <code>$SERIESLABELS$</code>: The label of the selected series, or an empty string</td>
</tr>
<tr>
<td><code>&gt;</code></td>
<td>For example, to let users click on the graph to open the page moreinfo.cfm, and pass all three values to the page, you use the following <code>url</code>:</td>
</tr>
<tr>
<td><code>&lt;cffile action=&quot;WRITE&quot; file=&quot;c:\inetpub\wwwroot\charts\vehicle.jpg&quot; output=&quot;#myChart#&quot;&gt;</code></td>
<td><code>url=&quot;moreinfo.cfm?Series=$SERIESLABELS$&amp;Item=$ITEMLABELS$&amp;Value=$VALUES$&quot;</code></td>
</tr>
<tr>
<td><code>&lt;/cfchart&gt;</code></td>
<td>The variables are not enclosed in number signs like ordinary ColdFusion variables. They are enclosed in dollar signs.</td>
</tr>
<tr>
<td><code>http://localhost:8500/tests/charts/moreinfo.cfm?Series=Department%20Salaries&amp;Item=Training&amp;Value=86000</code></td>
<td>If you click on a chart that uses this <code>url</code> attribute value, it could generate a URL in the following form:</td>
</tr>
</tbody>
</table>

Linking charts to URLs
ColdFusion provides a data drill-down capability with charts. This means that you can click the data and the legend areas of a chart to request a URL. For example, if you have a pie chart and want a user to be able to select a pie wedge for more information, you can build that functionality into your chart.

You use the `url` attribute of the `cfchart` tag to specify the URL to open when a user clicks anywhere on the chart. For example, the following code defines a chart that opens the page moreinfo.cfm when a user clicks on the chart:

```cfc
<cfchart>
   xAxisTitle="Department"
   yAxisTitle="Salary Average"
   url="moreinfo.cfm"
>
   <cfchartseries
      seriesLabel="Department Salaries"
      ...
   />
</cfchart>
```

You can use the following variables in the `url` attribute to pass additional information to the target page:

- `$VALUES$`: The value of the selected item, or an empty string
- `$ITEMLABELS$`: The label of the selected item, or an empty string
- `$SERIESLABELS$`: The label of the selected series, or an empty string

For example, to let users click on the graph to open the page moreinfo.cfm, and pass all three values to the page, you use the following `url`:

```
url="moreinfo.cfm?Series=$SERIESLABELS$&Item=$ITEMLABELS$&Value=$VALUES$"
```

The variables are not enclosed in number signs like ordinary ColdFusion variables. They are enclosed in dollar signs. If you click on a chart that uses this `url` attribute value, it could generate a URL in the following form:

```
http://localhost:8500/tests/charts/moreinfo.cfm?
   Series=Department%20Salaries&Item=Training&Value=86000
```
You can also use JavaScript in the URL to execute client-side scripts. For an example, see “Linking to JavaScript from a pie chart” on page 809.

**Dynamically linking from a pie chart**

In the following example, when you click a pie wedge, ColdFusion displays a table that contains the detailed salary information for the department represented by the wedge. The example is divided into two parts: creating the detail page and making the pie chart dynamic.

**Part 1: Creating the detail page**

This page displays salary information for the department you selected when you click on a wedge of the pie chart. The department name is passed to this page using the `$ITEMLABEL$` variable.

1. Create an application page with the following content:

   ```
   <cfquery name="GetSalaryDetails" datasource="cfdocexamples">
     SELECT Departmt.Dept_Name,
            Employee.FirstName,
            Employee.LastName,
            Employee.StartDate,
            Employee.Salary,
            Employee.Contract
     FROM Departmt, Employee
     WHERE Departmt.Dept_Name = '#URL.Item#'
     AND Departmt.Dept_ID = Employee.Dept_ID
     ORDER BY Employee.LastName, Employee.Firstname
   </cfquery>
   
   <html>
   <head>
     <title>Employee Salary Details</title>
   </head>
   <body>
   <h1><cfoutput>#GetSalaryDetails.Dept_Name[1]# Department Salary Details</cfoutput></h1>
   <table border cellspacing=0 cellpadding=5>
     <tr>
       <th>Employee Name</th>
       <th>StartDate</th>
       <th>Salary</th>
       <th>Contract?</th>
     </tr>
     <cfoutput query="GetSalaryDetails">
     <tr>
       <td>#FirstName# #LastName#</td>
       <td>#dateFormat(StartDate, "mm/dd/yyyy")#</td>
       <td>#numberFormat(Salary, ",999,999")#</td>
       <td>#Contract#</td>
     </tr>
     </cfoutput>
   </table>
   </body>
   </html>
   ``

2. Save the page as Salary_details.cfm in the myapps directory under the web root directory.
Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfquery name=&quot;GetSalaryDetails&quot; datasource=&quot;cfdocexamples&quot;&gt; SELECT Departmt.Dept_Name, Employee.FirstName, Employee.LastName, Employee.StartDate, Employee.Salary, Employee.Contract FROM Departmt, Employee WHERE Departmt.Dept_Name = '#URL.Item#' AND Departmt.Dept_ID = Employee.Dept_ID ORDER BY Employee.LastName, Employee.FirstName &lt;/cfquery&gt;</code></td>
<td>Get the salary data for the department whose name was passed in the URL parameter string. Sort the data by the employee's last and first names.</td>
</tr>
<tr>
<td><code>&lt;table border cellspacing=0 cellpadding=5&gt;</code> <code>&lt;tr&gt; &lt;th&gt;Employee Name&lt;/th&gt; &lt;th&gt;StartDate&lt;/th&gt; &lt;th&gt;Salary&lt;/th&gt; &lt;th&gt;Contract?&lt;/th&gt; &lt;/tr&gt;</code> <code>&lt;cfoutput query=&quot;GetSalaryDetails&quot;&gt; &lt;tr&gt; &lt;td&gt;#FirstName# #LastName#&lt;/td&gt; &lt;td&gt;#dateFormat(StartDate, &quot;mm/dd/yyyy&quot;)#&lt;/td&gt; &lt;td&gt;#numberFormat(Salary, &quot;,999,999&quot;)#&lt;/td&gt; &lt;td&gt;#Contract#&lt;/td&gt; &lt;/tr&gt; &lt;/cfoutput&gt;</code></td>
<td>Display the data retrieved by the query as a table. Format the start date into standard month/date/year format, and format the salary with a leading dollar sign, comma separator, and no decimal places.</td>
</tr>
</tbody>
</table>

Part 2: Making the chart dynamic

1. Open chartdata.cfm in your editor.
2. Edit the `cfchart` tag for the pie chart so it appears as follows:
   ```html
   <cfchart
      font="Times"
      fontBold="yes"
      backgroundColor="#CCFFFF"
      show3D="yes"
      url="Salary_Details.cfm?Item=$ITEMLABEL$"
   >
   <cfchartseries
      type="pie"
      query="DeptSalaries"
      valueColumn="AvgByDept"
      itemColumn="Dept_Name"
      colorlist="#990066,##660099,##006699,##069666"
   />
   </cfchart>
   ```
3. Save the file as chartdetail.cfm.
4. View the chartdata.cfm page in your browser.
5. Click the slices of the pie chart to request the Salary_details.cfm page and pass in the department name of the wedge you clicked. The salary information for that department appears.
Reviewing the code
The following table describes the highlighted code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>url = &quot;Salary_Details.cfm?Item=$ITEMLABEL$&quot;</td>
<td>When the user clicks a wedge of the pie chart, call the Salary_details.cfm page in the current directory, and pass it the parameter named Item that contains the department name of the selected wedge.</td>
</tr>
</tbody>
</table>

Linking to JavaScript from a pie chart
In the following example, when you click a pie wedge, ColdFusion uses JavaScript to display a pop-up window about the wedge.

Create a dynamic chart with JavaScript:
1. Create an application page with the following content:

   ```
   <script>
   function Chart_OnClick(theSeries, theItem, theValue){
     alert("Series: " + theSeries + ", Item: " + theItem + ", Value: " + theValue);
   }
   </script>
   
   <cfchart
      xAxisTitle="Department"
      yAxisTitle="Salary Average"
      tipstyle=none
      url="javascript:Chart_OnClick('"$SERIESLABEL$','"$ITEMLABEL$','"$VALUE$');"
    >
    <cfchartseries type="bar" seriesLabel="Average Salaries by Department">
      <cfchartData item="Finance" value="75000"></cfchartData>
      <cfchartData item="Sales" value="120000"></cfchartData>
      <cfchartData item="IT" value="83000"></cfchartData>
      <cfchartData item="Facilities" value="45000"></cfchartData>
    </cfchartseries>
  </cfchart>

2. Save the page as chartdata_withJS.cfm in the myapps directory under the web root directory.

3. View the chartdata_withJS.cfm page in your browser:

4. Click the slices of the pie chart to display the pop-up window.
Chapter 44: Creating Reports and Documents for Printing

You can use Adobe ColdFusion tags, functions, and tools to create pages and reports that are suitable for printing.

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Creating PDF and FlashPaper output with the cfdocument tag ................................................................. 811
Creating reports with Crystal Reports (Windows only) ................................................................. 816

About printable output

Although all web browsers let you print HTML pages, HTML-format pages are not optimized for printed output. For example, lack of control over line breaks, page breaks, headers, footers, and page numbers are just a few of the problems that you encounter when designing reports and other pages meant to be printed.

In the context of ColdFusion, the term printable output refers to pages that include the following features:

• Page numbers
• Headers and footers
• Page breaks
• Clickable hyperlinks when viewed online

ColdFusion provides the following tags for generating printable output:

• cfdocument: Creates printable output and returns it to the browser or saves it in a file. For more information, see “Creating PDF and FlashPaper output with the cfdocument tag” on page 811.

• cfreport: Invokes the specified report definition to create printable output and return it to the browser or save it in a file. ColdFusion supports report definitions from the following tools:
  • ColdFusion Report Builder: The ColdFusion Report Builder is a banded report writer that is integrated with ColdFusion. For more information, see “About Report Builder” on page 818.
  • Crystal Reports: Crystal Reports is a report writer whose report definitions you can use with the cfreport tag. For more information, see “Creating reports with Crystal Reports (Windows only)” on page 816.

ColdFusion printable reports are available in the following formats:

FlashPaper: ColdFusion creates a SWF file. Clients must have an up-to-date version of Adobe Flash Player installed.

Adobe Acrobat: ColdFusion creates a PDF file. Clients must have the Adobe Reader installed.

Microsoft Excel (ColdFusion reporting only): ColdFusion creates an Excel spreadsheet.

Note: The Excel report output format type provides limited support for the formatting options available in ColdFusion reporting. Images and charts are not supported and numeric data containing formatting (commas, percents, currency, etc.) appears as plain text in Excel. The Excel output format supports simple reports only and it is recommended that careful design and layout consideration be given to reports designed for Excel output.
Crystal Reports (Windows only): ColdFusion passes control to Crystal Reports, which creates HTML. This option is available with the `<cfreport>` tag only.

Creating PDF and FlashPaper output with the `<cfdocument>` tag

The `<cfdocument>` tag converts everything between its start and end tags into PDF or FlashPaper output format and returns it to the browser or saves it to a file. This lets you easily convert HTML to printable output, as the following example shows:

```cfdocument format="FlashPaper">
<p>This is a document rendered by the `<cfdocument>` tag.</p>
</cfdocument>
```

The `<cfdocument>` tag supports all HTML and CFML tags, with the following exceptions:

- `<cfchart>`
- Flash content
- Interactive tags, such as `<form>`, `<cfform>`, and `<cfapplet>`
- JavaScript that dynamically modifies elements or element positions

Additionally, the HTML wrapped by the `<cfdocument>` tag must be well-formed, with end tags for every start tag and proper nesting of block-level elements.

**Note:** ColdFusion does not return HTML and CFML outside of the `<cfdocument>` pair.

Creating basic reports from HTML and CFML

You can convert HTML-based reports into PDF or FlashPaper output by wrapping the HTML in the `<cfdocument>` start and end tags, and specifying `<cfdocument>` attributes, as appropriate, to customize the following items:

- Page size
- Page orientation
- Margins
- Encryption (PDF only)
- User password and owner password (PDF only)
- Permissions (PDF only)

For complete information on these options, see the `<cfdocument>` tag discussion in the CFML Reference.

**Note:** Embedding fonts in the report can help ensure consistent display across multiple browsers and platforms. For more information on the considerations related to embedding fonts, see “Creating a simple report” on page 840.

The following example displays a list of employees, using a `<cfoutput>` tag to loop through the query:

```cfdocument format="flashpaper">
<h1>Employee List</h1>
<!--- Inline query used for example purposes only. --->
<cfquery name="EmpList" datasource="cfdocexamples">
  SELECT FirstName, LastName, Salary, Contract FROM Employee
</cfquery>
```
Creating sections, headers, and footers

You can use the `cfdocument` and `cfdocumentsection` tags to fine-tune your printable output, as follows:

- `cfdocumentitem`: Creates page breaks, headers, or footers.
- `cfdocumentsection`: Divides output into sections, optionally specifying custom margins. Within a section, use the `cfdocumentitem` tag to specify unique headers and footers for each section. Each document section starts on a new page.

The `cfdocumentitem` tag

You use one or more `cfdocumentitem` tags to specify headers and footers or to create a page break. You can use `cfdocumentitem` tags with or without the `cfdocumentsection` tag, as follows:

- With `cfdocumentsection`: The `cfdocumentitem` attribute applies only to the section, and overrides previously specified headers and footers.
- Without `cfdocumentsection`: The `cfdocumentitem` attribute applies to the entire document, as follows:
  - If the tag is at the top of the document, it applies to the entire document.
  - If the tag is in the middle of the document, it applies to the rest of the document.
  - If the tag is at the end of the document, it has no affect.

You can use the `cfdocumentitem` tag to create a running header for an entire document, as the following example shows:

```coldfusion
<cfdocument format="PDF">
  <!--- Running header --->
  <cfdocumentitem type="header">
    <font size="-3"><i>Directory Report</i></font>
  </cfdocumentitem>
  <h3>cfdirectory Example</h3>
  <!--- Use cfdirectory to display directories by name and size --->
  <cfdirectory
directory="#GetDirectoryFromPath(GetTemplatePath())#"
  name="myDirectory" recurse="yes"
  sort="directory ASC, name ASC, size DESC">
    <!--- Output the contents of the cfdirectory as a cftable ----->
    <cftable query="myDirectory"
      htmltable colheaders>
      <cfcol header="DIRECTORY:" text="#directory#">
      <cfcol header="NAME:" text="#Name#">
      <cfcol header="SIZE:" text="#Size#">
    </cftable>
  </cfdirectory>
</cfdocument>
```

The `cfdocumentsection` tag

When using `cfdocumentsection`, all text in the document must be enclosed within `cfdocumentsection` tags. ColdFusion ignores HTML and CFML outside of `cfdocumentsection` tags. The margin attributes override margins specified in previous sections or in the parent `cfdocument` tag. If you specify margin attributes, the units are controlled by the unit attribute of the parent `cfdocument` tag; the default for the unit attribute is inches.
Within a section, use the `cfdocumentitem` tag to specify unique headers and footers for each section and a page break before each section, as the following example shows:

```cfm
<cfquery datasource="cfdocexamples" name="empSalary">
SELECT Emp_ID, firstname, lastname, e.dept_id, salary, d.dept_name
FROM employee e, departmt d
WHERE e.dept_id = d.dept_id
ORDER BY d.dept_name
</cfquery>

<cfdocument format="PDF">
<cfoutput query="empSalary" group="dept_id">
  <cfdocumentsection>
    <cfdocumentitem type="header">
      <font size="-3"><i>Salary Report</i></font>
    </cfdocumentitem>
    <cfdocumentitem type="footer">
      <font size="-3">Page #cfdocument.currentpagenumber#</font>
    </cfdocumentitem>
    <h2>#dept_name#</h2>
    <table width="95%" border="2" cellspacing="2" cellpadding="2">
      <tr>
        <th>Employee</th>
        <th>Salary</th>
      </tr>
      <cfset deptTotal = 0 >
      <!--- inner cfoutput --->
      <cfoutput>
        <tr>
          <td><font size="-1">#empSalary.lastname#, #empSalary.firstname#</font></td>
          <td align="right"><font size="-1">#DollarFormat(empSalary.salary)#</font></td>
        </tr>
        <cfset deptTotal = deptTotal + empSalary.salary>
      </cfoutput>
      <tr>
        <td align="right"><font size="-1">Total</font></td>
        <td align="right"><font size="-1">#DollarFormat(deptTotal)#</font></td>
      </tr>
      <cfset deptTotal = 0>
      </table>
  </cfdocumentsection>
</cfoutput>
</cfdocument>
```

### Using the cfdocument scope

When you use the `cfdocument` tag, ColdFusion creates a new scope named `cfdocument`. This scope contains the following variables:

- **currentpagenumber**: Displays the current page number.
- **totalpagecount**: Displays the total page count.
- **currentsectionpagenumber**: Displays the current section number.
- **totalsectionpagecount**: Displays the total number of sections.
Note: You can use the cfdocument scope variables in expressions within the cfdocumentitem tag only.

You typically use these variables in a header or footer to display the current page number and total number or pages, as the following example shows:

```cfdocumentitem type= "footer"> #cfdocument.currentpagenumber# of 
#cfdocument.totalpagecount#</cfdocumentitem>
```

Creating bookmarks in PDF files

You can use the cfdocument bookmark attribute to create bookmarks for each section within a PDF document, as the following example shows:

```<cfdocument format="PDF" bookmark="yes">
  <cfdocumentitem type="header">
    <font size="-1" align="center"><i>Building Better Applications</i></font>
  </cfdocumentitem>
  <cfdocumentitem type="footer">
    <font size="-1"><i>Page <cfoutput>#cfdocument.currentpagenumber# of 
#cfdocument.totalpagecount#</cfoutput></i></font>
  </cfdocumentitem>
  <cfdocumentsection name="Introduction">
    <h3>Introduction</h3>
    <p>The introduction goes here.</p>
  </cfdocumentsection>
  <cfdocumentsection name="Chapter 1">
    <h3>Chapter 1: Getting Started</h3>
    <p>Chapter 1 goes here.</p>
  </cfdocumentsection>
  <cfdocumentsection name="Chapter 2">
    <h3>Chapter 2: Building Applications</h3>
    <p>Chapter 2 goes here.</p>
  </cfdocumentsection>
  <cfdocumentsection name="Conclusion">
    <h3>Conclusion</h3>
    <p>The conclusion goes here.</p>
  </cfdocumentsection>
</cfdocument>`

The bookmarks appear in the bookmarks panel of the PDF document.

Using cfhttp to display web pages

You can use the cfhttp tag in combination with the cfdocument tag to display entire web pages in PDF or FlashPaper output format, as the following example shows:

```<!--- You can pass a URL in the URL string --->
<cfparam name="url.target_url" default="http://www.boston.com">
<cfoutput>
<cfhttp url="#url.target_url#" resolveurl="yes">
  <cfdocument format="FlashPaper">
    <cfdocumentitem type="header">
      <cfoutput>#url.target_url#</cfoutput>
    </cfdocumentitem>
    <cfdocumentitem>
      <cfoutput>#cfdocument.currentpagenumber# / #cfdocument.totalpagecount#</cfoutput>
    </cfdocumentitem>
    <cfdocumentitem type="footer">
      <cfoutput>#cfdocument.currentpagenumber# / #cfdocument.totalpagecount#</cfoutput>
    </cfdocumentitem>
  </cfdocument>
</cfoutput>
```

```<!---- Display the page --->
  #cfhttp.filecontent#```
Using advanced PDF options

The `<cfdocument>` tag supports the Acrobat security options, as the following table shows:

<table>
<thead>
<tr>
<th>Security option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encryption</td>
<td>Use the <code>encryption</code> attribute to specify whether PDF output is encrypted. Specify one of the following: • 128-bit • 40-bit • none</td>
</tr>
<tr>
<td>User password</td>
<td>Use the <code>userpassword</code> attribute to specify a password that users must enter to view the document.</td>
</tr>
<tr>
<td>Owner password</td>
<td>Use the <code>ownerpassword</code> attribute to specify a password that users must enter to view and optionally modify the document.</td>
</tr>
</tbody>
</table>

Additionally, the `<cfdocument>` tag supports the following Acrobat security permissions through the `permissions` attribute. Specify one or more of the following values; separate multiple permissions with a comma:

<table>
<thead>
<tr>
<th>Permission</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing</td>
<td>Specify the <code>AllowPrinting</code> attribute to enable viewers to print the document.</td>
</tr>
<tr>
<td>Modification</td>
<td>Specify the <code>AllowModifyContents</code> attribute to let viewers modify the document, assuming they have the required software.</td>
</tr>
<tr>
<td>Copy</td>
<td>Specify the <code>AllowCopy</code> attribute to let viewers select and copy text from the document.</td>
</tr>
<tr>
<td>Annotation</td>
<td>Specify <code>AllowModifyAnnotations</code> to let viewers add comments to the document. If users add annotations, they must save the PDF after making changes.</td>
</tr>
<tr>
<td>Screen readers</td>
<td>Specify <code>AllowScreenReaders</code> to enable access to the document through a screen reader.</td>
</tr>
<tr>
<td>Fill in</td>
<td>Specify <code>AllowFillIn</code> to enable users to use form fields.</td>
</tr>
<tr>
<td>Assembly</td>
<td>Specify <code>AllowAssembly</code> to enable users to create bookmarks and thumbnails, as well as insert, delete, and rotate pages.</td>
</tr>
<tr>
<td>Degraded printing</td>
<td>Specify <code>AllowDegradedPrinting</code> to enable low-resolution printing. Low resolution printing prints each page as a bitmap, so printing may be slower.</td>
</tr>
</tbody>
</table>

**Note:** The defaults for these options vary, based on encryption level. These options apply to PDF only. For more information, see the `<cfdocument>` discussion in the CFML Reference.

The following example creates a PDF document that allows copying only:

```html
<cfdocument format="PDF" encryption="40-bit"
    ownerpassword="us3rpa$$w0rd" userpassword="us3rpa$$w0rd"
    permissions="AllowCopy" >
<cfquery name="EmpList" datasource="cfdocexamples">
    SELECT FirstName, LastName, Salary
    FROM Employee
</cfquery>
<cfoutput query="EmpList">
    #EmpList.FirstName#, #EmpList.LastName#, #LSCurrencyFormat(EmpList.Salary)#<br>
</cfoutput>
</cfdocument>
```
Saving printable reports in files

You can use the `cfdocument filename` attribute to save the generated PDF or SWF output to a file, as the following example shows:

```cfdocument```

```cfdocumentsection```

```cfoutput```

```cfdocumentsection```

Creating reports with Crystal Reports (Windows only)

When running on Windows, the `cfr` tag also supports the execution of reports created using Crystal Reports version 9 or 10.

**Note:** When you install Crystal Reports, you must select the Enable export to HTML and Enable export to Disk options. These options are not enabled by default, so you must use the Custom Install option.

1. Create a report definition in Crystal Reports.
2. Create a CFM page and add a `cfr` tag that invokes the Crystal Reports report definition. The following example shows the `cfr` tag invoking a Crystal Reports report definition and passing a filter condition:

```
<cfr tag = '/reports/monthlysales.rpt'
    Departments.Department = 'International'
</cfr>```
3 Open a browser and display the CFM page.

ColdFusion uses COM to call Craxdrt9.dll for Crystal Reports version 9, and Craxdrt.dll for Crystal Reports version 10. If you have problems with the cfreport tag, ensure that these DLLs are registered and, if not, use regsvr32 to register them (the default location for these DLLs is C:\Program Files\Crystal Decisions\Report Designer Component\).

For complete information on defining reports in Crystal Reports, see the Crystal Reports documentation.
Chapter 45: Creating Reports with Report Builder

Improve your access to important business data by creating integrated business reports with Adobe ColdFusion Report Builder and CFML.

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About Report Builder

ColdFusion reporting adds integrated business reporting to ColdFusion, providing access to important business data. ColdFusion reporting consists of server-side run-time processing and a graphical user interface (GUI), called the Report Builder.

For information on installing the Report Builder, see “Getting started” on page 820.

The Report Builder is a Windows-only tool that lets you build banded reports. A banded report consists of multiple horizontal sections (bands), one band for each part of a printed report. For example, data and text in the report header band prints at the beginning of the report, data and text in the page header band prints at the beginning of each page, and data and text in the page footer band prints at the end of each page. In the middle of the report is the detail band, which, at run time, contains one row for each row in the report’s result set or database query.

The following example shows the Report Builder work space with a simple Employees by Department report:

The following example shows a preview of that report in Adobe FlashPaper format:
The Report Builder contains an extensive online Help system, including quick-start tutorial topics and context-sensitive dialog box Help. Press F1 to consult the online Help.

Report Builder and CFR files

The Report Builder is a stand-alone application that creates report definitions, interacting with a ColdFusion server, as necessary. The Report Builder stores report definition information in a ColdFusion Report (CFR) file. This file contains field definitions, formatting, database SQL statements, CFML, and other information. You display a CFR file by using the `cfreport` tag and, if enabled for the report, display the report by invoking the CFR file in a browser.

**Note:** The Report Builder runs in the Windows platform only. However, the CFR files created by the Report Builder run on all platforms that ColdFusion runs on and that have ColdFusion Reporting enabled.

RDS

Remote Development Services (RDS) is a proprietary protocol that uses HTTP to enable the Query Builder and Chart Wizard to access database data through a ColdFusion data source. To enable this functionality in the Report Builder, you define settings for an **RDS server**. RDS server is another name for an associated ColdFusion server that has enabled RDS.

For more information, see “Using CFML in reports” on page 834.

Run time

At run time, you invoke the CFR file by using a ColdFusion server that has ColdFusion Reporting enabled. You can display the CFR file directly or invoke it through the `cfreport` tag. Also, you can save the report to a file instead of returning output to the browser. If the report requires input parameters or a passed query, you must use the `cfreport` tag. If you pass a query attribute in the `cfreport` tag, it overrides any internal SQL statement in the report definition.
Getting started

For installation instructions, see *Installing and Using ColdFusion*. When you install the Report Builder, it also registers Windows DLLs that are used by RDS. If these DLLs fail to register properly, the Report Builder generates errors at startup and when using RDS.

**Setup Wizard**

The first time you start the Report Builder, it runs the Setup Wizard. The Setup Wizard prompts you to define default settings for an associated ColdFusion server. These settings include the following:

- Default unit of measurement: Inches, centimeters, or pixels.
- ColdFusion server (RDS must be enabled on this server). This is the RDS server that the Query Builder and Chart Wizard use to access database data. The Setup Wizard requires the following information:
  - Host name or IP address.
  - Web server port. Typically, the port is 80 if you are using a web server connector, 8500 if you are using the built-in web server in the server configuration, 8300 if you are using the built-in web server with the cfusion server in the multiserver configuration, or a J2EE-server-specific web server port number.
  - RDS password for the associated ColdFusion server.
- Directory path to the web root used by the associated ColdFusion server (for example, C:\Inetpub\wwwroot or C:\ColdFusion\wwwroot).
- URL for the web root used by the associated ColdFusion server (for example, http://localhost or http://localhost:8500).

After running the Setup Wizard, the Report Gallery dialog box appears. When you click the Using A Report Wizard radio button, the Report Builder runs the Report Creation Wizard, which prompts you for information and automatically generates a complete report definition.

For more information on the Report Creation Wizard, see the Report Builder online Help.

**Configuring RDS**

You must configure one RDS server for each ColdFusion server for which you define reports. After you configure an RDS server, you can use the Query Builder to access data sources that you defined in the associated ColdFusion server, and select database columns for use as query fields in a report.

**Add an RDS server**

1. Open the Preferences dialog box by selecting Edit > Preferences from the menu bar.
2. Click Server Connection.
3. Click the plus sign (+) next to the pop-up menu in the upper-left corner of the dialog box.
4. In the Configure RDS Server dialog box, specify the following information, and then click OK:
   - **Description**: A name for the server connection. This name appears in the pop-up menu on the left side of the Query Builder.
   - **Host name**: The host on which ColdFusion runs. Type `localhost` or an IP address.
   - **Port**: Web server port number. Accept the default port (80) or enter the port number of the ColdFusion server's built-in web server (8500 is the default port number).
Context Root (J2EE configuration only): The context root (if any) for the ColdFusion web application.

Use Secure Sockets Layer: (Optional) Enables SSL security.

User Name: Not applicable to ColdFusion RDS.

Password: RDS password. You set this password in the ColdFusion Administrator.

Do not confuse the RDS password with the ColdFusion Administrator password, which you also manage through the ColdFusion Administrator.

Prompt for password: Specifies whether to prompt for an RDS password each time you use the Query Builder. If you select this option, leave the User Name and Password fields blank.

Designate a default RDS server

1. Open the Preferences dialog box by selecting Edit > Preferences from the menu bar.
2. Click Server Connection.
3. Select an RDS server from the Preferred RDS Server pop-up menu, and click OK.

The Report Builder automatically connects to the specified server when you display the Query Builder or Chart Wizard.

User interface usage, tips, and techniques

The Report Builder work space includes the following areas:

- Toolbox: Contains nonvariable elements placed in a report, including text, shapes, images, subreports, and graphs. To use toolbox elements, click the element, and then click and drag in the report band to define the element's size. After you place an element on a report band, you can modify its appearance and behavior by using the Properties panel.

- Alignment palette: Use Control-click or Shift-click to select multiple elements in a report band, and then click the appropriate alignment icon. You can also use Control+A to select all elements in a report band.

- Report bands: Place toolbox elements, query fields, and calculated fields on report bands. The default report bands are report header, page header, column header, detail, column footer, page footer, report footer, and watermark. Page header, page footer, and watermark are closed by default; to open them drag one of the adjacent splitter bars. To define additional bands for groups, select Report > Group Management.

ColdFusion provides three panels that you use to place and format data elements in the work space:

- Properties panel: Contains display and report characteristics for the selected field. To display the Properties panel, choose Window > Properties Inspector from the main menu. To change a property value, type or select a new value, and press Enter. For complete information on properties, see the Report Builder online Help.

- Fields and parameters panel: Contains items for query fields, input parameters, and calculated fields. To display the Fields and parameters panel, choose Window > Fields and Parameters from the main menu. Use the add, edit, and delete icons to manage these fields. After you define a field, drag the field name to add the field, its associated label, or both, to a report band.

- Report styles panel: Contains the styles that you define for a report. To display the Report styles panel, choose Window > Report Styles from the main menu. Use the add, edit, and delete icons to manage report styles. After you define styles, you apply them to elements on the report instead of specifying font, font size, and so on, for each individual element. If your report layout, platform, or font availability requirements change, you can modify the style to apply the changes throughout the report. Additionally, you can specify a style as the default for the report: if no other style is applied to an element in the report, Report Builder applies the default style to that element.
The View menu lets you control whether toolboxes and panel windows appear. Also, you can click on a window’s title to undock it and drag it to another area of the screen. For example, you can drag all three panels and dock them in the same window. Report Builder lets you switch between them by clicking on the tabs at the top of the window. To re-dock a tool window or panel, drag it to the side or corner until a rectangle appears, and then release the mouse button.

For more information, see “Common reporting tasks and techniques” on page 823 and the online Help.

**Report definition guidelines**

To ensure a successful report, you should plan the following before defining it in the ColdFusion Report Builder:

- **Report design issues**:
  - **Audience**: Why are you creating this report? Who is the audience?
  - **Data**: What data needs to be in the report? Where does it come from? Whether you use the Query Builder or pass a query to the report, you should plan the data in advance.
  - **Grouping**: Are groups required? If so, ensure that the result set is returned in the correct order, and you define a group based on the sort column.
  - **Calculated fields**: Are there fields that must be totalled or calculated? For column totals, use calculated fields. For calculated totals on individual rows, use SQL. For more information, see “Common reporting tasks and techniques” on page 823.
  - **Input parameters**: Does the report require variable input? If so, define an input parameter and pass values to the report at run time by using the `cfreportparam` tag. For more information, see “Common reporting tasks and techniques” on page 823.

- **Data retrieval strategy**:
  - **Query Builder and basic SQL**: Use this option when your report has standard selection criteria (such as a WHERE clause with sorting and a fixed set of selection criteria) and when you have to develop a report quickly. This method also lets you specify `cfquery` options, such as caching.
  - **Query Builder and advanced query mode**: Use this option when you use a ColdFusion query encapsulated in the report definition. This option is also useful if the query comes from the `cfdirectory`, `cfldap`, or `cfpop` tags; query of queries; or is dynamically constructed with the `QueryNew` function.
  - **The `cfreport` tag and a passed query**: Use this option when you require more control over the result set used in the report; for example, your application might have a form that your clients use to construct dynamic selection criteria.

- **Related visual information**:
  - **Charts**: For more information, see “Using charts” on page 837.
  - **Subreports**: For more information, see “Using subreports” on page 838.

**Managing fonts with printable reports**

Ideally, reports should achieve a consistent look across all client platforms and all browsers. ColdFusion handles this automatically for graphics and images, using the size specifications in the report definition. However, potential differences in font availability across browsers, browser versions, languages, and platforms can affect the font display for your report. There are a variety of factors that you must understand to ensure consistent report display.
Embedded fonts
You can ensure consistent report display by embedding fonts. However, reports with embedded fonts have a larger file size.

Output format
The FlashPaper and PDF output formats handle embedded fonts differently.

FlashPaper: FlashPaper always embeds fonts, which ensures that reports always display appropriately.

PDF: PDF reports can optionally embed fonts, however, if your report doesn’t use embedded fonts, you must ensure that the fonts are available on the client computers.

Font availability on the server computer and the client computer
ColdFusion has different requirements for rendering the fonts in a report, depending on where the fonts are located.

Server computer: For all formats, the fonts used in a report must reside on the computer that runs ColdFusion. ColdFusion requires these fonts to render the report accurately. ColdFusion automatically locates Acrobat built-in fonts and fonts stored in typical font locations (such as the Windows/fonts directory). However, if your server has additional fonts installed in nonstandard locations, you must register them with the ColdFusion Administrator so that the cfdocument and cfreport tags can locate and render PDF and FlashPaper reports.

Client computer: If your PDF report does not embed fonts, the fonts reside on the client computer to ensure consistent report display.

Mapping logical fonts to physical fonts
If you are using Java logical fonts, such as serif, sans serif, or monospaced, ColdFusion maps these fonts to physical fonts by using specifications in the cf_root/lib/cffont.properties file (on the multiserver or J2EE configuration, this is the cf_webapp_root/WEB-INF/cfusion/lib directory). You can modify these mappings, if necessary. Also, if you are using an operating system whose locale is not English, you can create a locale-specific mapping file by appending java-locale-code to the filename. If ColdFusion detects that it is running on a non-English locale, it first checks for a cffont.properties.java-locale-code file. For example, on a computer that uses the Chinese locale, name the file cffont.properties.cn. For more information on Java locale codes, see the Sun website.

💡 The ColdFusion install includes a cffont.properties.ja file for the Japanese locale.

This discussion applies to both the cfdocument and cfreport tags. For more information, see the Report Builder online Help.

Common reporting tasks and techniques
With Report Builder, you can include data in reports in a variety of formats, and perform calculations on the information. For more information, including troubleshooting tips, see Report Builder online Help.
Grouping and group breaks
You can add clarity to a report's organization by grouping the information. You can define separate headings for each new group and also display group-specific summary information, such as subtotals at the end of each group's area of the report. For example, you might create a report that displays departments, employees, and their salaries. Grouping the data by department lets users quickly understand department salary characteristics. When the department ID changes, the ColdFusion Report Builder triggers a group break. The group break completes the old group by displaying the group footer and starts the new group by displaying the group header.

The ColdFusion Report Builder does not group data itself. You must ensure that the SQL used to retrieve the result set is already grouped in the appropriate order; typically you implement grouping by specifying an ORDER BY clause in the SQL SELECT statement used for the report. For example, you might use the following SQL SELECT statement:

```
SELECT EmployeeID, LastName, FirstName, Title, City, Region, Country
FROM Employees
ORDER BY Country, City
```

For this example, you can define two groups: one that corresponds to Country, and a second group that corresponds to City. When you define more than one group, the Group Management dialog box appears with Up Arrow and Down Arrow keys, which you can use to control group hierarchy. For example, country should be above city, because countries contain cities.

Define a group
1. Select Report > Group Management from the menu bar.
2. Click Add.
3. Specify a group name in the Name field.
4. Specify the value that controls grouping (also called a group expression) in the Group on field. At run time, ColdFusion triggers a group break when the result of this value changes. These values are often query field names. However, this value can also be a calculated field or other type of expression. Sample group expressions include the following:

   **Query field**: Creates a group break when the associated column in the result set contains a different value. The field that you specify must be one of the sort criteria for the result set; for example, query.country.

   **Calculated field**: Creates a group break when a calculated field returns a different value. For example, if the expression calc.FirstLetter returns the first letter of a query column, you can group a report in alphabetical order.

   **Boolean expression**: Creates a group break when a Boolean expression returns a different value. For example, if your result set is sorted by the passpercentage column, you might use the Boolean expression query.passpercentage LT 50.

5. Specify group break options:
   - **Start New Column**: Forces a new column on a group break.
   - **Start New Page**: Forces a new page on a group break.
   - **Reset Page Number**: Resets the page number to 1 on a group break.

6. Specify band size and printing information:
   - **Min. height for group**: The minimum height that must remain on a page for ColdFusion to print the group band on that page.
   - **Reprint Header on Each Page**: Displays the group header on each page.
7 Click OK.
   The Report Builder adds the group to the report and creates header and footer bands for the group.

8 Click OK again.

9 Add headings, text, query fields, calculated fields, and other information to the group’s header and footer.

Create group subtotals
1 Create a calculated field to contain the group subtotal. Create the calculated field that uses the following criteria:
   • Specify a numeric data type.
   • Select Sum in the Calculation field.
   • Specify the field to sum on in the Perform Calculation On field. For example, on an employees by department report, you might sum on query.emp_salary.
   • Specify that the field should be reset when the group changes.
2 Place the calculated field on the report.
For more information on calculated fields, see the Report Builder online Help.

Defining, modifying, and using fields and input parameters
The Report Builder supports variable data through query fields, input parameters, and calculated fields, as follows:

Query field: Maps to columns in the database result set associated with the report. You define one query field for each column in the associated database query.

Calculated field: Analyzes or sums multiple detail rows in a report. ColdFusion dynamically generates calculated field values at report-generation time, optionally recalculating the value with each new report, page, column, or group.

Input parameter: Specifies data fields that you pass to the report at run time through the cfreportparam tag or from a main report to a subreport. You can place input parameters directly on a report band or you can use them as input to a calculated field.

Define a query field
1 Choose Window > Fields and Parameters.
2 Click Query Fields.
3 Click the plus sign (+) at the upper edge of the tab.
4 Type a value for the name field. This must match a column name in the corresponding cfquery statement and cannot contain a period.
5 Type a default label.
6 Specify the data type of the corresponding database column, as follows:

<table>
<thead>
<tr>
<th>Object</th>
<th>Time</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boolean</td>
<td>Double</td>
<td>Short</td>
</tr>
</tbody>
</table>
Click OK.

**Note:** The Query Builder defines query fields automatically for all database columns in the result set (this does not apply to the Advanced Query Builder). Also, if you run the Query Builder as part of the Report Creation Wizard, the wizard places query fields on the report.

### Define a calculated field

1. Choose Window > Fields and Parameters.
2. Click Calculated Fields.
3. Click the plus sign (+) at the upper edge of the tab.
4. Specify a name, default label text, and data type. Data type options are the same as for query fields.
5. Specify calculation options:
   - **Calculation:** Specifies the type of calculation that ColdFusion performs. Valid values are: Average, Count, DistinctCount, First, Highest, Lowest, Nothing, Standard Deviation, Sum, System, and Variance. If you specify Nothing, you typically use the Perform Calculation On field to specify a dynamic expression. With the exception of Nothing (for which you use the Perform Calculation On field) and System (for which you write a customized scriptlet class), you use these calculations for group, page, and report totals.
   - **Perform Calculation On:** Specifies a field or expression. Click the ... button to display the Expression Builder.
   - **Initial Value:** Specifies an initial value for the calculated field.
6. Specify the following reset options, and click OK:
   - **Reset Field When:** Specifies when to reset the calculated field value. Valid values are: None, Report, Page, Column Group.
   - **Reset Group:** If Reset Field When is set to Group, use this field to specify the group whose group break triggers the reset.

For additional information on calculated fields, see the Report Builder online Help.

### Define an input parameter

1. Choose Window > Fields and Parameters.
2. In the Fields and Parameters panel, click Input Parameters.
3. Click the plus sign (+) at the upper edge of the tab.
4. In the Add Input Parameter dialog box, enter a value for the name field. This must match an input parameter, such as the name attribute of a `cfreportparam` tag included in the `cfreport` tag that invokes the report definition.
5. Enter the default label text.
6. Specify a data type and default value, and click OK. Data type options are the same as for query fields.

For more information on using input parameters, see “Using input parameters to pass variables and other data at run time” on page 834 and “Using subreports” on page 838.
Place a query field, calculated field, or input parameter on a report band

1. In the Fields and Parameters panel, use the radio buttons to specify whether to place the label, the field, or both.
2. Drag the query field, calculated field, or input parameter from the Fields and Parameters tab to the appropriate report band.
3. Drag the query field, calculated field, or input parameter to the desired band.
4. (Optional) Use the Properties panel to customize the field display.

For example, you might have a query field named query.emp_salary and a calculated field that sums query.emp_salary, resetting it with each group. Place query.emp_salary in the detail band, and the associated calculated field in the group footer band.

Using toolbox elements on report bands

You use the toolbox to add graphic and textual elements, such as images, circles, squares, lines, dynamic fields, charts, and subreports, to report bands.

The basic technique for adding toolbox elements is to click in the toolbox element and then drag to define an area in the appropriate report band. For some toolbox elements, such as image and text box, a dialog box immediately appears, prompting for more information. For all toolbox elements, you customize the appearance of the element by using the Properties sheet.

💡 You can add toolbox elements from the Insert menu.

For information on charts, see “Using charts” on page 837. For information on subreports, see “Using subreports” on page 838.

Create a text box

1. Click the Label icon (abc) in the toolbox.
2. Define the area for the label by dragging on the desired band.
3. Enter the label text in the Edit Label Text dialog box. To add a line break, press Control+Enter.
4. Click OK, or press Enter.

Note: ColdFusion trims leading and trailing blanks from labels. To include leading and trailing blanks, define a dynamic field and include the blanks in the expression, for example, " My Title ".

Import image files

1. Click the Image icon in the toolbox.
2. Define the area for the image by dragging on the desired band.
3. In the Image File Name dialog box, navigate to the file that contains the image, select the file, and click OK.

Use a database BLOB column as an image source

1. Click the image icon in the toolbox (the icon has a tree on it).
2. Define the area for the image by dragging on the desired band.

   The Image File Name dialog box appears.

💡 You can also drag the BLOB field from the Fields and Parameters tab to a report band.
3 Click Cancel.
   The Expression Builder appears.

4 Click the Image Type pop-up menu and change File/URL to BLOB.
5 Select the query field or input parameter that contains the BLOB column.
   **Note:** The BLOB column must contain a binary image in GIF, JPEG, or PNG format.

6 Click OK.
   **Note:** These instructions assume that the contents of the BLOB column can be rendered as an image.

**Add rectangles, ellipses, and lines**
1 Click the rectangle, ellipses, or line icon in the toolbox.
2 Define the area or line by dragging on the desired band.
3 Resize the selected element by dragging the handles that surround it.
   Pressing the Control key while resizing a rectangle, ellipsis, or line, constrains the element to a square, circle, or angles that are multiples of 45 degrees.

**Add dynamic fields**
1 Click the Field icon in the toolbox.
2 Define the area for the dynamic field by dragging on the desired band.
   The Add Field dialog box appears (if you haven't defined any query fields, the Expression Builder appears).
3 Select the field to add. If you select a query field, calculated field, or input parameter, this is the same as dragging from the Fields and Parameters tab.
4 (Optional) Select Manually Entered Expression.
   The Expression Builder appears. This option is useful for calculations that use variables in the same row. For example, to compute total price for an order detail line item, you might use the following expression:
   
   ```
   LSNumberFormat((query.unitprice * query.quantity), ",___.___")
   ```
5 Click OK.

**Aligning elements**
Organized element layout is essential to a visually pleasing report. You achieve this organization by aligning, spacing, and centering visual elements on each band relative to each other, to the band itself, and to elements on other bands.

The Report Builder Align Palette includes the following options:
- Align left, center, and right
- Align top, horizontal, and bottom
- Same heights, widths, and both
- Space equally horizontally
- Space equally vertically

You align, size, and space multiple report elements, as follows:
Relative to the band they are in: You control relative alignment through the Align to Band icon, which is the bottom icon in the Align Palette. When it is enabled, the Align to Band icon has a rectangle surrounding it, and the Report Builder aligns and spaces one or more elements relative to the height and width of the band.

Relative to each other: When Align to Band is disabled, Report Builder aligns and spaces two or more elements relative to each other.

Use the Align Palette
1 Select two or more elements by pressing Control-click, Shift-click, or using lasso select.
2 Click the alignment icon, or select Modify > Alignment > alignment option from the menu bar.

The Align Palette options are also available from Modify > Alignment on the menu bar.

For complete information on fine-tuning element display, see the Report Builder online Help.

Using report styles
A report style is similar to a font style in Microsoft Word. Instead of explicitly associating an element with formatting specifications, you associate the element with a style. This provides you with report-wide control of the formatting characteristics of your report.

Additionally, you can specify style that is the default for the report. The ColdFusion Report Builder uses the default style for all fields for which you have applied no other font specifications or styles. The default style, if defined, is displayed in bold in the Report Styles panel.

Report Builder also lets you import styles from a Cascading Style Sheet (CSS) file and export styles defined in Report Builder to a CSS file. This way you can enforce standard formatting across reports and override styles at run time from a CFM page. For more information, see “Using Cascading Style Sheets” on page 849 and the CFML Reference.

Note: When choosing fonts for your report, you must ensure that the fonts are available on the server that runs ColdFusion and (if you don't embed fonts) on the client computer. For more information on fonts, see “Creating a simple report” on page 840.

Define a style
1 Choose Window > Report Styles.
2 Click the (+) icon at the upper edge of the Report Styles tab.
3 Type a value for the Name field. Style names must be unique.
4 Add other style characteristics, and click OK.

Specify a style as the default
1 Edit an existing text style or create one.
2 Select the option with this label: This is the default style if no other style is selected for an object.
3 Add or modify other text style characteristics, and click OK.

Apply a style to a report element
1 Select the element in the report band.
2 Choose Window > Properties Inspector.
3 Choose the style from the Style pop-up menu.
For more information, see the Report Builder online Help.

**Previewing reports**
Report building is an iterative process and most developers periodically display the in-progress report to review their most recent changes. If your report uses an internal query and you established default web-root settings, preview functionality is enabled automatically. If your report uses a passed query, you must define an associated CFM page and associate that page with the report. The Report Builder invokes this page when you request Report Preview.

**Preview a report that uses an internal query**
1. (Optional) Define default server connection information using the Preferences dialog box, if you did not define these settings previously:
   - Default RDS server configuration (used for Query Builder and Chart Wizard only; not required for report preview).
   - Fully qualified path for the local web root directory; for example, `C:\ColdFusion\wwwroot` or `C:\Inetpub\wwwroot`.
   - URL for the local web root, for example, `http://localhost:8500` or `http://localhost`.
2. (Optional) Specify the output format in the Report Properties dialog box (the default format is FlashPaper).
3. (Optional) If your report is designed to be invoked by a CFM page, specify the URL of the CFM page in the Report Properties dialog box.
4. Save your report.
5. Select File > Preview from the menu bar to display the report.

*Note:* If the Report Builder displays the Edit Preview Report URL dialog box instead of displaying the Preview window, select Edit > Preferences from the menu bar and insure that the web root file and URL settings are correct on the Server Connection pane.

6. Close the preview window by pressing F12.

If your report is designed to accept a query object from a `cfreport` tag, you must associate a URL with the report. If necessary, the Report Builder prompts for this URL when you preview the report. Otherwise, you can open the Report Properties dialog box, and specify the URL of the CFM page in the Report Preview URL field.

*You can use the `cfreport` tag to invoke a report, regardless of whether the report has an internal query or is passed a query.*

**Preview with an associated CFM file**
2. Specify the URL of the associated CFM page in the Report Preview URL field. This CFM page must contain a `cfreport` tag whose `template` attribute specifies the current CFR file and, if necessary, passes a query in the `query` attribute.
3. Save your report.
4. Press F12. Depending on the output format that you have chosen, the Preview Report window displays your report in PDF, FlashPaper, RTF, XML, HTML, or Excel format.

**Displaying page numbers**
The Report Builder includes a built-in calculated field named `PAGE_NUMBER`, which displays the current page number when you place it on a report band.
Add a built-in calculated field
1. Click the Field tool in the toolbox.
2. Drag in the center of the header or footer band to define the size of the page number field.
   The Add Field dialog box appears, listing all fields defined for the report, including built-in calculated fields and input parameters.
3. Select `calc.PAGE_NUMBER`, and click OK.
   You can use the Field tool to add any type of field (query field, calculated field, input parameter) to a report.

For information on the other built-in calculated fields, see the Report Builder online Help.

Using layered controls
Layered controls are elements that you place at the same location of a report band, and then use PrintWhen expressions to conditionally display one or the other at run time. You can use layered elements to customize the circumstances under which the elements display and enhance a report's ability to communicate important information.

Place an element directly over another element
1. Place the elements on the band.
2. Choose Window > Properties to display the Properties panel.
3. Specify a PrintWhen expression, display properties, and placement properties for each element using the Properties panel, as follows:
4. Specify a PrintWhen expression for each element. For example, you might specify the following expression to display one element when shippeddate is later than requireddate (that is, late) and another element when shippeddate is earlier than requireddate:
   - **First element**: `query.shippeddate LTE query.requireddate`
   - **Second element**: `query.shippeddate GT query.requireddate`
5. Specify different display characteristics for each element. For example, if an order is late, display it in red text.
6. Set the Top, Left, Height, and Width properties to the same values for each element.
   When you specify identical placement properties, you access the individual elements through the Layered Controls menu.

Use the Layered Controls menu
1. Right-click on the top element.
2. Select Layered Controls > `elementname` from the pop-up menu. The Report Builder identifies each layered element by displaying its PrintWhen expression.
3. Select the element and choose Window > Properties Inspector to view the element properties.

Using links
You can include hyperlinks from query fields, calculated fields, input parameters, charts, and images to a variety of destinations:
- An anchor or page within the same report
- An anchor or page within another report
• An HTML page, optionally specifying an anchor and URL parameters

One use for links is to create drill-down reports, in which you click an item to display detailed information. For example, clicking an employee line item passes the employee ID as a parameter to a page that displays complete information for the employee.

For complete usage information on creating anchors and hyperlinks, see the Report Builder online Help.

**Defining properties for report elements**

Every element on a report, including the report itself, is defined by a set of properties. These properties affect the look, feel, and behavior of each element.

For many properties, the Report Builder lets you define their values through user interface elements, such as dialog boxes, toolbar icons, and menu items. For example, you set a text label's font size using a toolbar icon. You can set values for all properties, however, through the Properties panel, which display all properties for the currently selected element.

> Sometimes a report contains multiple, closely spaced elements and it is difficult to select an individual element using the mouse. In this case, selecting the element from the Properties panel pop-up menu is an easy way to select an element.

The Properties panel has two views:

**Sort alphabetically:** All properties for the currently selected element display in alphabetical order.

**Sort into groups:** The Properties panel displays related properties in the following predefined groups:

- Advanced
- Columns
- Page Layout
- Printing
- Colors and Style
- Data
- Font
- Font Style
- Formatting
- Hyperlinks
- Layout
- Print Control

The Report Builder displays only groups that relate to the currently selected element.

**Set or modify a property for an element in the work space**

1. Select the element.
2. (Optional) If the Properties panel is not already displayed, choose Window > Properties Inspector.
   
   The Report Builder displays its properties in the Properties panel.
3. Modify the property. Depending on the property, you enter a value, select a value from a pop-up menu, or open the Expression Builder to use an expression.
4  Press Enter.
   When you select a color, double-click the color.

Choose a different element
Select the element from the pop-up menu. When you select a new element, the Report Builder selects the element and displays its properties.

Although the Properties panel is a powerful way to set properties, you typically set properties through dialog boxes and toolbar icons. For example, you use the Report Properties dialog box to set report-wide settings. For complete information on setting properties, see “Property reference” in the Report Builder online Help.

Displaying reports
Your application can invoke a report by displaying the CFR file in a browser or by displaying a CFM page whose cfreport tag invokes the report.

You can optionally use the cfreport tag to save the report to a file.

The cfreport tag supports advanced PDF encryption options. For more information, see cfreport in the CFML Reference.

For information on report preview, see “Previewing reports” on page 830.

Display a report by using the cfreport tag
1  Create a report, with or without an internal query.
2  Create a CFM page and add a cfreport tag that invokes the report. If the report does not use an internal query, you must also populate a query and pass it using the query attribute. If the report uses an internal query and you use the query attribute, the passed query overrides the internal query.

   <cfquery name="northwindemployees" datasource="localnorthwind">
     SELECT EmployeeID, LastName, FirstName, Title, City, Region, Country
     FROM Employees
     ORDER BY Country, City
   </cfquery>

   <CFREPORT format="PDF" template="EmpReport.cfr">
     query="#northwindemployees#"/>
   </CFREPORT>

   Note: ColdFusion does not render text that occurs before or after the cfreport tag.

3  Open a browser and display the CFM page.
   ColdFusion generates the report.

   If you display a report in HTML format, ColdFusion generates temporary files for images in the report. You can specify how long the temporary files are saved on the server by using the resourceTimespan attribute of the cfreport tag. For more information, see the CFML Reference.

Display a CFR file in a browser
1  Create a report that uses an internal query and does not use input parameters.
2  Open a browser and display the CFR file.
Save a report to a file

1. Create a report, with or without an internal query.

2. Create a CFM page and add a `cfreport` tag that invokes the report. Optionally pass a `query` attribute, as described in the previous procedure. Include a `filename` attribute that specifies the fully qualified name of the file to be created, as the following example shows:

   ```
   <CFREPORT format="PDF" template="emppicture.cfr"
     filename="#GetDirectoryFromPath(GetTemplatePath())#/emppicture.pdf"
     overwrite="yes"/>
   ```

   If you write the report output to an HTML file, ColdFusion creates a directory located relative to the HTML file, generates files for the images (including charts) in the report, and stores the image files in the directory. For more information, see "Exporting the report in HTML format" on page 852.

   Use the .pdf extension for PDF output format, the .swf extension for FlashPaper output format, .xml extension for an XML file, .rtf extension for an RTF file, .html extension for HTML files, and the .xls extension for Excel format.

3. Open a browser and display the CFM page. ColdFusion generates the report, saves the file, and displays an empty page in the browser.

Disable browser display of the CFR file


2. Clear the Allow Direct .CFR Browser Invocation option, and click OK.

Using input parameters to pass variables and other data at run time

Input parameters are data fields that you pass to the report at run time. You can place input parameters directly on a report band or you can use them as input to a calculated field.

Define input parameters in the same manner as query fields. You can specify a default value that ColdFusion uses when there is no corresponding parameter. For more information on defining input parameters, see "Defining, modifying, and using fields and input parameters" on page 825.

You use input parameters in the following ways:

- **Through the `cfreportparam` tag**: Input parameters must correspond, by name, to `cfreportparam` tags embedded in the CFM page invocation. For example, if you define an input parameter named ReportTime, you pass a `cfreportparam` tag with a name attribute set to ReportTime, as the following example shows:

   ```
   <cfreport format="PDF" template="FourthReport.cfr" query="#coursedept#">
     <cfreportparam name="ReportTime" value="#DateFormat(Now())#, #TimeFormat(Now())#">
   </cfreport>
   ```

- **Subreport parameters**: When a subreport requires information from a main report, you define subreport parameters in the main report and corresponding input parameters in the subreport. For more information, see "Using subreports" on page 838.

For information on dynamically populating input parameters at run time, see “Advanced query mode” on page 835.

Using CFML in reports

CFML is the scripting language for the Report Builder. By leveraging CFML, you can create reports that select and format data to meet your needs. You use CFML in the following areas of the Report Builder:

- Advanced query mode
- Report functions
Expressions

Advanced query mode
In some cases, you might create a complex query, reuse an existing query, or encapsulate additional CFML processing as part of query creation for the report. To use a query in these ways, you use advanced query mode to create CFML that returns a query. When you click the Advanced button at the top of the Query Builder, the Report Builder displays a text entry area in which you can enter CFML that generates a query. ColdFusion executes this tag at report execution time and passes the query result set to the report.

Note: When you use advanced query mode, the Query Builder does not create query fields automatically. You must create the associated query fields manually.

The CFML used in advanced query mode must include a query object whose name matches that in the Variable that contains the query object field. You can use any CFML tag that returns a query object or the QueryNew function. The CFML can use multiple query objects, but can only return one.

Note: If you set an empty variable (for example, <cfset name=""), the Report Builder throws a Report data binding error.

This example CFML uses the cfhttp tag to retrieve a query:

```cfhttp
url="http://quote.yahoo.com/download/quotes.csv?Symbols=cisco,jnpr&format=csv11&ext=.csv"
method="GET"
name="qStockItems"
columns="Symbol,Change,LastTradedPrice"
textqualifier="\"
delimiter="",
firstrowasheaders="no">
```

Another possible use of advanced query mode is to test for passed parameters in the URL or FORM scopes and use those parameters to retrieve data, as the following example shows:

```
<!--- First look for URL parm. URL overrides cfreportparam. --->
<cfif isDefined("url.deptidin")>
  <cfset param.deptidin = url.deptidin>
</cfif>

<!-- Then look for FORM parm. Overrides URL parm. --->
<cfif isDefined("form.deptidin")>
  <cfset param.deptidin = form.deptidin>
</cfif>

<cfquery name="CFReportDataQuery" datasource="cfdocexamples" SELECTLastName, FirstName, Dept_ID FROMEmployee WHERE (Dept_ID = #param.deptidin#)>
```

Using report functions
Report functions are user-defined CFML functions that you code using the Report Function Editor and invoke in report fields. You can use them to format data (such as concatenating and formatting all the field that make up an address), to retrieve data, and for many other purposes.

Three built-in functions are unique to Report Builder: InitializeReport, BeforeExport, and FinalizeReport. For more information, see the Report Builder online Help.
Report Builder built-in functions
1. Select Report > Report Functions from the menu bar.
   The Report Function Editor displays.
2. Click the Add Default Functions icon (the first on the left).
   The built-in functions are added to the left pane.
3. Select a function from the left pane.
   Commented code associated with the function appears in the right pane.
4. Modify the code and click OK.

Create a report function
1. Select Report > Report Functions from the menu bar.
   The Report Function Editor displays.
2. Click the plus sign to add a new report function.
   The Add Report Function dialog box displays.
3. Specify a name and click OK.
4. The Report Function Editor places a cfreturn tag in the text entry area.
5. Code the function, and click OK. This is a ColdFusion user-defined function so all UDF rules and features are available for use. The following example shows a report function that concatenates address fields:

```coldfusion
<cfargument name="Name" required="yes"/>
<cfargument name="Address1" required="yes"/>
<cfargument name="Address2" required="yes"/>
<cfargument name="City" required="yes"/>
<cfargument name="State" required="yes"/>
<cfargument name="Zip" required="yes"/>
<cfset variables.CRLF = Chr(13) & Chr(10)>
<cfset variables.ResultVar="">
<cfif Trim(arguments.Name) NEQ "">
  <cfset variables.ResultVar='#arguments.Name#'>
</cfif>
<cfif Trim(arguments.Address1) NEQ "">
  <cfif variables.ResultVar NEQ ">
    <cfset variables.ResultVar='#variables.ResultVar & variables.CRLF#'>
  </cfif>
  <cfset variables.ResultVar='#variables.ResultVar & arguments.Address1#'>
</cfif>
<cfif Trim(arguments.Address2) NEQ "">
  <cfif variables.ResultVar NEQ ">
    <cfset variables.ResultVar='#variables.ResultVar & variables.CRLF#'>
  </cfif>
  <cfset variables.ResultVar='#variables.ResultVar & arguments.Address2#'>
</cfif>
<cfif variables.ResultVar NEQ "">
  <cfset variables.ResultVar='#variables.ResultVar & variables.CRLF#'>
</cfif>
```
<cfreturn variables.ResultVar>

**Use a report function**

1. Place a dynamic field on the appropriate report band. The Add Field dialog box displays.
2. Specify Manually Entered Expression, and click OK. The Expression Builder displays.
3. Specify "report.functionname", and click OK.

**Using expressions**

Many elements of the Report Builder (including query fields, calculated fields, input parameters, images, and report object attributes) are single operand ColdFusion expressions. Because these elements are expressions, you can manipulate them with CFML functions.

The Expression Builder is a graphical interface that lets you quickly apply CFML functions to Report Builder elements. Uses for the Expression Builder include the following:

- Many of the report object attributes (such as PrintWhen) accept expressions, which you can associate with query parameters, input parameters, or ColdFusion page variables. You can tie report attributes and columns to display based on run-time data or user preference.
- Concatenating fields
- Formatting fields
- Calculated fields
- Accessing and displaying ColdFusion page variables and scopes

For more information on using the Expression Builder, see Report Builder online Help.

For more information on expressions, see “Using Expressions and Number Signs” on page 50.

**Using charts**

Charts can help clarify large or complex data sets. The Report Builder lets you place a chart in any report band and supports many types of charts.

To add a chart to a report, you use the Chart Wizard, which steps you through the chart building process. The Chart Wizard, which is fully integrated with the Query Wizard to facilitate database-driven charts, helps you define the chart type, the data used for the report and other formatting options.

*As you use the Chart Wizard to choose and define the various aspects of a given chart, the Report Builder uses RDS to generate chart images in real time. However, the data in these chart images is not real.*

The Chart Wizard includes the following panels:

- **Chart Types**: Select the chart type (for example, bar) and subtype (for example, 3D-stacked).
- **Chart Series**: Select the data for the series. When you add a series, the Report Builder lets you hard-code series data or open the Query Builder to populate the series using a database query.
- **Chart Formatting**: Specifies title and series, general appearance, 3D appearance, lines and markers, and font.

*The data you specify through the Chart Wizard corresponds to the attributes specified in the *cfchart*, *cfchartseries*, and *cfchartdata* tags. For more information on these tags, see the CFML Reference.*
For complete information on ColdFusion charting capabilities, see “Creating Charts and Graphs” on page 785. For more information on charting using the Report Builder, see Report Builder online Help.

**Using subreports**

Subreports let you nest a report within your report. The data that you display in a subreport is typically related to the data in the main report, and you enable this by passing one or more subreport parameters to the subreport. However, the data displayed in a subreport can also be unrelated to the data in the main report.

Reasons to use subreports including the following:

- You prefer to avoid complex SQL, such as a RIGHT OUTER JOIN.
- Your report requires data from multiple databases.

The following example shows the use of subreport parameters and the relationship between a report and a subreport:

![Diagram showing the relationship between a main report and a subreport](image)

*Note: Although the Report Builder supports multiple levels of nesting, it displays one level of nesting only.*

For additional information on subreports, see the Report Builder online Help.

**Defining a subreport**

You can define a subreport and include it in a report, or you can define it as part of inserting the subreport in the main report.

A subreport has the following characteristics:

- Data displayed in the detail band only. A subreport uses no header or footer bands.
- If the subreport is related to the main report, it must include an internal query that uses a SELECT statement with a WHERE clause specifying the name of the input parameter used in the main report's Subreport Expression property.

If you have already defined a subreport, you add it to the main report and define subreport parameters, as necessary.

**Add an existing subreport**

1. Define or open your main report.
2. Click the Subreport icon in the toolbox.
3. Drag an area for the subreport in the desired report band.
4. Select From An Existing Report, specify the subreport, and click Next.
5. Select the fields in the main report that correspond to fields in the subreport and click Next.
6. Click Finish.
The Report Builder adds the subreport to the main report, saving the report to subreport mappings as subreport parameters.

7 To modify subreport parameter settings, select the subreport and click on Subreport Parameters in the Properties panel.

If you are certain about the data required for a subreport, you can define a new subreport while adding it to the main report.

Add a new subreport
1 Define or open your main report.
2 Click the Subreport icon in the toolbox.
3 Drag an area for the subreport in the report band.
4 Select As A New Report and click Next.
5 Click Query Builder.
6 Select the tables and columns for the subreport.
7 Specify a WHERE clause for the report by using the Condition and Criteria columns for the key columns.
   Specify a WHERE for Condition and either ="#CFVariable#" (string column) or =#CFVariable# (numeric column) for Criteria, and then overtype CFVariable with the name of the input parameter for the subreport (you define the input parameter name later in the procedure.)
8 Click Save, and then click Next.
9 Specify grouping fields, if appropriate for your subreport, and click Next.
10 Specify Free Form or Grid, and click Next.
11 Specify Only Detail Band, and click Next.
12 Specify a color scheme, and click Next.
13 Specify headings, as appropriate, and click Next.
14 For each parameter required by the subreport, specify the following:
   • Parameter name.
   • Associated value from the main report (select from the pop-up menu).
   • Data type.
15 Click Next.
16 Specify a fully qualified filename for the subreport, and then click Next.
17 Click Finish.

Report Builder adds the subreport to the main report. Report Builder lets you change subreport name and modify subreport parameters in a main report.

Modify subreport settings
1 Click the subreport element in the main report.
2 To change the subreport, modify Subreport Expression.
3 To modify subreport parameters:
   a Click the Subreport Parameters property.
Creating a simple report

The following example shows how to create a simple report by using the Report Wizard and then modifying it. The example uses the cfartgallery database, which is installed with ColdFusion.

The example shows how to perform the following tasks:

• Create a base report by using the Report Wizard and the Query Builder.
• Use the Expression Builder to modify the data presentation in the report.
• Modify the display text for column data.
• Add a text field to the report and format text and data elements by using report styles.
• Add an image file and images from a database.
• Create and add a calculated field to display the total sales by artist.
• Add group-level and report-level pie charts that show the ratio of sold and unsold art for each artist and for all the artists in the database.
• Export report styles to a Cascading Style Sheet (CSS) file.

Create a report by using the Report Wizard
1 Start Report Builder.
2 Click the Query Builder button:
   a From the list of data sources in the database pane, expand the cfartgallery database.
   b Expand the Tables folder.
   c Double-click the APP.ART table in the database pane. Report Builder adds the APP.ART table to the table pane.
   d Double-click on the APP.ARTISTS table in the database pane. Report Builder adds the APP.ARTISTS table to the table pane. Notice that it automatically creates the join between the two tables based on the ARTISTID column.
   e In the APP.ARTISTS table, double-click the FIRSTNAME and LASTNAME columns. The Query Builder adds the fields to the select statement in the SQL pane.
   f In the ART table, double-click the ARTNAME, DESCRIPTION, PRICE, and ISSOLD columns. The following example shows the completed query in the Query Builder:
Click the Test Query button to preview the results.

Close the test query window and click the Save button in the Query Builder window.

3. Double-click on the FIRSTNAME column to add it to the Non-printed Fields pop-up menu and click the Next button.

4. In the Available Fields list, double-click LASTNAME to group the records by the artists' last names.

5. Click the Next button three times to accept the default values.

6. Choose Silver and click the Next button.

7. Change the title of the report to Sales Report and click the Finish button. The Report Creation Wizard generates the report and displays it in the Report Builder work space.


9. Press F12 to preview the report. Report Builder displays the records grouped by the artists' last names.

10. Click the close box to close the Preview Report window and return to the Report Builder work space.

Changing the column heading labels

By default, the Report Wizard uses the column name for the column headers in the report, but you can change the label text for column headings.

Edit the heading label text

1. Double-click the LASTNAME field in the Column Header band.

2. Replace the column name with Artist Name, and click OK.

3. Replace the remaining column labels as follows:
   • ARTNAME > Title
Using expressions to format data

Use the Expression Builder to perform the following tasks:

- Change the display of the ISSOLD value to a yes/no expression. By default, Report Builder displays 0 (not sold) or 1 (sold) for the ISSOLD column based on how the data is stored in the database. You can use a function to change the display to yes or no.
- Change the value of the PRICE column to a dollar format.
- Concatenate the artists’ first and last names. Even though the FirstName field is a nonprinted field in the report, you can add it to an expression because it is part of the SQL query that you created.

Change a Boolean value to yes/no

1. Double-click the query.ISSOLD element in the detail band. Report Builder displays the Expression Builder for that element.
2. In the Expression Builder, expand the Functions folder.
3. Choose Display and Formatting from the Functions list. Report Builder displays the list of functions in the right pane of the Expression Builder.
4. Double-click YesNoFormat from the list of functions. Report Builder automatically completes the following expression in the expression pane:
   
   YesNoFormat(query.ISSOLD)

5. Click OK to close the Expression Builder and return to the report.
6. Choose File > Save to save your changes to the report.
7. Press F12 to preview the report. Yes or no appears in the Sold? column based on whether the artwork sold.

Display numbers in dollar format

1. Double-click the field in the PRICE column of the detail band.
2. In the expression pane, change the expression to the following text:
   
   DollarFormat(query.PRICE)

3. Click OK to close the Expression Builder and return to the report.

Concatenate the FIRSTNAME and LASTNAME fields

1. Double-click the query.LASTNAME field in the LASTNAME group header.
2. In the Expression Builder, type the following expression:
   
   query.FIRSTNAME & " & query.LASTNAME

   Notice that the Expression Builder prompts you with the available field names as you type.
3. Click the OK button in the Expression Builder.
4. Choose File > Save from the Report Builder menu bar to save your changes to the report.
5. Press F12 to preview the report.
Report Builder displays the first and last name for each of the artists. Notice that the report still is grouped alphabetically by last name.

6 Close the preview window.

Adding page breaks before group changes
Create a page break so that each artist name starts on at the top of a page in the report output.

Add page breaks between artist names
1 Choose Report > Group Management from the main menu bar. The Group Management dialog box appears with LASTNAME selected.
2 Click the Edit button.
3 Select the Start New Page option and click OK.

Adding a calculated field

Calculate the sum of the artwork sold by artist
1 Choose Window > Fields and Parameters.
2 Report Builder displays the Fields and Parameters panel.
3 Expand the list of calculated fields.
4 With Calculated Fields selected, click the (+) button at the upper edge of the Fields and Parameters panel.
5 Make the following changes in the Add Calculated Field dialog box:
   a Change the name of the calculated field to Sold.
   b Change the label text to Sold.
   c Change the Data Type to Float.
   d Change the Calculation to Sum.
   e In the Perform Calculation On field, enter the following expression:

   \[ \text{If}(\text{IsBoolean}(\text{query.ISSOLD}) \text{ and } \text{query.ISSOLD}, \text{query.Price}, 0) \]

   This expression multiplies the total price of the artwork per artist by the number of items sold to calculate the total sales per artist. If the ISSOLD value for a record is 1 (sold), the value is multiplied by 1 and added to the total; if the ISSOLD value for a record is 0 (unsold), the value is multiplied by 0.
   f Change the Reset Field When value to Group.
   g Change the Group Name value to LASTNAME, and click OK. Report Builder adds the calculated field definition in the Fields and Parameters panel.

Add the calculated field to your report
1 Insert a field in the LASTNAME Footer band.
2 In the Add Field dialog box, select calc.Sold from the pop-up menu.
3 In the Expression Builder, type the following code:

   \[ \text{DollarFormat}(\text{calc.Sold}) \]

4 Press F12 to preview the report. Report Builder displays the sum of the artwork sold for each artist.
Adding and formatting fields
You can add a text field to your report and define a style for it. When you define a style, you can reuse it throughout your report or export the style so that you can use it in other reports. Also, you can override report styles at run time by using the cfreport and the cfreportparam tags. For more information, see “Overriding report styles” on page 853.

Add a text field
1. In the Controls toolbox on the left side of the Report Builder window, click the text icon (the button with abc on it) and place the text field to the left of the calculated field in the LASTNAME footer.
2. In the Edit Label dialog box, type Total Sales, and click OK.

Create a style
1. Choose Window > Report Styles from the main menu.
2. Click the (+) button.
3. In the Name field, enter GroupFooter.
4. Click the Color and Style tab and change the color to #9999CC.
5. Click the Font tab and change the Font to Tahoma and click the bold option. Then click OK. Report Builder adds GroupFooter style to the pop-up menu of available styles in the report.
6. Choose File > Save from the menu bar to save your changes to the report.

Apply the style to text and data elements in the report
1. Select the Total Sales text box in the LASTNAME Footer band.
2. Choose Window > Properties Inspector.
3. Choose GroupFooter from the Style pop-up menu.
4. Select the calculated field element and apply the GroupFooter Style to it.
5. Press F12 to preview your report:
Adding images
When you add images with Report Builder, you can perform the following types of tasks:

- Replace the company name text box with a company logo in the report header.
- Use the Query Builder to add images from a database.
- Display the report in RTF format for faster display.

Add a logo to the report header
1. Select the Company Name text box located in the header band above Sales Report.
2. Choose Edit > Cut to remove the text box from the report.
3. Click the Add Image icon in the Controls toolbox. (The icon has a picture of a tree on it.)
4. Click and drag the mouse in the header band above the Sales Report text box. When you release the mouse, the Image File Name dialog box appears.
5. Navigate to the Art World logo file:
   C:\ColdFusion8\wwwroot\cfdocs\getting_started\photos\somewhere.jpg
6. Click Open. Report Builder displays the Art World logo in the area that you selected.
7. With the image selected in the work space, choose Windows > Properties Inspector. The Properties Inspector for the image appears:
   a. Under Colors and Style, change the Transparency to Transparent.
   b. Under Formatting, change Scale Image to Retain Shape.
8. In the Header band, control-click the logo image and the Sales Report text box in the work space to select them.
9. Click the Align Left Sides icon in the Controls toolbox.
10 Choose File > Save to save your changes.
11 Press F12 to preview the report.
12 Close the preview window and readjust the image size and location as needed.

**Add images from a database**
1 From the menu bar, choose Report > Report Query.
2 In the Art table, double-click LARGEIMAGE. The Query Builder adds the LARGEIMAGE column to the select statement.
3 Click the Test Query button. A list of image filenames appears to the right of the ISSOLD column.
4 Close the Test Query window and click the Save button in the Query Builder.
5 In the Report window, expand the Detail band by clicking on the lower splitter bar and dragging down.
6 Click the Add Image icon in the Controls toolbox and drag the mouse in Detail band of the report to the left of the query.ARTNAME field. When you release the mouse, the Image File Name dialog box appears.
7 Navigate to the cfartgallery images directory:
   C:\ColdFusion8\wwwroot\cfdocs\images\artgallery
8 In the File Name field, type #query.largeimage#.
9 Click the Open button. Report Builder adds the column to the Detail band of the report.
10 Align the image column with the top of the Detail band.
11 With the image element selected in the detail band, choose Window > Properties Inspector.
12 Change the following properties:
   a Transparency: Transparent.
   b Scale Image: Retain Shape. This option scales the images proportionately within the bounding box.
   c Error Control: No Image. This option ensures that Report Builder displays blank images rather than generates an error for images missing from the database.
   d Using Cache: False. This option enforces a refresh each time you preview the report output in the browser.
13 Choose File > Save to save your changes.

**Change the report output format**
1 Choose Report > Report Properties from the menu bar.
2 From the Default Output Format pop-up menu, choose RTF. Use this format for faster display in a web browser.
3 Click OK to close the Report Properties dialog box and return to the report.
4 Choose File > Save to save your changes.
5 Press F12 to preview the report. The images are displayed beneath Artist name and to the left of the art title.
Adding charts

You can use the Chart Builder to add two pie charts to your report: the first pie chart shows the total dollar amount of the art sold versus the total dollar amount unsold art for each artist; the second pie chart shows the sum of artwork sold versus unsold for all of the artists.

The two pie charts are the same except for the scope. To apply a pie chart to a group (the ratio of sold to unsold art for each artist), add the pie chart to the group footer band. To apply the pie chart to the report (the ratio of sold to unsold art for all artists), add the pie chart to the report footer band.

In "Adding a calculated field" on page 843, you added a calculated field for the total dollar amount of artwork sold. Before you can create the pie chart for this example, you must create a second calculated field for the total dollar amount of unsold art.

Add a calculated field for the sum of unsold art

1. Choose Window > Fields and Parameters.
2. Select the Calculated Fields heading in the Fields and Parameters panel.
3. Click the (+) icon at the upper edge of the panel:
   a. In the Name field, type Unsold.
   b. In the Default Label Text field, type Unsold.
   c. In the Data Type field, choose Big Decimal from the pop-up menu.
   d. In the Calculation field, choose Sum from the pop-up menu.
In the Perform Calculation On field, enter the following expression to calculate the dollar amount of unsold art:

```csharp
Iif(IsBoolean(query.ISSOLD) and not(query.ISSOLD), query.Price, 0)
```

In the Reset Field When field, choose Group from the pop-up menu.

In the Reset Group field, choose LASTNAME.

Click OK to close the Add Calculated Field dialog box and return to the report.

Choose File > Save from the menu bar to save your changes to the report.

**Add a pie chart to the group footer**

1. Expand the LASTNAME Footer band.

2. Choose Insert > Chart from the Report Builder menu bar:
   a. Choose Pie from the Base Chart Type list. The Chart Sub-Type appears to the right of the Base Chart Type.
   b. Choose the 3-D chart.

3. Click the Next button. Then click the Add button:
   a. In the Series Label field, type **Total Sales**.
   b. In the Paint Style field, choose Light.
   c. In the Data Label field, choose Value.
   d. In the Color List, type **Teal,Gray**.
   e. In the Chart Data Source area, ensure that the Data From A Fixed List of Values option is selected.

4. Click the Add button:
   a. In the Label field, type **Sold**.
   b. In the Value field, choose #calc.Sold# from pop-up menu.
   c. Click OK.

5. Click the Add button again:
   a. In the Label field, type **Unsold**.
   b. In the Value field, choose #calc.Unsold# from the pop-up menu.
   c. Click OK twice to return to the Chart Series dialog box.

6. Click the Next button. In the Chart Formatting dialog box, click the Titles & Series tab and make the following changes:
   a. In the Chart Title field, type **Total Sales** for #query.LASTNAME#.
   b. In the X Axis Title field, type **Sold**.
   c. In the Y Axis Title field, type **Unsold**.
   d. In the Label Format field, choose Currency from the pop-up menu.
   e. Click the 3-D Appearance tab and ensure that Show 3-D is selected.

7. Click the Font tab and make the following changes:
   a. Change the Font Name to Arial.
   b. Change the Font Size to 9.
8 Click the Finish button. Report Builder adds a placeholder for the pie chart in the report.
9 Resize and move the chart to the desired location within the LASTNAME Footer band.
10 Choose File > Save to save your changes to the report.
11 Press F12 to preview the report.

Add a pie chart to the report footer
1 Create two calculated fields to use in the report footer pie chart with the following parameters:

<table>
<thead>
<tr>
<th>Name</th>
<th>TotalSold</th>
<th>TotalUnsold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Label Text:</td>
<td>Total Sold</td>
<td>Total Sold</td>
</tr>
<tr>
<td>Data Type:</td>
<td>Big Decimal</td>
<td>Big Decimal</td>
</tr>
<tr>
<td>Calculation:</td>
<td>Sum</td>
<td>Sum</td>
</tr>
<tr>
<td>Perform Calculation On:</td>
<td>Iif(IsBoolean(query.ISSOLD) and query.ISSOLD, query.Price,0)</td>
<td>Iif(IsBoolean(query.ISSOLD) and not(query.ISSOLD), query.Price,0)</td>
</tr>
<tr>
<td>Initial Value:</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reset Field When:</td>
<td>Report (Changes)</td>
<td>Report (Changes)</td>
</tr>
<tr>
<td>Reset Group:</td>
<td>LASTNAME</td>
<td>LASTNAME</td>
</tr>
</tbody>
</table>

2 Expand the Report Footer band, which is located directly below the Page Footer band.
3 Copy the pie chart from the Group Footer and paste it in the Report Footer.
4 Double-click the pie chart and click the Next button.
5 Double-click Total Sales to display the Edit Chart Series dialog box.
6 Change the Series Label to Total Sales for Artists.
7 Change the chart series values:

<table>
<thead>
<tr>
<th>Label</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sold</td>
<td>#calc.TotalSold#</td>
</tr>
<tr>
<td>Unsold</td>
<td>#calc.TotalUnsold#</td>
</tr>
</tbody>
</table>

8 Click the Next button, and then Click the Title & Series tab.
9 Change the Chart Title to Total Sales for Artists, and click Finish.
10 Choose File > Save from the menu bar to save your changes to the report.
11 Press F12 to preview the report.

The Total Sales for Artists pie chart should appear only on the last page of the report. Verify that the calculations are correct.

Using Cascading Style Sheets
The Report Creation Wizard automatically creates and applies the following styles to your report:

- ReportTitle
The instructions on “Adding and formatting fields” on page 844 show how to add a field called GroupFooter and apply it to a text field and a data field in the GroupFooter band. You can export the styles in a report to a CSS file. Report Builder automatically generates the CSS code for the styles. This is an efficient way to maintain a single set of styles to use with multiple reports. You can modify the styles in the CSS file by using any text editor and either import the CSS file in Report Builder or override the styles in the report at run time.

**Export report styles to a CSS file**

2. Click the export icon (the icon with the orange arrow).
3. In the File Name field, type `artstyles`. Report Builder automatically adds the CSS extension.
4. Navigate the `artStyles.css` file and double-click on it to open it. The following example shows the generated CSS code:

```css
ReportTitle
{
    color:Black;
    font-size:24pt;
}
CompanyName
{
    color:#6188A5;
    font-weight:bold;
}
PageTitle
{
    color:#333333;
    font-size:14pt;
    font-weight:bold;
}
ReportDate
{
    color:#333333
}
SubTitle
{
    color:#6089A5;
    font-size:12pt;
    font-weight:bold;
}
DetailLabel
{
    color:Black;
```
Change the ReportTitle style color attribute to Red and add the font-weight attribute, as the following code shows:

```
ReportTitle
{
  color:Red;
  font-size:24pt;
  font-weight: bold;
}
```

5 Save the CSS file.

Also, you can override report styles from ColdFusion. Form more information, see “Overriding report styles” on page 853.

**Note:** If you add a style to the CSS file, you must add a style with the same name to the report in Report Builder. Also, Report Builder does not support all CSS styles. For more information, see the `cfreport` tag in the CFML Reference.

**Import the CSS file**

1 Choose Window > Report Styles.
2 Click the import styles icon (the one with the blue arrow).
3 Navigate to the location of the artStyles.css file, and click OK. Report Builder automatically updates the report style definition and applies the updated style to report title.
4 Press F12 to preview the report.
Overriding report settings at run time

You can use the `cfreport` tag in ColdFusion to override report settings in a Report Builder report at run time. The examples use the CFR file that you created in “Creating a simple report” on page 840.

Overriding the report query

This example filters the data in the report based on the log-in ID of the artist. When the artist logs on, the report displays the data and pie chart for that artist. The report also includes the pie chart with data from all the artists.

The following code creates a simple log-in page in ColdFusion. The form uses artist's last name as the user ID. (The code does not include password verification):

```cfc
<h3>Artist Login Form</h3>
<p>Please enter your last name and password.</p>
<cfform name="loginform" action="artSalesReport.cfm" method="post">
<table>
<tr>
<td>Last Name:</td>
<td><cfinput type="text" name="username" required="yes" message="A username is required."></td>
</tr>
<tr>
<td>Password:</td>
<td><cfinput type="password" name="password" required="yes" message="A password is required."></td>
</tr>
</table>
<br />
<cfinput type="submit" name="submit" value="Submit">
</cfform>
```

On the processing page, add a query similar to the one you created in the Report Builder report. The ColdFusion query must contain at least all of the columns included in the Report Builder query; however, the ColdFusion query can contain additional data.

The query in the following example selects all of the data from the ART and ARTISTS tables based on the artist's last name. The `cfreport` tag uses the pathname of the CFR file as the report template.

```cfc
<cfquery name="artsales" datasource="cfartgallery">
SELECT *
FROM APP.ART, APP.ARTISTS
WHERE APP.ART.ARTISTID = APP.ARTISTS.ARTISTID
AND APP.ARTISTS.LASTNAME = <cfqueryparam value="#FORM.username#">
ORDER BY ARTISTS.LASTNAME
</cfquery>
```

ColdFusion displays the report for the artist in RTF format. Notice that the value of the `format` attribute overrides the Default Output format defined in the CFR file.

Exporting the report in HTML format

To generate a report in HTML format and display it directly in the browser, change the format attribute to HTML:

```cfc
<cfreport template="ArtSalesReport1.cfr" format="RTF"/>
```

ColdFusion automatically generates a temporary directory where it stores all of the image files in the report (charts are saved as PNG files). The location of the temporary directory is:

`C:\ColdFusion8\tmpCache\CFFileServlet\_cfreport\_report[unique_identifier]`
You can specify when the temporary directory is removed from the server by using the `CreateTimeSpan` function as a value for the `resourceTimespan` attribute:

```cfreport
<cfreport query="#artsales#" template="ArtSalesReport1.cfr" format="HTML"
  resourceTimespan="#CreateTimeSpan(0,1,0,0)#"/>
</cfreport>
```

You can specify the time span in days, hours, minutes, and seconds. In this example, the temporary directory is deleted after one hour. For more information, see the `CFML Reference`.

To export the report output to an HTML file, specify the `filename` attribute. The following code writes the report output to an HTML file called `artSales.html`:

```cfreport
<cfreport template="ArtSalesReport1.cfr" format="HTML" filename="artSales.html"
  overwrite="yes"/>
</cfreport>
```

ColdFusion creates an image directory relative to the HTML output file in the format `filename_files`. In this example, ColdFusion automatically generates PNG files for the charts in the report and saves them to a directory called `artSales_files`. Also, it generates copies of all of the JPG images extracted from the cfartgallery database and stores them in the `artSales_files` directory. For more information, see the `CFML Reference`.

**Overriding report styles**

To override the report styles in a report, specify the `style` attribute of the `cfreport` tag. The value must contain valid CSS syntax, the pathname to a CSS file, or a variable that points to valid CSS code. The CSS style names must match the report style names defined in Report Builder.

The following code shows how to override the styles in the `ArtSalesReport1.cfr` report with the styles defined in the `artStyles.css` file:

```cfreport
<cfreport template="ArtSalesReport1.cfr" style="artStyles.css" format="PDF"/>
</cfreport>
```

The following code shows how to apply a CSS style as a value of the `style` attribute:

```cfreport
<cfreport template="ArtSalesReport1.cfr" style='ReportTitle {defaultStyle: false;
  font-family:"Tahoma"; color: "lime";}' format="FlashPaper">
</cfreport>
```

The following code shows how to create a variable called `myStyle` and use it as a value of the `style` attribute:

```cfset
mystyle='DetailData { defaultStyle: true; font-family: "Tahoma"; color: "#00FFFF;"}'>
<cfreport template="ArtSalesReport1.cfr" style="#mystyle#" format="HTML">
</cfreport>
```

For more information, see the `cfreport` tag in the `CFML Reference`. 
Chapter 46: Creating Slide Presentations

You can use Adobe ColdFusion to create slide presentations.

About ColdFusion presentations
ColdFusion lets you create dynamic slide presentations from source files and from CFML and HTML code on a ColdFusion page. You can use data extracted from a database to populate the slide content, including graphs and charts. Also, you can add images, audio tracks, and video clips to each slide in the presentation. ColdFusion provides three tags for creating slide presentations:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfpresentation</td>
<td>Defines the look of the presentation and determines whether the presentation is saved to files or run directly in the client browser.</td>
</tr>
</tbody>
</table>
| cfpresentationslide | Defines the content of the slide from one of the following:  
• A SWF file  
• An HTML file  
• A URL that returns HTML content  
• HTML and CFML code in the cfpresentationslide start and end tags |
| cfpresenter       | Provides information about the person presenting a slide. You can assign a presenter to one or more slides. Presenter information is displayed in the control panel for the duration of the slide. |

You specify at least one slide for the presentation and can assign each presenter to one or more slides. The following example shows a slide presentation with content from four different sources and two presenters:

```xml
<cfpresentation title="myPresentation">
  <cfpresenter name="Tuckerman" title="V.P. of Marketing" email="tuckerman@company.com">
    <cfpresentationslide src="slide1.swf" title="Overview" duration="10" presenter="Anne"/>
    <cfpresentationslide src="slide2.htm" title="Q1 Sales" duration="30" presenter="Anne"/>
  </cfpresenter>
  <cfpresenter name="Anne" title="V.P. of Sales" email="anne@company.com">
    <cfpresentationslide title="Summary" duration="10">
      <h3>Summary</h3>
      <ul>
        <li>Projected Sales</li>
      </ul>
    </cfpresentationslide>
  </cfpresenter>
</cfpresentation>
```
<li>Challenges Ahead</li>
<li>Long Term Goals</li>
</ul>
</cfpresentationslide>
</cfpresentation>

Note: The `cfpresentationslide` tag requires an end tag. If you specify a source file as the content for the slide instead of CFML and HTML code within start and end tags, use the end slash as a shortcut for the end tag.

When the presentation runs, the slides appear in the order they are listed on the ColdFusion page for the duration specified in each slide. The presenter information is displayed in a control panel next to the slide to which it is assigned.

Creating a slide presentation

Use the `cfpresentation` tag to customize the look of the slide presentation, including where the controls appear and the colors used in the presentation interface, as the following example shows:

```xml
<cfpresentation title="Sales Presentation" controlLocation="left" primaryColor="##0000FF" shadowColor="###000033" textColor="##FFFF00" showNotes="yes">
```

The title appears at the top of the control panel. The color settings affect the presentation interface, but not the format of the slides within the presentation. Set the `showNotes` attribute to `yes` to display text notes that are defined for individual slides.

If you do not specify a directory, as in the previous example, ColdFusion runs the presentation directly in the client browser from files written to a temp directory on the server. To save the presentation, specify an absolute path or a directory relative to the CFM page. (ColdFusion does not create the directory; it must exist already.) In the following example, the presentation files are stored in the salesPresentation directory on the local drive:

```xml
<cfpresentation title="Sales Presentation" directory="c:\salesPresenation">
```

ColdFusion automatically generates the following files necessary to run the presentation and saves them in the specified directory:

- `components.swf`
- `index.htm`
- `loadflash.js`
- `viewer.swf`

Also, ColdFusion creates a subdirectory called data where it stores the following files:

- `srchdata.xml` (which creates the search interface)
- `vconfig.xml`
- `viewer.xml`
- A SWF file generated for each slide in the presentation
- Copies of the media files referenced in the presentation slides

Media files can include JPEG files, FLV and SWF video files, and MP3 audio files. To run the presentation that you saved to files, double-click the `index.htm` file.

Note: ColdFusion does not overwrite the files referenced by the slides in the presentation; changes to the generated presentation files do not affect the source files.
Adding presenters

Optionally, you can add one or more presenters under the `<cfpresentation>` tag. ColdFusion displays the presenter information in the control panel for the current slide to which it is assigned. A slide does not require a presenter.

Use the `<cfpresenter>` tag to specify personal information, such as a title and an e-mail address, and JPEG images for a logo and the person’s image, as the following code shows:

```
<cfpresentation title="Sales Presentation">
  <cfpresenter name="Anne" title="V.P. of Sales" biography="Anne Taylor has been a top seller at Widgets R Us for five years." logo="images/logo.jpg" image="images/ataylor_empPhoto.jpg" email="ataylor@widgetsrus.com">
    The `name` attribute is required. You use this value to assign the presenter to one or more slides. To assign a presenter to a slide, use the value of the `name` attribute defined in the `<cfpresenter>` tag as the value for the `presenter` attribute in the `<cfpresentationslide>` tag. The following example creates a presenter named Tuckerman and assigns him to a slide called Overview:

    <cfpresentation title="Sales Presentation">
      <cfpresenter name="Tuckerman" title="V.P. of Marketing">
        <cfpresentationslide title="Overview" src="overview.swf" presenter="Tuckerman" duration="10"/>
        ...
      </cfpresenter>
    </cfpresentation>

    Note: You must assign presenters explicitly to slides. To assign a presenter to more than one slide, use the presenter name in each of the `<cfpresentationslide>` tags.

    When you assign a presenter to a slide, the presenter information is displayed in the control panel for the duration of the slide. Images must be in JPEG format and the files must be located in a pathname relative to the ColdFusion page. ColdFusion maps the value of the `email` attribute to the contact link in the control panel, which opens an e-mail message in the local e-mail application when you click on it.

    The following code creates three presenters for a presentation and assigns two of the presenters to slides:

    <cfpresentation title="Sales Presentation">
      <cfpresenter name="Hannah" title="V.P. of Marketing" image="hannah.jpg">
        <cfpresenter name="Anne" title="V.P. of Sales" image="Anne.jpg">
          <cfpresenter name="Wilson" title="V.P. of Engineering" image="Wilson.jpg">
            <cfpresentationslide title="Overview" presenter="Hannah" duration="30" src="slide1.htm"/>
            <cfpresentationslide title="Q1 Sales" presenter="Anne" duration="15" src="slide2.htm"/>
            <cfpresentationslide title="Projected Sales" presenter="Anne" duration="15" src="slide3.htm" video="promo.flv"/>
            <cfpresentationslide title="Conclusion" src="slide4.htm"/>
          </cfpresenter>
        </cfpresenter>
      </cfpresenter>
    </cfpresentation>

    The presenter Hannah is assigned to one slide and Anne is assigned to two slides. The last slide in the presentation has no presenter assigned to it. Because Wilson is not assigned to a slide, his information does not appear in the presentation. In the second slide, Anne's photo is displayed in the control panel. In the third slide, however, the video called promo.flv runs in place of Anne's photo in the control panel (not in the slide itself) for the duration of the slide.

    Note: Videos must be in SWF or FLV format. You cannot specify audio and video for the same slide.
Adding slides

Use one `cfpresentationslide` tag for each slide in the presentation. The presentation runs the slides in the order they are listed beneath the `cfpresentation` tag. You can create content for a slide in one of the following ways:

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SWF or HTML file</td>
<td>The file must be located on the system running ColdFusion. You can specify an absolute path or a path relative to the ColdFusion page.</td>
<td><code>&lt;cfpresentationslide title=&quot;slide 1&quot; src=&quot;presentation/slide1.swf&quot;/&gt;</code></td>
</tr>
<tr>
<td></td>
<td></td>
<td><code>&lt;cfpresentationslide title=&quot;slide 2&quot; src=&quot;/c:/presentation/slide2.htm&quot;/&gt;</code></td>
</tr>
<tr>
<td>A URL</td>
<td>The URL must return HTML content.</td>
<td><code>&lt;cfpresentationslide title=&quot;slide 3&quot; src=&quot;http://www.worldview.com/index.htm&quot;/&gt;</code></td>
</tr>
</tbody>
</table>
| HTML and CFML code on the ColdFusion page | Enclose the HTML and CFML code within the `cfpresentationslide` start and end tags. | `</cfpresentationslide>`

Creating content from source files

The following code creates a presentation with three slides from source files in different locations:

```coldfusion
<cfpresentation title="Garden Mania" directory="gardenPresentation">
  <cfpresentationslide title="Seeds of Change" src="/c:/gardening/seeds.html" audio="/media/hendrix.mp3" duration="30"/>
  <cfpresentationslide title="Flower Power" src="/shockwave/flowerPower.swf" duration="40"/>
  <cfpresentationslide title="Dig Deep" src="http://www.smartgarden.com/index.htm" duration="15"/>
</cfpresentation>
```

In this example, ColdFusion generates the files required to run the presentation in the gardenPresentation directory and a new SWF file from each of the slides in the data subdirectory. ColdFusion also copies the hendrix.mp3 file and saves it in the data subdirectory.

*Note: Links within slides created from HTML files are not active.*

Creating content from HTML and CFML code

If you do not specify a source file for a slide, you must create the content by using HTML or CFML code in the `cfpresentationslide` start and end tags on the ColdFusion page. The following presentation contains one slide with content generated from HTML, one slide with content generated from HTML and CFML code, and one slide with content extracted from an HTML file from an external website:

```coldfusion
<cfpresentation title="The Road Ahead">
  <cfpresentationslide title="Yellow Bricks" audio="/myaudiol.mp3" duration="10">
    <h3>Yellow Bricks</h3>
    <table cellpadding=10>
      <tr>
        <td>
          <ul>
            <li>Way to go Dorothy</li>
            <li>Making tracks</li>
            <li>No place like home</li>
          </ul>
        </td>
      </tr>
    </table>
  </cfpresentationslide>
</cfpresentation>
```
Note: The value for the format attribute of the cfchart tag must be JPG or PNG.

The content for slides is not limited to static data; you can generate content from information extracted from a database or a query of queries.

Sample presentations

This section provides two sample presentations.

Example 1

The following example creates a simple presentation that incorporates data retrieved from the cfdocexamples database. It shows how to perform the following tasks:

- Create slides generated from HTML and CFML.
- Add images to slides.
- Add charts and tables with data extracted from a database.
- Add audio tracks to individual slides.

<!---- The following query extracts employee data from the cfdocexamples database. --->
<cfquery name="GetSalaryDetails" datasource="cfdocexamples">
  SELECT Departmt.Dept_Name,
         Employee.FirstName,
         Employee.LastName,
         Employee.StartDate,
         Employee.Salary,
         Employee.Contract
  From Departmt, Employee
  WHERE Departmt.Dept_ID = Employee.Dept_ID
  ORDER BY Employee.LastName, Employee.FirstName
</cfquery>

<!---- The following code creates a presentation with three presenters. --->
<cfpresentation title="Employee Satisfaction" primaryColor="#0000FF" glowColor="#FF00FF"
lightColor="#FFFF00" showoutline="no">
  <cfpresenter name="Jeff" title="CFO" email="jeff@company.com"
  logo="../cfdocs/getting_started/photos/somewhere.jpg" image="../cfdocs/images/artgallery/jeff01.jpg">
  <cfpresenter name="Lori" title="VP Marketing" email="lori@company.com"
  logo="../cfdocs/getting_started/photos/somewhere.jpg" image="../cfdocs/images/artgallery/lori01.jpg">
  <cfpresenter name="Paul" title="VP Sales" email="paul@company.com"
  logo="../cfdocs/getting_started/photos/somewhere.jpg" image="../cfdocs/images/artgallery/paul01.jpg">

<!---- The following code creates the first slide in the presentation from HTML. --->
  <cfpresentationslide title="Introduction" presenter="Jeff"
    audio="myAudio1.mp3" duration="5">
    <h3>Introduction</h3>
    <table>
      <tr><td>
        <ul>
          <li>Company Overview</li>
          <li>Salary by Department</li>
          <li>Employee Salary Details</li>
        </ul>
      </td></tr>
    </table>
  </cfpresentationslide>

<!---- The following code creates the second slide in the presentation. The chart is populated with data from the database query. --->
  <cfpresentationslide title="Salary by Department" presenter="Lori"
    duration="5" audio="myAudio3.mp3">
    <h3>Salary by Department</h3>
    <cfchart format="jpg" xaxistitle="Department" yaxistitle="Salary">
      <cfchartseries type="bar" query="GetSalaryDetails"
        itemcolumn="Dept_Name" valuecolumn="salary">
      </cfchartseries>
    </cfchart>
  </cfpresentationslide>

<!---- The following code creates the third slide in the presentation. The table is populated with data from the query. The table also contains an image located relative to the CFM page on the server. --->
  <cfpresentationslide title="Salary Details" presenter="Paul"
    duration="10" audio="myAudio1.mp3">
    <h3>Employee Salary Details</h3>
    <table border cellspacing=0 cellpadding=5 valign="top">
      <tr>
        <th>Employee Name</th>
        <th>Start Date</th>
        <th>Salary</th>
        <th>Department</th>
        <th>Contract?</th>
      </tr>
      <cfoutput query="GetSalaryDetails">
        <tr>
          <td>#FirstName# #LastName#</td>
          <td>#dateFormat(StartDate, "mm/dd/yyyy")#</td>
        </tr>
      </cfoutput>
    </table>
  </cfpresentationslide>
</cfpresentation>
Example 2

The following example shows how to create a simple sales presentation with data from the cfartgallery database. Specifically, it shows how to perform the following tasks:

- Create slides generated from HTML and CFML.
- Create a slide from a URL that returns HTML content.
- Add charts with data extracted from a database and a query of queries.
- Add video and audio tracks to individual slides.

<!--- The following query extracts data from the cfartgallery database. --->
<cfquery name="artwork" datasource="cfartgallery">
SELECT FIRSTNAME || ' '|| LASTNAME AS FULLNAME, ARTISTS.ARTISTID, ARTNAME, PRICE, ISSOLD
FROM ARTISTS, ART
WHERE ARTISTS.ARTISTID = ART.ARTISTID
ORDER BY LASTNAME
</cfquery>

<!--- The following query of queries determines the total dollar amount of sales per artist. --->
<cfquery dbtype="query" name="artistname">
SELECT FULLNAME,
SUM(PRICE) AS totalSale
FROM ARTWORK
WHERE ISSOLD = 1
GROUP BY FULLNAME
ORDER BY totalSale
</cfquery>

<!--- The following code determines the look of the slide presentation. ColdFusion displays the slide presentation directly in the browser because no destination is specified. The title appears above the presenter information. --->
<cfpresentation title="Art Sales Presentation" primaryColor="#0000FF" glowColor="#FF00FF" lightColor="#FFFF00" showOutline="yes" showNotes="yes"/>

<!--- The following code defines the presenter information. You can assign each presenter to one or more slides. --->
<cfpresenter name="Aiden" title="Artist" email="Aiden@artgallery.com" image="../cfdocs/images/artgallery/aiden01.jpg">
<cfpresenter name="Raquel" title="Artist" email="raquel@artgallery.com" image="../cfdocs/images/artgallery/raquel05.jpg">
<cfpresenter name="Paul" title="Artist" email="paul@artgallery.com" image="../cfdocs/images/artgallery/paul01.jpg">
<!---- The following code defines the content for the first slide in the presentation. The duration of the slide determines how long the slide plays before proceeding to the next slide. The audio plays for the duration of the slide. --->
<cfpresentationslide title="Introduction" presenter="Aiden" duration="5">
  <h3>Introduction</h3>
  <table>
    <tr><td>
      <ul>
        <li>Art Sales Overview</li>
        <li>Total Sales</li>
        <li>Total Sales by Artist</li>
        <li>Conclusion</li>
      </ul>
    </td>
    <td><img src="../cfdocs/images/artgallery/maxwell01.jpg"/></td>
  </table>
</cfpresentationslide>

<!---- The following code generates the second slide in the presentation from an HTML file located on an external website. --->
<cfpresentationslide title="Artwork Sales Overview" presenter="Raquel" audio="myAudio2.mp3" duration="5" src="http://www.louvre.com/index.html"/>

<!---- The following code generates the third slide in the presentation, which contains a pie chart with data extracted from the initial database query. Although the presenter is the same as in the first slide, ColdFusion runs the video defined in the cfpresentationslide tag in place of the image defined in the cfpresenter tag. --->
<cfpresentationslide title="Total Artwork Sold" presenter="Aiden" duration="5" video="video1.flv">
  <h3>Total Sales</h3>
  <cfchart format="jpg" chartwidth="500" show3d="yes">
    <cfchartseries type="pie" query="artwork" colorlist="##00FFFF,##FF00FF" itemcolumn="issold" valuecolumn="price"/>
  </cfchart>
</cfpresentationslide>

<!---- The following code generates the fourth slide in the presentation with data extracted from the query of queries. --->
<cfpresentationslide title="Sales by Artist" presenter="Paul" duration="5" audio="myAudio3.mp3">
  <h3>Total Sales by Artist</h3>
  <table border cellspacing=10 cellpadding=0>
    <TR>
      <TD>
        <table border cellspacing=0 cellpadding=5>
          <tr>
            <th>Artist Name</th>
            <th>Total Sales</th>
          </tr>
          <cfoutput query="artistname">
            <tr>
              <td>#FULLNAME#</td>
              <td>#dollarFormat(totalSale)#</td>
            </tr>
          </cfoutput>
        </table>
      </TD>
    </TR>
  </table>
</cfpresentationslide>
<cfchart format="jpg" xaxistitle="Artist" yaxistitle="Total Sales"
chartwidth="400">
  <cfchartseries type="bar" query="artistname"
  itemcolumn="fullname" valuecolumn="totalSale"/>
</cfchart>
</td>
</tr>
</table>
</cfpresentationslide>

<!--- The following code defines the final slide in the presentation. This slide does not
have a presenter assigned to it. --->
<cfpresentationslide title="Conclusion" duration="1" notes="Special thanks to Lori and
Jeff for contributing their art and expertise.">
  <h1>Great Job Team!</h1>
  <p><img src="../cfdocs/images/artgallery/paul05.jpg"></p>
</cfpresentationslide>
</cfpresentation>
Part 7: Using Web Elements and External Objects

This part contains the following topics:

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Using Web Services ................................................................. 900
Integrating J2EE and Java Elements in CFML Applications ................ 927
Using Microsoft .NET Assemblies ............................................ 950
Integrating COM and CORBA Objects in CFML Applications ............ 972
Chapter 47: Using XML and WDDX

You can use ColdFusion to create, use, and manipulate XML documents. You can also use Web Distributed Data Exchange (WDDX), an XML dialect, for transmitting structured data, including transferring data between applications and between CFML and JavaScript. To use these technologies, you should be familiar with XML.

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About XML and ColdFusion

XML has rapidly become the universal language for representing documents and data on the web. These documents can extend beyond the traditional concept of a paper document or its equivalent. For example, XML is often used to represent database or directory information. XML is also commonly used to represent transaction information, such as product orders or receipts, and for information such as inventory records and employee data.

Because XML represents data in a tagged, textual format it is an excellent tool for representing information that must be shared between otherwise-independent applications such as order entry and inventory management. No application needs to know anything about the other. Each application only needs to be prepared to get data in a format that is structured according to the XML DTD or Schema. For example, in a distributed order processing application, the order placement component, order fulfilment component, inventory management component, and billing component can all share information with each other in XML format. They could use a common XML DTD, of different components could communicate with each other using different DTDs.

After an application parses the XML document, it can then manipulate the information in any way that is appropriate. For example, you can convert tabular XML data into a ColdFusion recordset, perform queries on the data and then export the data as an XML document. For example, the code in “Example: using XML in a ColdFusion application” on page 886 takes a customer order in XML, converts the data to a recordset, and uses a query to determine the order cost. It then prepares a receipt as an XML document.

ColdFusion provides a comprehensive and easy-to-use set of tools for creating and using XML documents. ColdFusion lets you do the following with XML documents:

- Convert XML text into ColdFusion XML document objects.
- Create new ColdFusion XML document objects.
- Modify ColdFusion XML document objects.
- Validate XML against a DTD or Schema
- Transform XML using XSLT (Extensible Stylesheet Language Transformation).
- Extract data from XML documents using XPath expressions.
- Convert ColdFusion XML document objects to text and save them in files.

ColdFusion can also represent forms that you create using the `cfform` tag as XML. You can have ColdFusion generate the XML and process it using an XSLT skin to generate output for display, or ColdFusion can generate XML text and put it in a variable for further processing. For more information on XML Forms, see “Creating Skinnable XML Forms” on page 594

**The XML document object**

ColdFusion represents an XML document as an object, called an *XML document object*, that is much like a standard ColdFusion structure. In fact, most ColdFusion structure functions, such as `StructInsert`, work with XML document objects. For a full list of ColdFusion functions that work on XML document objects, see “Functions for XML object management” on page 877.

You can look at the overall structure of an XML document in two ways: a basic view and a DOM (Document Object Model)-based node view. The basic view presents all the information in the document, but does not separate the data into as fine-grained units as the node view. ColdFusion can access XML document contents using either view.

**A simple XML document**

The next sections describe the basic and node views of the following simple XML document. This document is used in many of the examples in this chapter.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<employee>
 <!-- A list of employees -->
 <name EmpType="Regular">
   <first>Almanzo</first>
   <last>Wilder</last>
 </name>
 <name EmpType="Contract">
   <first>Laura</first>
   <last>Ingalls</last>
 </name>
</employee>
```

**Basic view**

The basic view of an XML document object presents the object as a container that holds one root element structure. The root element can have any number of nested element structures. Each element structure represents an XML tag (start tag/end tag set) and all its contents; it can contain additional element structures. A basic view of the simple XML document looks like the following:
DOM node view

The DOM node view presents the XML document object using the same format as the document’s XML Document Object Model (DOM). In fact, an XML document object is a representation of a DOM object.

The DOM is a World Wide Web Consortium (W3C) recommendation (specification) for a platform- and language-neutral interface to dynamically access and update the content, structure, and style of documents. ColdFusion conforms to the DOM Level 2 Core specification, available at www.w3.org/TR/DOM-Level-2-Core.

In the DOM node view, the document consists of a hierarchical tree of nodes. Each node has a DOM node type, a node name, and a node value. Node types include Element, Comment, Text, and so on. The DOM structures the document object and each of the elements it contains into multiple nodes of different types, providing a finer-grained view of the document structure than the basic view. For example, if an XML comment is in the middle of a block of text, the DOM node view represents its position in the text while the basic view does not.

ColdFusion also lets you use the DOM objects, methods, and properties defined in the W3C DOM Level 2 Core specification to manipulate the XML document object.

For more information on referencing DOM nodes, see “XML DOM node structure” on page 869. This document does not cover the node view and using DOM methods and properties in detail.

XML document structures

An XML document object is a structure that contains a set of nested XML element structures. The following image shows a section of the cfdump tag output for the document object for the XML in “A simple XML document” on page 866. This image shows the long version of the dump, which provides complete details about the document object. Initially, ColdFusion displays a short version, with basic information. Click the dump header to change between short, long, and collapsed versions of the dump.
The following code displays this output. It assumes that you save the code in a file under your web root, such as C:\inetpub\wwwroot\testdocs\employeessimple.xml

```cfc
<cffile action="read" file="C:\inetpub\wwwroot\testdocs\employeessimple.xml" variable="xmldoc">
<cfset mydoc = XmlParse(xmldoc)>
<cfdump var="#mydoc#">
```

**The document object structure**

At the top level, the XML document object has the following three entries:

<table>
<thead>
<tr>
<th>Entry name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmlRoot</td>
<td>Element</td>
<td>The root element of the document.</td>
</tr>
<tr>
<td>XmlComment</td>
<td>String</td>
<td>A string made of the concatenation of all comments on the document, that is, comments in the document prologue and epilog. This string does not include comments inside document elements.</td>
</tr>
<tr>
<td>XmlDocType</td>
<td>XmlNode</td>
<td>The DocType attribute of the document. This entry only exists if the document specifies a DocType. This value is read-only; you cannot set it after the document object has been created. This entry does not appear when the <code>cfdump</code> tag displays an XML element structure.</td>
</tr>
</tbody>
</table>

**The element structure**

Each XML element has the following entries:

<table>
<thead>
<tr>
<th>Entry name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmlName</td>
<td>String</td>
<td>The name of the element; includes the namesapce prefix.</td>
</tr>
<tr>
<td>XmlNsPrefix</td>
<td>String</td>
<td>The prefix of the namespace.</td>
</tr>
<tr>
<td>XmlNsURI</td>
<td>String</td>
<td>The URI of the namespace.</td>
</tr>
</tbody>
</table>
### XML DOM node structure

The following table lists the contents of an XML DOM node structure:

<table>
<thead>
<tr>
<th>Entry name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmlName</td>
<td>String</td>
<td>The node name. For nodes such as Element or Attribute, the node name is the element or attribute name.</td>
</tr>
<tr>
<td>XmlType</td>
<td>String</td>
<td>The node XML DOM type, such as Element or Text.</td>
</tr>
<tr>
<td>XmlValue</td>
<td>String</td>
<td>The node value. This entry is used only for Attribute, CDATA, Comment, and Text type nodes.</td>
</tr>
</tbody>
</table>

**Note:** The tag does not display XmlNode structures. If you try to dump an XmlNode structure, the `cfdump` tag displays "Empty Structure."

The following table lists the contents of the XmlName and XmlValue fields for each node type that is valid in the XmlType entry. The node types correspond to the objects types in the XML DOM hierarchy.

<table>
<thead>
<tr>
<th>Node type</th>
<th>XmlName</th>
<th>xmlValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDATA</td>
<td><code>#cdata-section</code></td>
<td>Content of the CDATA section</td>
</tr>
<tr>
<td>COMMENT</td>
<td><code>#comment</code></td>
<td>Content of the comment</td>
</tr>
<tr>
<td>ELEMENT</td>
<td>Tag name</td>
<td>Empty string</td>
</tr>
<tr>
<td>ENTITYREF</td>
<td>Name of entity referenced</td>
<td>Empty string</td>
</tr>
<tr>
<td>PI (processing instruction)</td>
<td>Target entire content excluding the target</td>
<td>Empty string</td>
</tr>
<tr>
<td>TEXT</td>
<td><code>#text</code></td>
<td>Content of the text node</td>
</tr>
<tr>
<td>ENTITY</td>
<td>Entity name</td>
<td>Empty string</td>
</tr>
<tr>
<td>NOTATION</td>
<td>Notation name</td>
<td>Empty string</td>
</tr>
<tr>
<td>DOCUMENT</td>
<td><code>#document</code></td>
<td>Empty string</td>
</tr>
<tr>
<td>FRAGMENT</td>
<td><code>#document-fragment</code></td>
<td>Empty string</td>
</tr>
<tr>
<td>DOCTYPE</td>
<td>Document type name</td>
<td>Empty string</td>
</tr>
</tbody>
</table>
**Note:** Although XML attributes are nodes on the DOM tree, ColdFusion does not expose them as XML DOM node data structures. To view an element’s attributes, use the element structure’s XMLAttributes structure.

The XML document object and all its elements are exposed as DOM node structures. For example, you can use the following variable names to reference nodes in the DOM tree that you created from the XML example in "A simple XML document" on page 866:

```plaintext
mydoc.XmlName
mydoc.XmlValue
mydoc.XmlRoot.XmlName
mydoc.employee.XmlType
mydoc.employee.XmlNodes[1].XmlType
```

### ColdFusion XML tag and functions

The following table lists the ColdFusion tag () and functions that create and manipulate XML documents:

<table>
<thead>
<tr>
<th>Tag or function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfxml variable=&quot;objectName&quot;</code> [caseSensitive=&quot;Boolean&quot;]&gt;`</td>
<td>Creates a new ColdFusion XML document object consisting of the markup in the tag body. The tag can include XML and CFML tags. ColdFusion processes all CFML in the tag body before converting the resulting text to an XML document object. If you specify the CaseSensitive=&quot;True&quot; attribute, the case of names of elements and attributes in the document is meaningful. The default value is False. For more information on using the <code>cfxml</code> tag, see &quot;Creating a new XML document object using the <code>cfxml</code> tag&quot; on page 875.</td>
</tr>
<tr>
<td><code>XmlParse (XMLText [, caseSensitive], validator)</code></td>
<td>Converts an XML document in a file or a string variable into an XML document object, and optionally validates the document against a DTD or schema. If you specify the optional second argument as True, the case of names of elements and attributes in the document is meaningful. The default value is False. For more information on using the <code>XmlParse</code> function, see &quot;Creating an XML document object from existing XML &quot; on page 876.</td>
</tr>
<tr>
<td><code>XmlNew([caseSensitive])</code></td>
<td>Returns a new, empty XML document object. If you specify the optional argument as True, the case of names of elements and attributes in the document is meaningful. The default value is False. For more information on using the <code>XmlNew</code> function, see &quot;Creating a new XML document object using the <code>XmlNew</code> function&quot; on page 875.</td>
</tr>
<tr>
<td><code>XmlElemNew(objectName[, namespaceURI], elementName)</code></td>
<td>Returns a new XML document object element with the specified name, optionally belonging to the specified namespace. You can omit the namespaceURI parameter and use only a namespace prefix if the prefix is defined elsewhere in the object. For more information on using the<code>XmlElemNew</code> function, see “Adding an element” on page 880.</td>
</tr>
<tr>
<td><code>XmlTransform(XMLVar, XSLTStringVar[, parameters])</code></td>
<td>Applies an Extensible Stylesheet Language Transformation (XSLT) to an XML document. The document can be represented as a string variable or as an XML document object. The function returns the resulting XML document as a string. For more information on using the<code>XmlTransform</code> function, see &quot;Transforming documents with XSLT&quot; on page 885.</td>
</tr>
</tbody>
</table>
About case-sensitivity and XML document objects
The tags and functions that create XML document objects let you specify whether ColdFusion will treat the object in a case-sensitive manner. If you do not specify case-sensitivity, ColdFusion ignores the case of XML document object component identifiers, such as element and attribute names. If you do specify case-sensitivity, names with different cases refer to different components. For example, if you do not specify case-sensitivity, the names mydoc.employee.name[1] and mydoc.employee.NAME[1] always refer to the same element. If you specify case-sensitivity, these names refer to two separate elements. You cannot use dot notation references for element or attribute names in a case-sensitive XML document; for more information see “Referencing the contents of an XML object” on page 872.

Using an XML object
Because an XML document object is represented as a structure, you can access XML document contents using either, or a combination of both, of the following ways:

<table>
<thead>
<tr>
<th>Tag or function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XmlSearch(objectName, XPathExpression)</td>
<td>Uses an XPath expression to search an XML document object and returns an array of XML elements that match the search criteria. For more information on using the XmlSearch function, see “Extracting data with XPath” on page 886.</td>
</tr>
<tr>
<td>XmlValidate(xmlDoc[, validator])</td>
<td>Uses a Document Type Definition (DTD) or XML Schema to validate an XML text document (in a string or file) or an XML document object. The validator can be a DTD or Schema. If you omit the validator parameter, the document must specify a DTD or schema. For more information on using the XmlValidate function, see “Validating XML documents” on page 885.</td>
</tr>
<tr>
<td>XmlChildPos(element, elementName, position)</td>
<td>Returns the position (index) in an XmlChildren array of the Nth child with the specified element name. For example, XmlChildPos(mydoc.employee, &quot;name&quot;, 2) returns the position in mydoc.employee.XmlChildren of the mydoc.employee.name[2] element. This index can be used in the ArrayInsertAt and ArrayDeleteAt functions. For more information on using the XmlChildPos function, see “Determining the position of a child element with a common name” on page 880, “Adding an element” on page 880, and “Deleting elements” on page 882.</td>
</tr>
<tr>
<td>XmlGetNodeType(xmlNode)</td>
<td>Returns a string identifying the type of an XML document object node returned by the function or in an element’s XmlNodes array.</td>
</tr>
<tr>
<td>IsWDDX(String)</td>
<td>Determines whether a string is a well-formed WDDX packet.</td>
</tr>
<tr>
<td>IsXML(String)</td>
<td>Determines whether a string is well-formed XML text.</td>
</tr>
<tr>
<td>IsXmlAttribute(variable)</td>
<td>Determines whether the function parameter is an XML Document Object Model (DOM) attribute node.</td>
</tr>
<tr>
<td>IsXmlDoc(objectName)</td>
<td>Returns True if the function argument is an XML document object.</td>
</tr>
<tr>
<td>IsXmlElem(elementName)</td>
<td>Returns True if the function argument is an XML document object element.</td>
</tr>
<tr>
<td>IsXmlNode(variable)</td>
<td>Determines whether the function parameter is an XML document object node.</td>
</tr>
<tr>
<td>IsXmlRoot(elementName)</td>
<td>Returns True if the function argument is the root element of an XML document object.</td>
</tr>
<tr>
<td>ToString(objectName)</td>
<td>Converts an XML document object to a string representation.</td>
</tr>
<tr>
<td>XmlFormat(string)</td>
<td>Escapes special XML characters in a string so that the string can be used as text in XML.</td>
</tr>
</tbody>
</table>
• Using the element names, such as mydoc.employee.name[1]
• Using the corresponding structure entry names (that is, XmlChildren array entries), such as mydoc.employee.XmlChildren[1]

Similarly, you can use either, or a combination of both, of the following notation methods:
• Structure (dot) notation, such as mydoc.employee
• Associative array (bracket) notation, such as mydoc["employee"]

Referencing the contents of an XML object

Use the following rules when you reference the contents of an XML document object on the right side of an assignment or as a function argument:

• By default, ColdFusion ignores element name case. As a result, it considers the element name MyElement and the element name myElement to be equivalent. To make element name matching case-sensitive, specify CaseSensitive="True" in the cfxml tag, or specify True as a second argument in the XmlParse or XmlNew function that creates the document object.
• If your XML object is case sensitive, do not use dot notation to reference an element or attribute name. Use the name in associative array (bracket) notation, or a reference that does not use the case-sensitive name. For example, do not use names such as the following:
  MyDoc.employee.name[1]
  MyDoc.employee.XmlAttributes.Version

  Instead, use names such as the following:
  MyDoc.xmlRoot.XmlChildren[1]
  MyDoc.xmlRoot["name"][1]
  MyDoc."employee"."name"[1]

  MyDoc.xmlRoot.XmlAttributes["Version"]
  MyDoc."employee".XmlAttributes["Version"]

  Important: Because ColdFusion always treats variable names as case-insensitive, using dot notation for element and attribute names in a case sensitive XML document can generate unexpected results (such as all-uppercase variable names), exceptions, or both.

• If your XML object is case sensitive, you cannot use dot notation to reference an element or attribute name. Use the name in associative array (bracket) notation, or a reference that does not use the case-sensitive name (such as XmlChildren[1]) instead.
• Use an array index to specify one of multiple elements with the same name; for example, #mydoc.employee.name[1] and #mydoc.employee.name[2].

  If you omit the array index on the last component of an element identifier, ColdFusion treats the reference as the array of all elements with the specified name. For example, mydoc.employee.name refers to an array of two name elements.
• Use an array index into the XmlChildren array to specify an element without using its name; for example, mydoc.XmlRoot.XmlChildren[1].
• Use associative array (bracket) notation to specify an element name that contains a period or colon; for example, myotherdoc.XmlRoot["Type1.Case1"].
• You can use DOM methods in place of structure entry names.
For example, the following variables all refer to the XmlText value "Almanzo" in the XML document created in “A simple XML document” on page 866:

mydoc.XmlRoot.XmlChildren[1].XmlChildren[1].XmlText
mydoc.employee.name[1].first.XmlText
mydoc.employee.name[1]["first"].XmlText
mydoc["employee"].name[1]["first"].XmlText
mydoc.XmlRoot.name[1].XmlChildren[1]["XmlText"]

The following variables all refer to the EmpType attribute of the first name element in the XML document created in “A simple XML document” on page 866:

mydoc.employee.name[1].XmlAttributes.EmpType
mydoc.employee.name[1].XmlAttributes["EmpType"]
mydoc.employee.XmlChildren[1].XmlAttributes.EmpType
mydoc.XmlRoot.name[1].XmlAttributes["EmpType"]
mydoc.XmlRoot.XmlChildren[1].XmlAttributes.EmpType

Neither of these lists contains a complete set of the possible combinations that can make up a reference to the value or attribute.

**Assigning data to an XML object**

When you use an XML object reference on the left side of an expression, most of the preceding rules apply to the reference up to the last element in the reference string.

For example, the rules in “Referencing the contents of an XML object” on page 872 apply to

mydoc.employee.name[1].first in the following expression:

mydoc.employee.name[1].first.MyNewElement = XmlElemNew(mydoc, NewElement);

The rule for naming in case correct document objects, however, applies to the full reference string, as indicated by the following caution:

**Important:** Because ColdFusion always treats variable names as case insensitive, using dot notation for element and attribute names in a case-sensitive XML document can generate unexpected results (such as all-uppercase variable names), exceptions, or both. In case-sensitive XML documents, use associative array notation or DOM notation names (such as XmlRoot or XmlChildren[2]).

**Referencing the last element on the left side of an expression**

The following rules apply to the meaning of the last component on the left side of an expression:

1  The component name is an element structure key name (XML property name), such as XmlComment, ColdFusion sets the value of the specified element structure entry to the value of the right side of the expression. For example, the following line sets the XML comment in the mydoc.employee.name[1].first element to "This is a comment":

    mydoc.employee.name[1].first.XmlComment = "This is a comment";

2  If the component name specifies an element name and does not end with a numeric index, for example mydoc.employee.name, ColdFusion assigns the value on the right of the expression to the first matching element.

For example, if both mydoc.employee.name[1] and mydoc.employee.name[2] exist, the following expression replaces mydoc.employee.name[1] with a new element named address, not an element named name:

mydoc.employee.name = XmlElemNew(mydoc, "address");
After executing this line, if there had been both `mydoc.employee.name[1]` and `mydoc.employee.name[2]`, there is now only one `mydoc.employee.name` element with the contents of the original `mydoc.employee.name[2]`.

3. If the component name does not match an existing element, the element names on the left and right sides of the expression must match. ColdFusion creates a new element with the name of the element on the left of the expression. If the element names do not match, it generates an error.

   For example, if there is no `mydoc.employee.name.phoneNumber` element, the following expression creates a new `mydoc.employee.name.phoneNumber` element:

   ```coldfusion
   mydoc.employee.name.phoneNumber = XmlElemNew(mydoc, "phoneNumber");
   ```

   The following expression causes an error:

   ```coldfusion
   mydoc.employee.name.phoneNumber = XmlElemNew(mydoc, "address");
   ```

4. If the component name does not match an existing element and the component’s parent or parents also do not exist, ColdFusion creates any parent nodes as specified on the left side and use the previous rule for the last element. For example, if there is no `mydoc.employee.phoneNumber` element, the following expression creates a PhoneNumber element containing an AreaCode element:

   ```coldfusion
   mydoc.employee.name.phoneNumber.AreaCode = XmlElemNew(mydoc, "AreaCode");
   ```

Assigning and retrieving CDATA values

To identify that element text is CDATA by putting it inside CDATA start and end marker information items, assign the text to the XmlCdata element, not the XmlText element. You must do this because ColdFusion escapes the `<` and `>` symbols in the element text when you assign it to an XmlText entry. You can assign a value to an element’s XmlText entry or its XmlCdata entry, but not to both, as each assignment overwrites the other.

When you retrieve data from the document object, references to XmlCdata and XmlText return the same string.

The following example shows how ColdFusion handles CDATA text:

```coldfusion
<cfscript>
   myCDATA = "This is CDATA text";
   MyDoc = XmlNew();
   MyDoc.xmlRoot = XmlElemNew(MyDoc,"myRoot");
   MyDoc.myRoot.XmlChildren[1].XmlCData = "#myCDATA#";
</cfscript>

<h3>Assigning a value to MyDoc.myRoot.XmlChildren[1].XmlCdata.</h3>
<cfoutput>
   The type of element MyDoc.myRoot.XmlChildren[1] is:
   #MyDoc.myRoot.XmlChildren[1].XmlType#<br>
   The value when output using XmlCdata is: #MyDoc.myRoot.XmlChildren[1].XmlCData#<br>
   The value when output using XmlText is: #MyDoc.myRoot.XmlChildren[1].XmlText#<br>
</cfoutput>
<br>
The XML text representation of Mydoc is:
<cfoutput><XMP>#toString(MyDoc)#</XMP></cfoutput>

<h3>Assigning a value to MyDoc.myRoot.XmlChildren[1].XmlText.</h3>
<cfset MyDoc.myRoot.XmlChildren[1].XmlText = "This is XML plain text">
<cfoutput>
   The value when output using XmlCdata is: #MyDoc.myRoot.XmlChildren[1].XmlCData#<br>
   The value when output using XmlText is: #MyDoc.myRoot.XmlChildren[1].XmlText#<br>
</cfoutput>
<br>
The XML text representation of Mydoc is:
<coutput><XMP>#tostring(MyDoc)#</XMP></coutput>

Creating and saving an XML document object

The following sections show the ways you can create and save an XML document object. The specific technique that you use will depend on the application and your coding style.

Creating a new XML document object using the cfxml tag

The cfxml tag creates an XML document object that consists of the XML markup in the tag body. The tag body can include CFML code. ColdFusion processes the CFML code and includes the resulting output in the XML. The following example shows a simple cfxml tag:

```
<cfset testVar = True>
<cfxml variable="MyDoc">
 <MyDoc>
   <cfif testVar IS True>
     <cfoutput>The value of testVar is True.</cfoutput>
   <cfelse>
     <cfoutput>The value of testVar is False.</cfoutput>
   </cfif>
   <cfloop index = "LoopCount" from = "1" to = "4">
     <childNode>
       This is Child node <cfoutput>#LoopCount#.</cfoutput>
     </childNode>
   </cfloop>
 </MyDoc>
</cfxml>
```

This example creates a document object with a root element MyDoc, which includes text that displays the value of the ColdFusion variable testVar. MyDoc has four nested child elements, which are generated by an indexed cfloop tag. The cfdump tag displays the resulting XML document object.

Note: When you use the cfxml tag, do not include an <?xml ?> processing directive in the tag body. This directive is not required, and causes an error. To process XML text that includes the <?xml ?> directive, use the function.

Creating a new XML document object using the XmlNew function

The XmlNew function creates a new XML document object, which you must then populate. For information on how to populate a new XML document, see "Adding, deleting, and modifying XML elements" on page 879.

Note: You cannot set the XmlDocType property for an XML document object that you create with the XmlNew function.

The following example creates and displays the same ColdFusion document object as in "Creating a new XML document object using the cfxml tag" on page 875.

```
<cfset testVar = True>
<cfscript>
 MyDoc = XmlNew();
 MyDoc.xmlRoot = XmlElemNew(MyDoc,"MyRoot");
 if (testVar IS TRUE)
   MyDoc.MyRoot.XmlText = "The value of testVar is True.";
 else
   MyDoc.MyRoot.XmlText = "The value of testVar is False.";
```
for (i = 1; i <= 4; i = i + 1)
{
    MyDoc.MyRoot.XmlChildren[i].XmlText = "This is Child node " & i & ",";
}
</cfscript>
<cfscript>
<cfdump var=#MyDoc#>

**Creating an XML document object from existing XML**

The `XmlParse` function converts an XML document or document fragment represented as text into a ColdFusion document object. You can use a string variable containing the XML or the name or URL of a file that contains the text. For example, if your application uses `cfhttp action="get"` to get the XML document, use the following line to create the XML document object:

```cfscript```
<cfset myXMLDocument = XmlParse(cfhttp.fileContent)>```

The following example converts an XML text document in a file to an XML document object:

```cfscript```
<cfset myXMLDocument = XmlParse("C:\temp\myxmldoc.xml" variable="XMLFileText")>```

The `XmlParse` function takes a second, optional, attribute that specifies whether to maintain the case of the elements and attributes in the document object. The default is to have the document object be case-insensitive. For more information on case-sensitivity, see “Referencing the contents of an XML object” on page 872.

The `XmlParse` function also lets you specify a DTD or Schema to validate the XML text; if the XML is not valid, ColdFusion generates an error. You can specify the filename or URL of the validator, or the DTD or Schema can be in a CFML variable. You can also tell ColdFusion to use a DTD or Schema that is identified in the XML text. If you specify validation, you must also specify whether the document is be case-sensitive. The following example validates an XML document on file using a DTD that it specifies using a URL:

```cfscript```
myDoc=XMLParse("C:\CFusion\wwwroot\examples\custorder.xml", false, "http://localhost:8500/examples/custorder.dtd")>```

**Saving and exporting an XML document object**

The `ToString` function converts an XML document object to a text string. You can then use the string variable in any ColdFusion tag or function.

To save the XML document in a file, use the `ToString` function to convert the document object to a string variable, then use the `cffile` tag to save the string as a file. For example, use the following code to save the XML document `myXMLDocument` in the file `C:\temp\myxmldoc.xml`:

```cfscript```
<cfset XMLText=ToString(myXMLDocument)>
<cffile action="write" file="C:\temp\myxmldoc.xml" output="#XMLText#">
```

**Modifying a ColdFusion XML object**

As with all ColdFusion structured objects, you can often use a number of methods to change the contents of an XML document object. For example, you often have the choice of using an assignment statement or a function to update the contents of a structure or an array. The following section describes the array and structure functions that you can use to modify an XML document object. The section “XML document object management reference” on page 878 provides a quick reference to modifying XML document object contents. Later sections describe these methods for changing document content in detail.
Functions for XML object management

The following table lists the ColdFusion array and structure functions that you can use to manage XML document objects and their functions, and describes their common uses. In several cases you can use either an array function or a structure function for a purpose, such as for deleting all of an element's attributes or children.

<table>
<thead>
<tr>
<th>Function</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArrayLen</td>
<td>Determines the number of child elements in an element, that is, the number of elements in an element's XmlChildren array.</td>
</tr>
<tr>
<td>ArrayIsEmpty</td>
<td>Determines whether an element has any elements in its XmlChildren array.</td>
</tr>
<tr>
<td>StructCount</td>
<td>Determines the number of attributes in an element's XmlAttributes structure.</td>
</tr>
<tr>
<td>StructIsEmpty</td>
<td>Determines whether an element has any attributes in its XmlAttributes structure. Returns True if the specified structure, including the XML document object or an element, exists and is empty.</td>
</tr>
<tr>
<td>StructKeyArray</td>
<td>Gets an array or list with the names of all of the attributes in an element's XmlAttributes structure. Returns the names of the children of an XML element.</td>
</tr>
<tr>
<td>StructKeyList</td>
<td></td>
</tr>
<tr>
<td>ArrayInsertAt</td>
<td>Adds a new element at a specific location in an element's XmlChildren array.</td>
</tr>
<tr>
<td>ArrayAppend</td>
<td>Adds a new element at the end or beginning of an element's XmlChildren array.</td>
</tr>
<tr>
<td>ArrayPrepend</td>
<td></td>
</tr>
<tr>
<td>ArraySwap</td>
<td>Swaps the children in the XmlChildren array at the specified position.</td>
</tr>
<tr>
<td>ArrayDeleteAt</td>
<td>Deletes a specific element from an element's XmlChildren array.</td>
</tr>
<tr>
<td>ArrayClear</td>
<td>Deletes all child elements from an element's XmlChildren array.</td>
</tr>
<tr>
<td>StructDelete</td>
<td>Deletes a selected attribute from an element's XmlAttributes structure. Deletes all children with a specific element name from an element's XmlChildren array. Deletes all attributes of an element. Deletes all children of an element. Deletes a selected property value.</td>
</tr>
<tr>
<td>StructClear</td>
<td>Deletes all attributes from an element's XmlAttributes structure.</td>
</tr>
<tr>
<td>Duplicate</td>
<td>Copies an XML document object, element, or node structure.</td>
</tr>
<tr>
<td>IsArray</td>
<td>Returns True for the XmlChildren array. Returns false if you specify an element name, such as mydoc.XmlRoot.name, even if there are multiple name elements in XmlRoot.</td>
</tr>
<tr>
<td>IsStruct</td>
<td>Returns False for XML document objects, elements, and nodes. Returns True for XmlAttributes structures.</td>
</tr>
<tr>
<td>StructGet</td>
<td>Returns the specified structure, including XML document objects, elements, nodes, and XmlAttributes structures.</td>
</tr>
<tr>
<td>StructAppend</td>
<td>Appends a document fragment XML document object to another XML document object.</td>
</tr>
<tr>
<td>StructInsert</td>
<td>Adds a new entry to an XmlAttributes structure.</td>
</tr>
<tr>
<td>StructUpdate</td>
<td>Sets or replaces the value of a document object property such as XmlName, or of a specified attribute in an XmlAttributes structure.</td>
</tr>
</tbody>
</table>
Note: Array and structure functions not in the preceding table or the table in the next section, do not work with XML document objects, XML elements, or XML node structures.

Treating elements with the same name as an array
In many cases an XML element has multiple children with the same name. For example, the example document used in this chapter has multiple name elements in the employee elements. In many cases, you can treat the child elements with identical names as an array. For example, to reference the second name element in mydoc.employee, you can specify mydoc.employee.name[2]. However, you can only use a limited set of Array functions when you use this notation. The following table lists the array functions that are valid for such references:

<table>
<thead>
<tr>
<th>Array function</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsArray(elemPath.elemName)</td>
<td>Always returns False.</td>
</tr>
<tr>
<td>ArrayClear(elemPath.elemName)</td>
<td>Removes all the elements with name elemName from the elemPath element.</td>
</tr>
<tr>
<td>ArrayLen(elemPath.elemName)</td>
<td>Returns the number of elements named elemName in the elemPath element.</td>
</tr>
<tr>
<td>ArrayDeleteAt(elemPath.elemName, n)</td>
<td>Deletes the n-th child named elemName from the elemPath element.</td>
</tr>
<tr>
<td>ArrayIsEmpty(elemPath.elemName)</td>
<td>Always returns False.</td>
</tr>
<tr>
<td>ArrayToList(elemPath.elemName, n)</td>
<td>Returns a comma separated list of all the XmlText properties of all the children of elemPath named elemName.</td>
</tr>
</tbody>
</table>

XML document object management reference
The following tables provide a quick reference to the ways you can modify the contents of an XML document object. The sections that follow describe in detail how to modify XML contents.

Note: If your XML object is case sensitive, you cannot use dot notation to reference an element or attribute name. Use the name in associative array (bracket) notation, or a reference that does not use the case-sensitive name (such as xmlChildren[1]) instead.

Adding information to an element
Use the following techniques to add new information to an element:

<table>
<thead>
<tr>
<th>Type</th>
<th>Using a function</th>
<th>Using an assignment statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
<td>StructInsert(xmlElemPath.XmlAttributes, &quot;key&quot;, &quot;value&quot;)</td>
<td>xmlElemPath.XmlAttributes.key = &quot;value&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xmlElemPath.XmlAttributes[&quot;key&quot;] = &quot;value&quot;</td>
</tr>
<tr>
<td>Child element</td>
<td>To append: ArrayAppend(xmlElemPath.XmlChildren, newElem)</td>
<td>xmlElemPath.XmlChildren[i] = newElem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>xmlElemPath.newChildName = newElem</td>
</tr>
<tr>
<td></td>
<td>To insert: ArrayInsertAt(xmlElemPath.XmlChildren, position, newElem)</td>
<td>(where newChildname must be the same as newElem.XmlName and cannot be an indexed name such as name[3])</td>
</tr>
</tbody>
</table>

Deleting information from an element
Use the following techniques to delete information from an element:
Changing contents of an element
Use the following techniques to change the contents of an element:

<table>
<thead>
<tr>
<th>Type</th>
<th>Using a function</th>
<th>Using an assignment statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
<td>StructDelete(xmlElemPath, propertyName)</td>
<td>xmlElemPath.propertyName=&quot;&quot;</td>
</tr>
<tr>
<td>Attribute</td>
<td>All attributes:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>StructDelete(xmlElemPath, XmlAttributes)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A specific attribute:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>StructDelete(xmlElemPath.XmlAttributes,&quot;attributeName&quot;)</td>
<td></td>
</tr>
<tr>
<td>Child element</td>
<td>All children of an element:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>StructDelete(xmlElemPath, &quot;XmlChildren&quot;)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ArrayClear(xmlElemPath.XmlChildren)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A specific child:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ArrayDeleteAt(xmlElemPath.XmlChildren,position)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ArrayDeleteAt(xmlElemPath.elemName,position)</td>
<td></td>
</tr>
</tbody>
</table>

Adding, deleting, and modifying XML elements
The following sections describe the basic techniques for adding, deleting, and modifying XML elements. The example code uses the XML document described in "A simple XML document" on page 866.
Counting and finding the position of child elements

Often, an XML element has several children with the same name. For example, in the XML document defined in the simple XML document, the employee root element has multiple name elements.

To manipulate such an object, you often need to know the number of children of the same name, and you might need to know the position in the XmlChildren array of a specific child name that is used for multiple children. The following sections describe how to get this information.

Counting child elements

The following user-defined function determines the number of child elements with a specific name in an element:

```cfscript
function NodeCount (xmlElement, nodeName)
{
    nodesFound = 0;
    for (i = 1; i LTE ArrayLen(xmlElement.XmlChildren); i = i+1)
    {
        if (xmlElement.XmlChildren[i].XmlName IS nodeName)
            nodesFound = nodesFound + 1;
    }
    return nodesFound;
}
</cfscript>
```

The following lines use this function to display the number of nodes named “name” in the mydoc.employee element:

```
<cfoutput>
Nodes Found: #NodeCount(mydoc.employee, "name")#
</cfoutput>
```

Determining the position of a child element with a common name

The XmlChildPos function determines the location in the XmlChildren array of a specific element with a common name. You use this index when you need to tell ColdFusion where to insert or delete child elements. For example, if there are several name elements in mydoc.employee, use the following code to locate name[2] in the XmlChildren array:

```
<cfset nameIndex = XmlChildPos(mydoc.employee, "name", 2)>
```

Adding an element

You can add an element by creating a new element or by using an existing element.

Use the XmlElemNew function to create a new, empty element. This function has the following form:

```
XmlElemNew(docObject, elementName)
```

where `docObject` is the name of the XML document object in which you are creating the element, and `elementName` is the name you are giving the new element.

Use an assignment statement with an existing element on the right side to create a new element using an existing element. See “Copying an existing element” on page 882 for more information on adding elements using existing elements.

Adding an element using a function

You can use the ArrayInsertAt or the ArrayAppend function to add an element to an XML document object. For example, the following line adds a phoneNumber element after the last element for employee.name[2]:

```
<cfset ArrayAppend(mydoc.employee.name[2].XmlChildren, XmlElemNew(mydoc, "phoneNumber"))>
```
The following line adds a new department element as the first element in employee. The name elements become the second and third elements.

```coldfusion
<cfset ArrayInsertAt(mydoc.employee.XmlChildren, 1, XmlElemNew(mydoc, "department"))>
```

You must use the format `parentElement.XmlChildren` to specify the array of elements to which you are adding the new element. For example, the following line causes an error:

```coldfusion
<cfset ArrayInsertAt(mydoc.employee.name, 2, XmlElemNew(mydoc, "PhoneNumber"))>
```

If you have multiple child elements with the same name, and you want to insert a new element in a specific position, use the function to determine the location in the `XmlChildren` array where you want to insert the new element. For example, the following code determines the location of mydoc.employee.name[1] and inserts a new name element as the second name element:

```coldfusion
cfscript
nameIndex = XmlChildPos(mydoc.employee, "name", 1);
ArrayInsertAt(mydoc.employee.XmlChildren, nameIndex + 1, XmlElemNew(mydoc, "name"));
</cfscript>
```

**Using a namespace:** When you use a function to add an element, you can assign the element to a namespace by including the namespace prefix in the element name. If you have not yet associated the prefix with a namespace URI, you must also include a parameter with the namespace URI in the `XmlElemNew` function. This parameter must be the second parameter in the method, and the element name must be the third parameter. ColdFusion then associates the namespace prefix with the URI, and you can omit the URI parameter in further `xmlElemNew` functions.

The following example adds two to the supplies document root two elements in the Prod namespace. The first `XmlElemNew` function use sets the association between the Prod namespace prefix and the URI; the second use only needs to specify the prefix on the element name.

```coldfusion
cfscript
</cfscript>
```

**Adding an element using direct assignment**
You can use direct assignment to append a new element to an array of elements. You cannot use direct assignment to insert an element into an array of elements.

When you use direct assignment, you can specify on the left side an index into the `XmlChildren` array greater than the last child in the array. For example, if there are two elements in mydoc.employee, you can specify any number greater than two, such as mydoc.employee.XmlChildren[6]. The element is always added as the last (in this case, third) child.

For example, the following line appends a name element to the end of the child elements of mydoc.employee:

```coldfusion
<cfset mydoc.employee.XmlChildren[9] = XmlElemNew(mydoc, "name")>
```

If the parent element does not have any children with the same name as the new child, you can specify the name of the new node or the left side of the assignment. For example, the following line appends a PhoneNumber element to the children of the first name element in mydoc.employee:

```coldfusion
<cfset mydoc.employee.name[1].phoneNumber = XmlElemNew(mydoc, "phoneNumber")>
```

You cannot use the node name on the left to add an element with the same name as an existing element in the parent. For example, if mydoc.employee has two name nodes, the following line causes an error:

```coldfusion
<cfset mydoc.employee.name[1].name = XmlElemNew(mydoc, "name")>
```
<cfset mydoc.employee.name[3] = XmlElemNew(mydoc, "name")>

However, the following line does work:
<cfset mydoc.employee.XmlChildren[3] = XmlElemNew(mydoc, "name")>

### Copying an existing element

You can add a copy of an existing element elsewhere in the document. For example, if there is a `mydoc.employee.name[1].phoneNumber` element, but no `mydoc.employee.name[2].phoneNumber`, the following line creates a new `mydoc.employee.name[2].phoneNumber` element with the same value as the original element. This assignment copies the original element. Unlike with standard ColdFusion structures, you get a true copy, not a reference to the original structure. You can change the copy without changing the original.

<cfset mydoc.employee.name[2].phoneNumber = mydoc.employee.name[1].phoneNumber>

When you copy an element, the new element must have the same name as the existing element. If you specify the new element by name on the left side of an assignment, the element name must be the same as the name on the right side. For example, the following expression causes an error:
<cfset mydoc.employee.name[2].telephne = mydoc.employee.name[1].phoneNumber>

### Deleting elements

There are many ways to delete individual or multiple elements.

#### Deleting individual elements

Use the `ArrayDeleteAt` function to delete a specific element from an XML document object. For example, the following line deletes the second child element in the `mydoc.employee` element:

<cfset ArrayDeleteAt(mydoc.employee.XmlChildren, 2)>

If an element has only one child element with a specific name, you can also use the `StructDelete` function to delete the child element. For example, the following line deletes the `phoneNumber` element named in the second `employee.name` element:

<cfset StructDelete(mydoc.employee.name[2], "phoneNumber")>

When there are multiple child elements of the same name, you must specify the element position, either among the elements of the same name, or among all child elements. For example, you can use the following line to delete the second name element in `mydoc.employee`:

<cfset ArrayDeleteAt(mydoc.employee.name, 2)>

You can also determine the position in the `XmlChildren` array of the element you want to delete and use that position. To do so, use the `XmlChildPos` function. For example, the following lines determine the location of `mydoc.employee.name[2]` and delete the element:

<cfset idx = XmlChildPos(mydoc.employee, "name", 2)>
<cfset ArrayDeleteAt(mydoc.employee.XmlChildren, idx)>

#### Deleting multiple elements

If an element has multiple children with the same name, use the `StructDelete` function or `ArrayClear` function with an element name to delete all of an element’s child elements with that name. For example, both of the following lines delete all name elements from the employee structure:

<cfset StructDelete(mydoc.employee, "name")>
<cfset ArrayClear(mydoc.employee.name)>

Use the `StructDelete` or `ArrayClear` function with `XmlChildren` to delete all of an element's child elements. For example, each of the following lines deletes all child elements of the `mydoc.employee.name[2]` element:
<cfset StructDelete(mydoc.employee.name[2], "XmlChildren")>
<cfset ArrayClear(mydoc.employee.name[2].XmlChildren)>

Adding, changing, and deleting element attributes
You modify an element's attributes the same way you change the contents of any structure. For example, each of the
following lines adds a Status attribute the second mydoc.employee.name element:
<cfset mydoc.employee.name[2].XmlAttributes.Status="Inactive">
<cfset StructInsert(mydoc.employee.name[2].XmlAttributes, "Status", "Inactive")>

To change an attribute, use a standard assignment statement; for example:
<cfset mydoc.employee.name[2].XmlAttributes.Status="Active">

To delete an attribute, use StructDelete; for example:
<cfset StructDelete(mydoc.employee.name[1].XmlAttributes, "Status")>

Changing element properties
To change an element's properties, including its text and comment, use a standard assignment expression. For
example, use the following line to add "in the MyCompany Documentation Department" to the mydoc.employee
XML comment:
<cfset mydoc.employee.XmlComment = mydoc.employee.XmlComment & "in the
MyCompany Documentation Department">

Changing an element name
The XML DOM does not support changing an element name directly. To change the name of an element, you must
create a new element with the new name, insert it into the XML document object before or after the original element,
copy all the original element's contents to the new element, and then delete the original element.

Clearing an element property value
To clear an element property value, either assign the empty string to the property or use the StructDelete function.
For example, each of the following lines clears the comment string from mydoc.employee:
<cfset mydoc.employee.XmlComment = "">
<cfset StructDelete(mydoc.employee, "XmlComment")>

Replacing or moving an element
To replace an element with a new element, use a standard replacement expression. For example, to replace the
mydoc.employee.department element with a new element named organization, use either of the following lines:
<cfset mydoc.employee.department = XmlElemNew(mydoc, "Organization")>
<cfset mydoc.employee.XmlChildren[1] = XmlElemNew(mydoc, "Organization")>

To replace an element with a copy of an existing element, use the existing element on the right side of an expression.
For example, the following line replaces the phoneNumber element for mydoc.employee.name[2] with the phone-
Number element from mydoc.employee.name[1]:
<cfset mydoc.employee.name[2].phoneNumber=mydoc.employee.name[1].phoneNumber>

This creates a true copy of the name[1].phoneNumber element as name[2].phoneNumber.

To move an element, you must assign it to its new location, then delete it from its old location. For example, the
following lines move the phoneNumber element from mydoc.employee.name[1] to mydoc.employee.name[2]:
<cfset mydoc.employee.name[2].phoneNumber=mydoc.employee.name[1].phoneNumber>
<cfset StructDelete(mydoc.employee.name[1], "phoneNumber")>

Note: You cannot copy or move an element from one document object to another document object.
Using XML and ColdFusion queries
You can convert XML documents into ColdFusion query objects and manipulate them using queries of queries. This technique does not require the use of XPath and provides a method of searching XML documents and extracting data that is natural to ColdFusion programmers.

Converting XML to a ColdFusion query
The following example reads an XML document, converts it to a query object, and then performs a query of queries on the object to extract selected data:

<!--- Read the file and convert it to an XML document object --->
<cffile action="read" file="C:\CFusion\wwwroot\myexamples\employees.xml" variable="myxml">
<cfset mydoc = XmlParse(myxml)>

<!--- get an array of employees --->
<cfset emp = mydoc.employee.XmlChildren>
<cfset size = ArrayLen(emp)>

<!--- create a query object with the employee data --->
<cfset myquery = QueryNew("fname, lname")>
<cfset temp = QueryAddRow(myquery, #size#)>
<cfloop index="i" from = "1" to = #size#>
<cfset temp = QuerySetCell(myquery, "fname",
    #mydoc.employee.name[i].first.XmlText#, #i#)>
<cfset temp = QuerySetCell(myquery, "lname",
    #mydoc.employee.name[i].last.XmlText#, #i#)>
</cfloop>

<!--- Dump the query object --->
Contents of the myquery Query object: <br>
<cfdump var=#myquery#>

<!--- Select entries with the last name starting with A and dump the result --->
<cfquery name="ImqTest" dbType="query">
    SELECT lname, fname
    FROM myquery
    WHERE lname LIKE 'A%'
</cfquery>
<cfdump var=#ImqTest#>

Converting a query object to XML
The following example shows how to convert a query object to XML. It uses cfquery to get a list of employees from the cfdocexamples database and saves the information as an XML document.

<!--- Query the database and get the names in the employee table --->
<cfquery name="myQuery" datasource="cfdocexamples">
    SELECT FirstName, LastName
    FROM employee
</cfquery>

<!--- Create an XML document object containing the data --->
<cfxml variable="mydoc">
    <employee>
        <cfoutput query="myQuery">


Validating XML documents

ColdFusion provides the following methods for validating a document against a DTD or an XML Schema:

- The `XmlParse` function can validate XML text that it is parsing against a DTD or Schema. If the function encounters a validation error, ColdFusion generates an error and stops parsing the text. If the validator generates warnings, but no errors, ColdFusion parses the document and returns the result.
- The `XmlValidate` function can validate an XML text document or XML document object against a DTD or Schema. The function returns a data structure with detailed information from the validator, including arrays of warning, error, and fatal error messages, and a Boolean status variable indicating whether the document is valid. Your application can examine the status information and determine how to handle it further.

For examples of XML validation, see `XmlParse` and `XmlValidate` in the CFML Reference. The `XmlParse` example validates a document using a DTD. The `XmlValidate` example validates the document using an XML Schema that represents the same document structure as the DTD.

Transforming documents with XSLT

The Extensible Stylesheet Language Transformation (XSLT) technology transforms an XML document into another format or representation. For example, one common use of XSLT is to convert XML documents into HTML for display in a browser. XSLT has many other uses, including converting XML data to another format, such as converting XML in a vocabulary used by an order entry application into a vocabulary used by an order fulfillment application.

XSLT transforms an XML document by applying an Extensible Stylesheet Language (XSL) stylesheet. (When stored in a file, XSL stylesheets typically have the .xsl extension.) ColdFusion provides the `XmlTransform` function to apply an XSL transformation to an XML document. The function takes an XML document in string format or as an XML document object, and an XSL stylesheet in string format, and returns the transformed document as a string.

The following code:

1. Reads the simpletransform.xsl stylesheet file into a string variable.
2. Uses the stylesheet to transform the mydoc XML document object.

```csharp
<cffile action="read" file="C:\CFusion\wwwroot\testdocs\simpletransform.xsl"
        variable="xslDoc">
```
<cfset transformedXML = XmlTransform(mydoc, xslDoc)>
<cffile action="write" file="C:\CFusion\wwwroot\testdocs\transformeddoc.xml"
       output=transformedXML>

XSL and XSLT are specified by the World Wide Web Consortium (W3C). For detailed information on XSL, XSLT, and XSL stylesheets, see the W3C website at www.w3.org/Style/XSL/. There are also several books available on using XSL and XSLT.

Extracting data with XPath

XPath is a language for addressing parts of an XML document. Like XSL, XPath is a W3C specification. One of the major uses of XPath is in XSL transformations. However, XPath has more general uses. In particular, it can extract data from XML documents, such as complex data set representations. Thus, XPath is another data querying tool.

XPath uses a pattern called an XPath expression to specify the information to extract from an XML document. For example, the simple XPath expression /employee/name selects the name elements in the employee root element.

The XmlSearch function uses XPath expressions to extract data from XML document objects. The function takes an XML document object and an XPath expression in string format, and returns the results of matching the XPath expression with the XML. The returned results can be any XPath return type that ColdFusion can represent, such as an array of XML object nodes or a Boolean value. For more information, see XmlSearch in the CFML Reference.

The following example extracts all the elements named last, which contain the employee's last names, from the employeesimple.xml file, and displays the names:

<cffile action="read"
       file="C:\inetpub\wwwroot\examples\employeesimple.xml"
       variable="myxml">
<cfscript>
myxmldoc = XmlParse(myxml);
selectedElements = XmlSearch(myxmldoc, "/employee/name/last");
for (i = 1; i LTE ArrayLen(selectedElements); i = i + 1)
   writeoutput(selectedElements[i].XmlText & "<br>");
</cfscript>

XPath is specified by the World-Wide Web Consortium. For detailed information on XPath, see the W3C website at www.w3.org/TR/xpath. Most books that cover XSLT also discuss XPath.

Example: using XML in a ColdFusion application

The example in this section shows how you can use XML to represent data, and how ColdFusion can use XML data in an application. Although the example is too simple to be used in an application without substantial changes, it presents some of the common uses of XML with ColdFusion.

The example receives an order in the form of an XML document, processes it, and generates an XML receipt document. In this case, the order document is in a file, but it could be received as the result of an HTTP request, or retrieved using cfpop, cfhttp, or other methods. The ColdFusion page does the following with the order:

1. Generates a query object from an XML document.
2. Queries a database table to determine the order discount percentage to use.
3. Uses a query of queries to calculate the total price, then calculates the discounted price.
4 Generates the receipt as an XML document. This example displays the results of the processing steps to show you what has been done.

The XML document
The order.xml document has the following structure:

- The root element is named order and has one attribute, id.
- There is one customer element with firstname, lastname, and accountnum attributes. The customer element does not have a body
- There is one items element that contains multiple item elements
- Each item element has an id attribute and contains a name, quantity, and unitprice element. The name, quantity, and unitprice elements contain their value as body text.

The following order.xml document works correctly with the information in the cfdocexamples database:

```xml
<order id="4323251">
  <customer firstname="Philip" lastname="Cramer" accountNum="21"/>
  <items>
    <item id="43">
      <name>Large Hammer</name>
      <quantity>1</quantity>
      <unitprice>15.95</unitprice>
    </item>
    <item id="54">
      <name>Ladder</name>
      <quantity>2</quantity>
      <unitprice>40.95</unitprice>
    </item>
    <item id="68">
      <name>Paint</name>
      <quantity>10</quantity>
      <unitprice>18.95</unitprice>
    </item>
  </items>
</order>
```

The ColdFusion page
The ColdFusion page looks like the following:

```coldfusion
<!--- Convert file to XML document object --->
```
<cffile action="read" file="C:\CFusion\wwwroot\examples\order.xml" variable="myxml">
<cfset mydoc = XmlParse(myxml)>

<!--- Extract account number --->
<cfset accountNum=#mydoc.order.customer.XmlAttributes.accountNum#>

<!--- Display Order Information --->
<cfoutput>
  <b>Name=</b>#mydoc.order.customer.XmlAttributes.firstname#
  #mydoc.order.customer.XmlAttributes.lastname#
<br>
  <b>Account=</b>#accountNum#
<br>
  <cfset numItems = ArrayLen(mydoc.order.items.XmlChildren)>
  <b>Number of items ordered=</b> #numItems#
</cfoutput>

<!--- Process the order into a query object --->
<cfset orderquery = QueryNew("item_Id, name, qty, unitPrice")>
<cfset temp = QueryAddRow(orderquery, #numItems#)>
<cfloop index="i" from = "1" to = #numItems#>
  <cfset temp = QuerySetCell(orderquery, "item_Id", #mydoc.order.items.item[i].XmlAttributes.id#, #i#)>
  <cfset temp = QuerySetCell(orderquery, "name", #mydoc.order.items.item[i].name.XmlText#, #i#)>
  <cfset temp = QuerySetCell(orderquery, "qty", #mydoc.order.items.item[i].quantity.XmlText#, #i#)>
  <cfset temp = QuerySetCell(orderquery, "unitPrice", #mydoc.order.items.item[i].unitprice.XmlText#, #i#)>
</cfloop>

<!--- Display the order query --->
<cfdump var=#orderquery#>
<br>

<!--- Determine the discount --->
<cfquery name="discountQuery" datasource="cfdocexamples">
  SELECT *
  FROM employee
  WHERE Emp_Id = #accountNum#
</cfquery>
<cfset drate = 0>
<cfif #discountQuery.RecordCount# is 1>
  <cfset drate = 10>
</cfif>

<!--- Display the discount rate --->
<cfoutput>
  <b>Discount Rate =</b> #drate#%
</cfoutput>
<br>

<!--- Compute the total cost and discount price--->
<cfquery name="priceQuery" dbType="query">
  SELECT SUM(qty*unitPrice) AS totalPrice
  FROM orderquery
</cfquery>
<cfset discountPrice = priceQuery.totalPrice * (1 - drate/100)>

<!--- Display the full price and discounted price --->
<cfoutput>
	<b>Pull Price</b>= #priceQuery.totalPrice#$br>
	<b>Discount Price</b>= #discountPrice#
</cfoutput>
<br>

<!---Generate an XML Receipt --->
<cfxml variable="receiptxml">
<receipt num = "34">
<cfoutput>
	<price>#discountPrice#</price>
	<cfif drate GT 0 >
		<discountRate>#drate#</discountRate>
	</cfif>
</cfoutput>
<itemsFilled>
<cfoutput query="orderQuery">
	<name>#name#</name>
	<qty> #qty#</qty>
	<price> #qty*unitPrice#</price>
</cfoutput>
</itemsFilled>
</receipt>
</cfxml>

<!--- Display the resulting receipt --->
<cfdump var=#receiptxml#>

**Reviewing the code**

The following table describes the CFML code and its function. For the sake of brevity, it does not include code that displays the processing results.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cffile action=&quot;read&quot; file=&quot;C:\jCfusion\wwwroot\examples\order.xml&quot; variable=&quot;myxml&quot;&gt;</code>&lt;cfset mydoc = XmlParse(myxml)&gt;&lt;cfset accountNum = mydoc.order.customer.XmlAttributes.accountNum#&gt;</td>
<td>Reads the XML from a file and convert it to an XML document object. Sets the accountNum variable from the customer entry’s accountnum attribute.</td>
</tr>
<tr>
<td><code>&lt;cfset orderquery = QueryNew(&quot;item_id, name, qty, unitPrice&quot;) &gt;</code>&lt;cfset temp = QueryAddRow(orderquery, #numItems#)&gt;&lt;cfloop index=&quot;i&quot; from = &quot;1&quot; to = #numItems#&gt;<code>&lt;cfset temp = QuerySetCell(orderquery, &quot;item_id&quot;, mydoc.order.items.item[i].XmlAttributes.id#, #i#)&gt;</code>&lt;cfset temp = QuerySetCell(orderquery, &quot;name&quot;, mydoc.order.items.item[i].name.XmlText#, #i#)&gt;<code>&lt;cfset temp = QuerySetCell(orderquery, &quot;qty&quot;, mydoc.order.items.item[i].quantity.XmlText#, #i#)&gt;</code>&lt;cfset temp = QuerySetCell(orderquery, &quot;unitPrice&quot;, mydoc.order.items.item[i].unitprice.XmlText#, #i#)&gt;``` &lt;/cfloop&gt;</td>
<td>Converts the XML document object into a query object. Creates a query with columns for the item_id, name, qty, and unitPrice values for each item. For each XML item entry in the mydoc.order.items entry, fills one row of the query with the item’s id attribute and the text in the name, quantity, and unitPrice entries that it contains.</td>
</tr>
<tr>
<td><code>&lt;cfquery name=&quot;discountQuery&quot; datasource=&quot;cfdocexamples&quot;&gt;</code>&lt;cfset drate = 0&gt;&lt;cfif #discountQuery.RecordCount# is 1&gt;&lt;cfset drate = 10&lt;/cfif&gt;</td>
<td>If the account number is the same as an employee ID in the cfdocexamples database Employee table, the query returns one record, and RecordCount equals 1. In this case, sets a discount rate of 10%. Otherwise, sets a discount rate of 0%.</td>
</tr>
<tr>
<td><code>&lt;cfquery name=&quot;priceQuery&quot; dbType=&quot;query&quot;&gt;</code>&lt;cfset discountPrice = priceQuery.totalPrice * (1 - drate/100)&gt;</td>
<td>Uses a query of queries with the SUM operator to calculate the total cost before discount of the ordered items, then applies the discount to the price. The result of the query is a single value, the total price.</td>
</tr>
<tr>
<td><code>&lt;cfxml variable=&quot;receiptxml&quot;&gt;</code>&lt;receipt num = &quot;34&quot;&gt;<code>&lt;cfoutput&gt;&lt;price&gt;#discountPrice#&lt;/price&gt;&lt;cfif drate GT 0 &gt;</code>&lt;discountRate&gt;#drate#&lt;/discountRate&gt;&lt;/cfif&gt;<code> &lt;/cfoutput&gt;&lt;itemsFilled&gt;&lt;cfoutput query=&quot;orderQuery&quot;&gt;</code>&lt;name&gt;#name#&lt;/name&gt;&lt;qty&gt;#qty#&lt;/qty&gt;&lt;price #qty*unitPrice#&lt;/price&gt;&lt;/cfoutput&gt; &lt;/itemsFilled&gt; &lt;/receipt&gt;``` &lt;/cfxml&gt;</td>
<td>Creates an XML document object as a receipt. The receipt has a root element named receipt, which has the receipt number as an attribute. The receipt element contains a price element with the order cost and an itemsFilled element with one item element for each item.</td>
</tr>
</tbody>
</table>
Moving complex data across the web with WDDX

WDDX is an XML vocabulary for describing a complex data structure, such as an array, associative array (such as a ColdFusion structure), or a recordset, in a generic fashion. It lets you use HTTP to move the data between different application server platforms and between application servers and browsers. Target platforms for WDDX include ColdFusion, Active Server Pages (ASP), JavaScript, Perl, Java, Python, COM, Flash, and PHP.

The WDDX XML vocabulary consists of a document type definition (DTD) that describes the structure of standard data types and a set of components for each of the target platforms to do the following:

- **Serialize**: The data from its native representation into a WDDX XML document or document fragment.
- **Deserialize**: A WDDX XML document or document fragment into the native data representation, such as a CFML structure.

This vocabulary creates a way to move data, its associated data types, and descriptors that allow the data to be manipulated on a target system, between arbitrary application servers.

**Note**: The WDDX DTD, which includes documentation, is located at www.openwddx.org/downloads/dtd/wddx_dtd_10.txt.

WDDX is a valuable tool for ColdFusion developers, however, its usefulness is not limited to CFML. If you serialize a common programming data structure (such as an array, recordset, or structure) into WDDX format, you can use HTTP to transfer the data across a range of languages and platforms. Also, you can use WDDX to store complex data in a database, file, or even a client variable.

WDDX has two features that make it useful for transferring data in a web environment:

- It is lightweight. The JavaScript used to serialize and deserialize data, including a debugging function to dump WDDX data, occupies less than 22K.
- Unlike traditional client-server approaches, the source and target system can have minimal-to-no prior knowledge of each other. They only need to know the structure of the data that is being transferred.

WDDX was created in 1998, and many applications now expose WDDX capabilities. The best source of information about WDDX is www.openwddx.org. This site offers free downloads of the WDDX DTD and SDK and a number of resources, including a WDDX FAQ, a developer forum, and links to additional sites that provide WDDX resources.

**Uses of WDDX**

WDDX is useful for transferring complex data between applications. For example, you can use it to exchange data between a CFML application and a CGI or PHP application. WDDX is also useful for transferring data between the server and client-side JavaScript.

**Exchanging data across application servers**

WDDX is useful for the transfer of complex, structured data seamlessly between different application server platforms. For example, an application based on ColdFusion at one business could use `cfhttp` to convert a purchase order structure to WDDX. It could then use `cfhttp` to send the WDDX to a supplier running a CGI-based system.

The supplier could then deserialize the WDDX to its native data form, the extract information from the order, and pass it to a shipping company running an application based on ASP.
Transferring data between the server and browser

You can use WDDX for server-to-browser and browser-to-server data exchanges. You can transfer server data to the browser in WDDX format and convert it to JavaScript objects on the browser. Similarly, your application pages can serialize JavaScript data generated on the browser into WDDX format and transfer the data to the application server. You then deserialize the WDDX XML into CFML data on the server.

On the server you use the `cfwddx` tag to serialize and deserialize WDDX data. On the browser, you use WddxSerializer and WddxRecordset JavaScript utility classes to serialize the JavaScript data to WDDX. (ColdFusion installs these utility classes on your server as webroot/CFIDE/scripts/wddx.js.)

WDDX and web services

WDDX does not compete with web services. It is a complementary technology focused on solving simple problems of application integration by sharing data on the web in a pragmatic, productive manner at very low cost.

WDDX offers the following advantages:

- It can be used by lightweight clients, such as browsers or the Flash player.
- It can be used to store complex data structures in files and databases.

Applications that take advantage of WDDX can continue to do so if they start to use web services. These applications could also be converted to use web services standards exclusively; only the service and data interchange formats—not the application model—must change.

How WDDX works

The following example shows how WDDX works. A simple structure with two string variables might have the following form after it is serialized into a WDDX XML representation:

```xml
<var name='x'>
  <struct>
    <var name='a'>
      <string>Property a</string>
    </var>
    <var name='b'>
      <string>Property b</string>
    </var>
  </struct>
</var>
```

When you deserialize this XML into CFML or JavaScript, the result is a structure that is created by either of the following scripts:

<table>
<thead>
<tr>
<th>JavaScript</th>
<th>CFScript</th>
</tr>
</thead>
<tbody>
<tr>
<td>x = new Object();;</td>
<td>x = structNew();</td>
</tr>
<tr>
<td>x.a = &quot;Property a&quot;;</td>
<td>x.a = &quot;Property a&quot;;</td>
</tr>
<tr>
<td>x.b = &quot;Property b&quot;;</td>
<td>x.b = &quot;Property b&quot;;</td>
</tr>
</tbody>
</table>

Conversely, when you serialize the variable `x` produced by either of these scripts into WDDX, you generate the XML listed above.

ColdFusion provides a tag and JavaScript objects that convert between CFML, WDDX, and JavaScript. Serializers and deserializers for other data formats are available on the web. For more information, see [www.openwddx.org](http://www.openwddx.org).
Note: The cfwddx tag and the wddx.js JavaScript functions use UTF-8 encoding to represent data. Any tools that deserialize ColdFusion-generated WDDX must accept UTF-8 encoded characters. UTF-8 encoding is identical to the ASCII and ISO 8859 single-byte encodings for the standard 128 "7-bit" ASCII characters. However, UTF-8 uses a two-byte representation for "high-ASCII" ISO 8859 characters where the initial bit is 1.

WDDX data type support
The following sections describe the data types that WDDX supports. This information is a distillation of the description in the WDDX DTD. For more detailed information, see the DTD at www.openwddx.org.

Basic data types
WDDX can represent the following basic data types:

<table>
<thead>
<tr>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null</td>
<td>Null values in WDDX are not associated with a type such as number or string. The tag converts WDDX Nulls to empty strings.</td>
</tr>
<tr>
<td>Numbers</td>
<td>WDDX documents use floating point numbers to represent all numbers. The range of numbers is restricted to +/-1.7E+-308. The precision is restricted to 15 digits after the decimal point.</td>
</tr>
<tr>
<td>Date-time values</td>
<td>Date-time values are encoded according to the full form of ISO8601; for example, 2002-9-15T09:05:32+4:0.</td>
</tr>
<tr>
<td>Strings</td>
<td>Strings can be of arbitrary length and must not contain embedded nulls. Strings can be encoded using double-byte characters.</td>
</tr>
</tbody>
</table>

Complex data types
WDDX can represent the following complex data types:

<table>
<thead>
<tr>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array</td>
<td>Arrays are integer-indexed collections of objects of arbitrary type. Because most languages start array indexes at 0, while CFML array indexes start at 1, working with array indices can lead to nonportable data.</td>
</tr>
<tr>
<td>Structure</td>
<td>Structures are string-indexed collections of objects of arbitrary type, sometimes called associative arrays. Because some of the languages supported by WDDX are not case-sensitive, no two variable names in a structure can differ only in their case.</td>
</tr>
<tr>
<td>Recordset</td>
<td>Recordsets are tabular rows of named fields, corresponding to ColdFusion query objects. Only simple data types can be stored in recordsets. Because some of the languages supported by WDDX are not case-sensitive, no two field names in a recordset can differ only in their case. Field names must satisfy the regular expression [_A-Za-z][_.0-9A-Za-z]* where the period (.) stands for a literal period character, not &quot;any character&quot;.</td>
</tr>
<tr>
<td>Binary</td>
<td>The binary data type represents strings (blobs) of binary data. The data is encoded in MIME base64 format.</td>
</tr>
</tbody>
</table>

Data type comparisons
The following table compares the basic WDDX data types with the data types to which they correspond in the languages and technologies commonly used on the web:

<table>
<thead>
<tr>
<th>WDDX</th>
<th>CFML</th>
<th>XML Schema</th>
<th>Java</th>
<th>ECMAScript/JavaScript</th>
<th>COM</th>
</tr>
</thead>
<tbody>
<tr>
<td>null</td>
<td>N/A</td>
<td>N/A</td>
<td>null</td>
<td>null</td>
<td>VT_NULL</td>
</tr>
<tr>
<td>boolean</td>
<td>Boolean</td>
<td>boolean</td>
<td>java.lang.Boolean</td>
<td>boolean</td>
<td>VT_BOOL</td>
</tr>
<tr>
<td>number</td>
<td>Number</td>
<td>number</td>
<td>java.lang.Double</td>
<td>number</td>
<td>VT_RB</td>
</tr>
</tbody>
</table>
Time zone processing
Producers and consumers of WDDX packets can be in geographically dispersed locations. Therefore, it is important to use time zone information when serializing and deserializing data, to ensure that date-time values are represented correctly.

The `cfwddx` action=`cfml2wddx` tag `useTimezoneInfo` attribute specifies whether to use time zone information in serializing the date-time data. In the JavaScript implementation, `useTimezoneInfo` is a property of the `WddxSerializer` object. In both cases the default `useTimezoneInfo` value is `True`.

Date-time values in WDDX are represented using a subset of the ISO8601 format. Time zone information is represented as an hour/minute offset from Coordinated Universal Time (UTC); for example, “2002-9-8T12:6:26-4:0”.

When the `cfwddx` tag deserializes WDDX to CFML, it automatically uses available time zone information, and converts date-time values to local time. In this way, you do not need to worry about the details of time zone conversions.

However, when the JavaScript objects supplied with ColdFusion deserialize WDDX to JavaScript expressions, they do not use time zone information, because in JavaScript it is difficult to determine the time zone of the browser.

### Using WDDX

The following sections describe how you can use WDDX in ColdFusion applications. The first two sections describe the tools that ColdFusion provides for creating and converting WDDX. The remaining sections show how you use these tools for common application uses.

#### Using the `cfwddx` tag

The `cfwddx` tag can do the following conversions:

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFML</td>
<td>WDDX</td>
</tr>
</tbody>
</table>
A typical cfwddx tag used to convert a CFML query object to WDDX looks like the following:

```xml
<cfwddx action="cfml2wddx" input="#MyQueryObject#" output="WddxTextVariable">```

In this example, MyQueryObject is the name of the query object variable, and WddxTextVariable is the name of the variable in which to store the resulting WDDX XML.

Note: For more information on the cfwddx tag, see the CFML Reference.

Validating WDDX data

The cfwddx tag has a Validate attribute that you can use when converting WDDX to CFML or JavaScript. When you set this attribute to True, the XML parser uses the WDDX DTD to validate the WDDX data before deserializing it. If the WDDX is not valid, ColdFusion generates an error. By default, ColdFusion does not validate WDDX data before trying to convert it to ColdFusion or JavaScript data.

The isWDDX function returns True if a variable is a valid WDDX data packet. It returns False otherwise. You can use this function to validate WDDX packets before converting them to another format. For example, you can use it instead of the cfwddx validate attribute, so that invalid WDDX is handled within conditional logic instead of error-handling code. You can also use it to pre-validate data that will be deserialized by JavaScript at the browser.

Using JavaScript objects

ColdFusion provides two JavaScript objects, WddxSerializer object and WddxRecordset object, that you can use in JavaScript to convert data to WDDX. These objects are defined in the file webroot/cfide/scripts/wddx.js.

The CFML Reference describes these objects and their methods in detail. The example “Transferring data from the browser to the server” on page 896 shows how you can use these objects to serialize JavaScript to WDDX.

Converting CFML data to a JavaScript object

The following example demonstrates the transfer of a cfquery recordset from a ColdFusion page executing on the server to a JavaScript object that is processed by the browser.

The application consists of four principal sections:

- Running a data query
- Including the WDDX JavaScript utility classes
- Calling the conversion function
- Writing the object data in HTML

The following example uses the cfdocexamples data source that is installed with ColdFusion:

```xml
<!--- Create a simple query --->
<cfquery name = "q" datasource ="cfdocexamples">
  SELECT Message_Id, Thread_id, Username, Posted
  FROM messages
</cfquery>
```
<!---- Load the wddx.js file, which includes the dump function --->
<script type="text/javascript" src="/CFIDE/scripts/wddx.js"></script>

<script>
// Use WDDX to move from CFML data to JavaScript
<cfwddx action="cfml2js" input="#q#" topLevelVariable="qj">
// Dump the recordset to show that all the data has reached
// the client successfully.
    document.write(qj.dump(true));
</cfwddx>
</script>

Note: To see how <cfwddx Action="cfml2js" works, save this code under your webroot directory, for example in wwwroot/myapps/wddxjavascript.cfm, run the page in your browser and select View Source in your browser.

Transferring data from the browser to the server

The following example serializes form field data, posts it to the server, deserializes it, and displays the data. For simplicity, it only collects a small amount of data. In applications that generate complex JavaScript data collections, you can extend this basic approach very effectively. This example uses the WddxSerializer JavaScript object to serialize the data, and the <cfwddx> tag to deserialize the data.

Use the example

1. Save the file under your webroot directory, for example in wwwroot/myapps/wddxserializedeserialize.cfm.
3. Enter a first name and last name in the form fields.
4. Click Next.
    The name appears in the Names added so far box.
5. Repeat steps 3 and 4 to add as many names as you wish.
6. Click Serialize to serialize the resulting data.
    The resulting WDDX packet appears in the WDDX packet display box. This step is intended only for test purposes. Real applications handle the serialization automatically.
7. Click Submit to submit the data.
    The WDDX packet is transferred to the server-side processing code, which deserializes it and displays the information.

<!---- load the wddx.js file --->
<script type="text/javascript" src="/CFIDE/scripts/wddx.js"></script>

<!---- Data binding code --->
<script>
    // Generic serialization to a form field
    function serializeData(data, formField) {
        wddxSerializer = new WddxSerializer();
        wddxPacket = wddxSerializer.serialize(data);
        if (wddxPacket != null) {
            formField.value = wddxPacket;
        } else {
            alert("Couldn't serialize data");
        }
    }
</script>
// Person info recordset with columns firstName and lastName
// Make sure the case of field names is preserved
var personInfo = new WddxRecordset(new Array("firstName", "lastName"), true);

// Add next record to end of personInfo recordset
function doNext() {
    // Extract data
    var firstName = document.personForm.firstName.value;
    var lastName = document.personForm.lastName.value;

    // Add names to recordset
    nRows = personInfo.getRowCount();
    personInfo.firstName[nRows] = firstName;
    personInfo.lastName[nRows] = lastName;

    // Clear input fields
    document.personForm.firstName.value = "";
    document.personForm.lastName.value = "";

    // Show added names on list
    // This gets a little tricky because of browser differences
    var newName = firstName + " " + lastName;
    if (navigator.appVersion.indexOf("MSIE") == -1) {
        document.personForm.names[length] =
            new Option(newName, "", false, false);
    } else {
        // IE version
        var entry = document.createElement("OPTION");
        entry.text = newName;
        document.personForm.names.add(entry);
    }
}
</script>

<!--- Data collection form --->
<form action="#cgi.script_name#" method="Post" name="personForm">
    <!--- Input fields ---
    Personal information<br>
    First name: <input type=text name=firstName><br>
    Last name: <input type=text name=lastName><br>
<br>
    <!--- Navigation & submission bar ---
    <input type="button" value="Next" onclick="doNext()">
    <input type="button" value="Serialize"
    onclick="serializeData(personInfo, document.personForm.wddxPacket)">
    <input type="submit" value="Submit">
<br>
    Names added so far:<br>
    <select name="names" size="5">
    </select>
<br>
    <!--- This is where the WDDX packet will be stored ---
<br>
    WDDX packet display:<br>
<textarea name="wddxPacket" rows="10" cols="80" wrap="Virtual">
</textarea>
</form>

<!---- Server-side processing ---->
<hr>
<b>Server-side processing</b><br>
<br>
<cfif isdefined("form.wddxPacket")>
<cfif form.wddxPacket neq ">
<!--- Deserialize the WDDX data --->
<cfwddx action="wddx2cfml" input="#form.wddxPacket#" output="personInfo">
<!--- Display the query --->
The submitted personal information is:<br>
<cfoutput query=personInfo>
Person #CurrentRow#: #firstName# #lastName#<br>
</cfoutput>
<cfelse>
The client did not send a well-formed WDDX data packet!
</cfif>
<cfelse>
No WDDX data to process at this time.
</cfif>

Storing complex data in a string

The following simple example uses WDDX to store complex data, a data structure that contains arrays as a string in a client variable. It uses the cfdump tag to display the contents of the structure before serialization and after deserialization. It uses the HTMLEditFormat function in a cfoutput tag to display the contents of the client variable. The HTMLEditFormat function is required to prevent the browser from trying to interpret (and throwing away) the XML tags in the variable.

<!---- Enable client state management ---->
<cfapplication name="relatives" clientmanagement="Yes">
<!---- Build a complex data structure ---->
<cfscript>
relatives = structNew();
relatives.father = "Bob";
relatives.mother = "Mary";
relatives.sisters = arrayNew(1);
arrayAppend(relatives.sisters, "Joan");
relatives.brothers = arrayNew(1);
arrayAppend(relatives.brothers, "Tom");
arrayAppend(relatives.brothers, "Jesse");
</cfscript>

A dump of the original relatives structure:<br>
<br>
<cfdump var="#relatives#">
<br>
<br>
<!---- Convert data structure to string form and save it in the client scope ---->
<cfwddx action="cfml2wddx" input="#relatives#" output="Client.wddxRelatives">
The contents of the Client.wddxRelatives variable:<br>
<cfoutput>%HtmlEditFormat(Client.wddxRelatives)%</cfoutput><br>

<!---- Now read the data from client scope into a new structure --->
<cfwddx action="wddx2cfml" input="#Client.wddxRelatives#" output="sameRelatives">
</cfwddx>
A dump of the sameRelatives structure generated from client.wddxRelatives<br>
<cfdump var="#sameRelatives#">
Web services let you publish and consume remote application functionality over the Internet. When you consume web services, you access remote functionality to perform an application task. When you publish a web service, you let remote users access your application functionality to build it into their own applications.

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Troubleshooting SOAP requests and responses 924

Web services
Since its inception, the Internet has allowed people to access content stored on remote computers. This content can be static, such as a document represented by an HTML file, or dynamic, such as content returned from a ColdFusion page or CGI script.

Web services let you access application functionality that someone created and made available on a remote computer. With a web service, you can make a request to the remote application to perform an action.

For example, you can request a stock quote, pass a text string to be translated, or request information from a product catalog. The advantage of web services is that you do not have to recreate application logic that someone else has already created and, therefore, you can build your applications faster.

Referencing a remote web service within your ColdFusion application is called consuming web services. Since web services adhere to a standard interface regardless of implementation technology, you can consume a web service implemented as part of a ColdFusion application, or as part of a .NET or Java application.

You can also create your own web services and make them available to others for remote access, called publishing web service. Applications that consume your web service can be implemented in ColdFusion or by any application that recognizes the web service standard.

Accessing a web service
In its simplest form, an access to a web service is similar to a function call. Instead of the function call referencing a library on your computer, it references remote functionality over the Internet.

One feature of web services is that they are self-describing. That means a person who makes a web service available also publishes a description of the API to the web service as a Web Services Description Language (WSDL) file.

A WSDL file is an XML-formatted document that includes information about the web service, including the following information:
• Operations that you can call on the web service
• Input parameters that you pass to each operation
Consuming web services typically is a two-step process:

1. Parse the WSDL file of the web service to determine its interface.

A web service makes its associated WSDL file available over the Internet. You must know the URL of the WSDL file defining the service. For example, you can access the WSDL file for the TemperatureService web service at the following URL:

www.xmethods.net/sd/2001/TemperatureService.wsdl

For an overview of WSDL syntax, see “Working with WSDL files” on page 902.

2. Make a request to the web service.

The following example invokes an operation on the Temperature web service to retrieve the temperature in zip code 55987:

```cftmpl
<cfinvoke
webservice="http://www.xmethods.net/sd/2001/TemperatureService.wsdl"
method="getTemp"
returnvariable="aTemp">
  <cfinvokeargument name="zipcode" value="55987"/>
</cfinvoke>
<coutput>The temperature at zip code 55987 is #aTemp#</coutput>
```

For more information on consuming web services, see “Consuming web services” on page 904.

**Basic web service concepts**

You must be familiar with the underlying architecture of a web service provider in order to fully understand how web services work.

*Note: This section contains an overview of the architecture of web services. For detailed information, consult one of the many web services books.*

The following are three primary components of the web services platform:

- SOAP (Simple Object Access Protocol)
- WSDL (Web Services Description Language)
- UDDI (Universal Description, Discovery, and Integration)

The following simple image shows how the ColdFusion implementation of web services work:

![Diagram of web service architecture](image)

The following sections describe the components shown in this image.
Supporting web services with SOAP
SOAP provides a standard XML structure for sending and receiving web service requests and responses over the Internet. Usually you send SOAP messages using HTTP, but you also can send them using SMTP and other protocols. ColdFusion integrates the Apache Axis SOAP engine to support web services.

The ColdFusion Web Services Engine performs the underlying functionality to support web services, including generating WSDL files for web services that you create. In ColdFusion, to consume or publish web services does not require you to be familiar with SOAP or to perform any SOAP operations.

You can find additional information about SOAP in the W3C’s SOAP 1.1 note at www.w3.org/TR/SOAP/.

Describing web services with WSDL
A WSDL document is an XML file that describes a web service’s purpose, where it is located, and how to access it. The WSDL document describes the operations that you can invoke and their associated data types.

ColdFusion can generate a WSDL document from a web service, and you can publish the WSDL document at a URL to provide information to potential clients. For more information, see “Working with WSDL files” on page 902.

Finding web services with UDDI
As a consumer of web services, you want to know what web services are available. As a publisher of web services, you want others to be able to find information about your web services. Universal Description, Discovery and Integration (UDDI) provides a way for web service clients to dynamically locate web services that provide specific capabilities. You use a UDDI query to find service providers. A UDDI response contains information, such as business contact information, business category, and technical details, about how to invoke a web service.

Although ColdFusion does not directly support UDDI, you can manually register or find a web service using a public UDDI registry, such as the IBM UDDI Business Registry at https://www-3.ibm.com/services/uddi/protect/registry.html.

You can find additional information about UDDI at www.uddi.org/about.htm.

Working with WSDL files
WSDL files define the interface to a web service. To consume a web service, you access the service’s WSDL file to determine information about it. If you publish your application logic as a web service, you must create a WSDL file for it.

WSDL is a draft standard supported by the World Wide Web Consortium. You can access the specification at www.w3.org/TR/wsdl.

Creating a WSDL file
To publish a web service, you construct the service’s functionality and then create the WSDL file defining the service. In ColdFusion, you use components to create web services. ColdFusion automatically generates the WSDL file for a component that you use to produce a web service. For more information on creating web services, see “Publishing web services” on page 911.

For more information on components, see “Building and Using ColdFusion Components” on page 158.
Accessing web services using Dreamweaver

The Dreamweaver Components tab lets you view web services, including operation names, parameter names, and parameter data types.

Open the Components tab in Dreamweaver and add a web service

1. Select Window > Components, or use Control+F7, to open the Components panel.
2. In the Components panel, select Web Services from the drop-down list in the upper-left of the panel.
3. Click the Plus (+) button.
   The Add Using WSDL dialog box appears.
4. Specify the URL of the WSDL file.

After the web service is defined to Dreamweaver, you can drag it onto a page to call it using the `cfinvoke` tag.

For more information on using Dreamweaver, see its online Help system.

Note: The Web Services option is not available if you are running Dreamweaver on the Macintosh. However, you can still use web services by writing code manually.

Reading a WSDL file

A WSDL file takes practice to read. You can view the WSDL file in a browser, or you can use a tool such as Dreamweaver, which contains a built-in utility for displaying WSDL files in an easy-to-read format.

The following example shows a WSDL file for the TemperatureService web service:

```xml
<?xml version="1.0"?>
<definitions name="TemperatureService"
targetNamespace="http://www.xmethods.net/sd/TemperatureService.wsdl"
xmlns:tns="http://www.xmethods.net/sd/TemperatureService.wsdl"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns="http://schemas.xmlsoap.org/wsdl/">
  <message name="getTempRequest">
    <part name="zipcode" type="xsd:string"/>
  </message>
  <message name="getTempResponse">
    <part name="return" type="xsd:float"/>
  </message>
  <portType name="TemperaturePortType">
    <operation name="getTemp">
      <input message="tns:getTempRequest"/>
      <output message="tns:getTempResponse"/>
    </operation>
  </portType>
  <binding name="TemperatureBinding" type="tns:TemperaturePortType">
    <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http"/>
    <operation name="getTemp">
      <input>
        <soap:body use="encoded" namespace="urn:xmethods-Temperature"
        encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
      </input>
      <output>
        <soap:body use="encoded" namespace="urn:xmethods-Temperature"
        encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
      </output>
    </operation>
  </binding>
</definitions>
```
The following are the major components of the WSDL file:

<table>
<thead>
<tr>
<th>Component</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>definitions</td>
<td>The root element of the WSDL file. This area contains namespace definitions that you use to avoid naming conflicts between multiple web services.</td>
</tr>
<tr>
<td>types</td>
<td>(Not shown) Defines data types used by the service's messages.</td>
</tr>
<tr>
<td>message</td>
<td>Defines the data transferred by a web service operation, typically the name and data type of input parameters and return values.</td>
</tr>
<tr>
<td>port type</td>
<td>Defines one or more operations provided by the web service.</td>
</tr>
<tr>
<td>operation</td>
<td>Defines an operation that can be remotely invoked.</td>
</tr>
<tr>
<td>input</td>
<td>Specifies an input parameter to the operation using a previously defined message.</td>
</tr>
<tr>
<td>output</td>
<td>Specifies the return values from the operation using a previously defined message.</td>
</tr>
<tr>
<td>fault</td>
<td>(not shown) Optionally specifies an error message returned from the operation.</td>
</tr>
<tr>
<td>binding</td>
<td>Specifies the protocol used to access a web service including SOAP, HTTP GET and POST, and MIME.</td>
</tr>
<tr>
<td>service</td>
<td>Defines a group of related operations.</td>
</tr>
<tr>
<td>port</td>
<td>Defines an operation and its associated inputs and outputs.</td>
</tr>
</tbody>
</table>

For additional descriptions of the contents of this WSDL file, see “Consuming web services” on page 904.

**Consuming web services**

ColdFusion provides a variety of methods for consuming web services. The method that you choose depends on your ColdFusion programming style and application.

The following table describes these methods:

<table>
<thead>
<tr>
<th>Method</th>
<th>CFML operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFScript</td>
<td>0</td>
<td>Consumes a web service from within a CFScript block.</td>
</tr>
<tr>
<td>CFML tag</td>
<td></td>
<td>Consumes a web service from within a block of CFML code.</td>
</tr>
<tr>
<td>CFML tag</td>
<td></td>
<td>Consumes a web service from within a block of CFML code.</td>
</tr>
</tbody>
</table>

One important consideration is that all consumption methods use the same underlying technology and offer the same performance.
About the examples in this section

The examples in this section reference the TemperatureService web service from XMethods. This web service returns the temperature for a given zip code. You can read the WSDL file for this web service in "Reading a WSDL file" on page 903.

The TemperatureService web service has one input parameter, a string that contains the requested zip code. It returns a float that contains the temperature for the specified zip code.

Passing parameters to a web service

The message and operation elements in the WSDL file contain subelements that define the web service operations and the input and output parameters of each operation, including the data type of each parameter. The following example shows a portion of the WSDL file for the TemperatureService web service:

```
<message name="getTempRequest">
  <part name="zipcode" type="xsd:string"/>
</message>
<message name="getTempResponse">
  <part name="return" type="xsd:float"/>
</message>
<portType name="TemperaturePortType">
  <operation name="getTemp">
    <input message="tns:getTempRequest"/>
    <output message="tns:getTempResponse"/>
  </operation>
</portType>
```

The operation name used in the examples in this section is getTemp. This operation takes a single input parameter defined as a message of type getTempRequest.

You can see that the message element named getTempRequest contains one string parameter: zipcode. When you call the getTemp operation, you pass the parameter as input.

Handling return values from a web service

Web service operations often return information back to your application. You can determine the name and data type of returned information by examining subelements of the message and operation elements in the WSDL file.

The following example shows a portion of the WSDL file for the TemperatureService web service:

```
<message name="getTempRequest">
  <part name="zipcode" type="xsd:string"/>
</message>
<message name="getTempResponse">
  <part name="return" type="xsd:float"/>
</message>
<portType name="TemperaturePortType">
  <operation name="getTemp">
    <input message="tns:getTempRequest"/>
    <output message="tns:getTempResponse"/>
  </operation>
</portType>
```

The operation getTemp returns a message of type getTempResponse. The message statement in the WSDL file defines the getTempResponse message as containing a single string parameter named return.
Using **cfinvoke** to consume a web service

This section describes how to consume a web service using the `cfinvoke` tag. With the `cfinvoke` tag, you reference the WSDL file and invoke an operation on the web service with a single tag.

The `cfinvoke` tag includes attributes that specify the URL to the WSDL file, the method to invoke, the return variable, and input parameters. For complete syntax, see the CFML Reference.

**Note:** You can pass parameters to a web service using the `cfinvokeargument` tag or by specifying parameter names in the `cfinvoke` tag itself. For more information, see “Passing parameters to methods by using the `cfinvoke` tag” on page 177.

Access a web service using `cfinvoke`

1 Create a ColdFusion page with the following content:

```cfc
<cfscript>
stArgs = structNew();
stArgs.zipcode = "55987";
</cfscript>

<cfinvoke
 webservice="http://www.xmethods.net/sd/2001/TemperatureService.wsdl"
 method="getTemp"
 returnvariable="aTemp">
 <cfinvokeargument name="zipcode" value="55987"/>
 </cfinvoke>
<cfoutput>The temperature at zip code 55987 is #aTemp#</cfoutput>
```

2 Save the page as `wscfc.cfm` in your web root directory.

3 View the page in your browser.

You can omit a parameter by setting the `omit` attribute to "yes". If the WSDL specifies that the argument is nullable, ColdFusion sets the associated argument to null. If the WSDL specifies minoccurs=0, ColdFusion omits the argument from the WSDL. However, CFC web services must still specify `required="true"` for all arguments.

You can also use an attribute collection to pass parameters. An attribute collections is a structure where each structure key corresponds to a parameter name and each structure value is the parameter value passed for the corresponding key. The following example shows an invocation of a web service using an attribute collection:

```cfc
<cfscript>
stArgs.zipcode = "55987";
</cfscript>

<cfinvoke
 webservice="http://www.xmethods.net/sd/2001/TemperatureService.wsdl"
 method="getTemp"
 argumentcollection="#stArgs#"
 returnvariable="aTemp">
 <cfoutput>The temperature at zip code 55987 is #aTemp#</cfoutput>
```

In this example, you create the structure in a CFScript block, but you can use any ColdFusion method to create the structure.

Using **CFScript** to consume a web service

The example in this section uses CFScript to consume a web service. In CFScript, you use the `CreateObject` function to connect to the web service. After connecting, you can make requests to the service. For `CreateObject` syntax, see the CFML Reference.

After creating the web service object, you can call operations of the web service using dot notation, in the following form:
You can handle return values from web services by writing them to a variable, as the following example shows:

```
resultVar = webServiceName.operationName(inputVal1, inputVal2, ...);
```

Or, you can pass the return values directly to a function, such as the `WriteOutput` function, as the following example shows:

```
writeoutput(webServiceName.operationName(inputVal1, inputVal2, ...));
```

**Access a web service from CFScript**

1. Create a ColdFusion page with the following content:

   ```
   <cfscript>
   ws = CreateObject("webservice", "http://www.xmethods.net/sd/2001/TemperatureService.wsdl");
   xlatstring = ws.getTemp("55987");
   writeoutput(xlatstring);
   </cfscript>
   ``

2. Save the page as wscfscript.cfm in your web root directory.

3. View the page in your browser.

You can also use named parameters to pass information to a web service. The following example performs the same operation as above, except that it uses named parameters to make the web service request:

```
<cfscript>
ws = CreateObject("webservice", "http://www.xmethods.net/sd/2001/TemperatureService.wsdl");
xlatstring = ws.getTemp(zipcode = "55987");
writeoutput("The temperature at 55987 is " & xlatstring);
</cfscript>
```

**Consuming web services that are not generated by ColdFusion**

To consume a web service that is implemented in a technology other than ColdFusion, the web service must have one of the following sets of options:

- rpc as the SOAP binding style and encoding as the encodingStyle
- document as the SOAP binding style and literal as the encodingStyle

The following example shows a portion of the WSDL file for the TemperatureService web service:

```
<binding name="TemperatureBinding" type="tns:TemperaturePortType">
  <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http"/>
  <operation name="getTemp">
    <soap:operation soapAction=""/>
    <input>
      <soap:body use="encoded" namespace="urn:xmethods-Temperature" encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
    </input>
    <output>
      <soap:body use="encoded" namespace="urn:xmethods-Temperature" encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
    </output>
  </operation>
</binding>
```

The WSDL file for the TemperatureService web service is compatible with ColdFusion because it uses rpc as the binding style, and encoding as the encodingStyle.
Calling web services from a Flash client

The Flash Remoting service lets you call ColdFusion pages from a Flash client, but it does not let you call web services directly. To call web services from a Flash client, you can use Flash Remoting to call a ColdFusion component that calls the web service. The Flash client can pass input parameters to the component, and the component can return to the Flash client any data returned by the web service.

For more information, see “Using the Flash Remoting Service” on page 674.

Catching errors when consuming web services

Web services might throw errors, including SOAP faults, during processing that you can catch in your application. If uncaught, these errors propagate to the browser.

To catch errors, you specify an error type of application to the ColdFusion cfcatch tag, as the following example shows:

```cftry>
    Put your application code here ...
    <cfcatch type="application">
        <!--- Add exception processing code here ... --->
    </cfcatch>
    ...
    <cfcatch type="Any">
        <!--- Add exception processing code appropriate for all other exceptions here ... --->
    </cfcatch>
</cftry>
```

For more information on error handling, see “Handling Errors” on page 246.

Handling inout and out parameters

Some web services define inout and out parameters. You use out parameters to pass a placeholder for a return value to a web service. The web service then returns its result by writing it to the out parameter. Inout parameters let you pass a value to a web service and lets the web service return its result by overwriting the parameter value.

The following example shows a web service that takes as input an inout parameter containing a string and writes its results back to the string:

```cfset S="foo">
<cfscript>
    ws=createobject("webservice", "URLtoWSDL")
    ws.modifyString("S");
</cfscript>
<cfoutput>#S#</cfoutput>
```

Even though this web service takes as input the value of S, because you pass it as an inout parameter, you do not enclose it in number signs.

**Note:** ColdFusion supports the use of inout and out parameters to consume web services. However, ColdFusion does not support inout and out parameters when creating web services for publication.

Configuring web services in the ColdFusion Administrator

The ColdFusion Administrator lets you register web services so that you do not have to specify the entire WSDL URL when you reference the web service.

**Note:** The first time you reference a web service, ColdFusion automatically registers it in the Administrator.
For example, the following code references the URL to the TemperatureService WSDL file:

```cfscript
<cfscript>
ws = CreateObject("webservice", "http://www.xmethods.net/sd/2001/TemperatureService.wsdl");
xlatstring = ws.getTemp("55987");
writeoutput(xlatstring);
</cfscript>
```

If you register the TemperatureService web service in the Administrator using (for example, the name wsTemp), you can then reference the web service as follows:

```cfscript
<cfscript>
    ws = CreateObject("webservice", "wsTemp");
    xlatstring = ws.getTemp("55987");
    writeoutput("wsTemp: " & xlatstring);
</cfscript>
```

Not only does this enable you to shorten your code, registering a web service in the Administrator lets you change a web service’s URL without modifying your code. So, if the TemperatureService web service moves to a new location, you only update the administrator setting, not your application code.

For more information, see the ColdFusion Administrator online Help.

### Data conversions between ColdFusion and WSDL data types

A WSDL file defines the input and return parameters of an operation, including data types. For example, the TemperatureService web service contains the following definition of input and return parameters:

```xml
<message name="getTempRequest">
    <part name="zipcode" type="xsd:string"/>
</message>
<message name="getTempResponse">
    <part name="return" type="xsd:float"/>
</message>
```

As part of consuming web services, you must understand how ColdFusion converts WSDL defined data types to ColdFusion data types. The following table shows this conversion:

<table>
<thead>
<tr>
<th>ColdFusion data type</th>
<th>WSDL data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>numeric</td>
<td>SOAP-ENC:double</td>
</tr>
<tr>
<td>boolean</td>
<td>SOAP-ENC:boolean</td>
</tr>
<tr>
<td>string</td>
<td>SOAP-ENC:string</td>
</tr>
<tr>
<td>array</td>
<td>SOAP-ENC:Array</td>
</tr>
<tr>
<td>binary</td>
<td>xsd:base64Binary</td>
</tr>
<tr>
<td>numeric</td>
<td>xsd:float</td>
</tr>
<tr>
<td>string</td>
<td>xsd:enumeration</td>
</tr>
<tr>
<td>date</td>
<td>xsd:dateTime</td>
</tr>
<tr>
<td>void (operation returns nothing)</td>
<td></td>
</tr>
<tr>
<td>struct</td>
<td>complex type</td>
</tr>
<tr>
<td>query</td>
<td>tns1:QueryBean (Returned by CFCs)</td>
</tr>
</tbody>
</table>
For many of the most common data types, such as string and numeric, a WSDL data type maps directly to a ColdFusion data type. For complex WSDL data types, the mapping is not as straightforward. In many cases, you map a complex WSDL data type to a ColdFusion structure. For more information on handling complex data types, see "Handling complex data types" on page 920.

Consuming ColdFusion web services

Your application can consume web services created in ColdFusion. You do not have to perform any special processing on the input parameters or return values because ColdFusion handles data mappings automatically when consuming a ColdFusion web service.

For example, when ColdFusion publishes a web service that returns a query, or takes a query as an input, the WSDL file for that service lists its data type as QueryBean. However, a ColdFusion application consuming this web service can pass a ColdFusion query object to the function as an input, or write a returned QueryBean to a ColdFusion query object.

Note: For a list of how ColdFusion data types map to WSDL data types, see “Data conversions between ColdFusion and WSDL data types” on page 909.

The following example shows a ColdFusion component that takes a query as input and echoes the query back to the caller:

```coldfusion
<cfcomponent>
  <cffunction name='echoQuery' returnType='query' access='remote'>
    <cfargument name='input' type='query'>
    <cfreturn #arguments.input#>
  </cffunction>
</cfcomponent>
```

In the WSDL file for the echotypes.cfc component, you see the following definitions that specify the type of the function's input and output as QueryBean:

```
<wSDL:message name="echoQueryResponse">
  <wSDL:part name="echoQueryReturn" type="tns1:QueryBean"/>
</wSDL:message>
<wSDL:message name="echoQueryRequest">
  <wSDL:part name="input" type="tns1:QueryBean"/>
</wSDL:message>
```

For information on displaying WSDL, see “Producing WSDL files” on page 912.

Since ColdFusion automatically handles mappings to ColdFusion data types, you can call this web service as the following example shows:

```coldfusion
<cfquery name="GetEmployees" datasource="cfdocexamples">
  SELECT FirstName, LastName, Salary
  FROM Employee
</cfquery>
<cfinvoke
  webservice = "http://localhost/echotypes.cfc?wsdl"
  method = "echoQuery"
  input="#GetEmployees#"
  returnVariable = "returnedQuery">
```
Publishing web services

To publish web services for consumption by remote applications, you create the web service using ColdFusion components. For more information on components, see “Building and Using ColdFusion Components” on page 158.

Creating components for web services

ColdFusion components (CFCs) encapsulate application functionality and provide a standard interface for client access to that functionality. A component typically contains one or more functions defined by the `cffunction` tag.

For example, the following component contains a single function:

```coldfusion
<cfcomponent>
  <cffunction name="echoString" returnType="string" output="no">
    <cfargument name="input" type="string">
    <cfreturn #arguments.input#>
  </cffunction>
</cfcomponent>
```

The function, named echoString, echoes back any string passed to it. To publish the function as a web service, you must modify the function definition to add the `access` attribute and specify remote, as the following example shows:

```coldfusion
<cffunction name="echoString" returnType="string" output="no" access="remote">
  <cfreturn #arguments.input#>
</cffunction>
```

By defining the function as remote, ColdFusion includes the function in the WSDL file. Only those functions marked as remote are accessible as a web service.

The following list defines the requirements for how to create web services for publication:

1. The value of the `access` attribute of the `cffunction` tag must be `remote`.
2. The `cffunction` tag must include the `returnType` attribute to specify a return type.
3. The `output` attribute of the `cffunction` tag must be set to `No` because ColdFusion converts all output to XML to return it to the consumer.
4. The attribute setting `required="false"` for the `cfargument` tag is ignored. ColdFusion considers all parameters as required.

Specifying data types of function arguments and return values

The `cffunction` tag lets you define a single return value and one or more input parameters passed to a function. As part of the function definition, you include the data type of the return value and input parameters.

The following example shows a component that defines a function with a return value of type string, one input parameter of type string, and one input parameter of type numeric:
As part of publishing the component for access as a web service, ColdFusion generates the WSDL file that defines the component where the WSDL file includes definitions for how ColdFusion data types map to WSDL data types. The following table shows this mapping:

<table>
<thead>
<tr>
<th>ColdFusion data type</th>
<th>WSDL data type published</th>
</tr>
</thead>
<tbody>
<tr>
<td>numeric</td>
<td>SOAP-ENC:double</td>
</tr>
<tr>
<td>boolean</td>
<td>SOAP-ENC:boolean</td>
</tr>
<tr>
<td>string</td>
<td>SOAP-ENC:string</td>
</tr>
<tr>
<td>array</td>
<td>SOAP-ENC:Array</td>
</tr>
<tr>
<td>binary</td>
<td>xsd:base64Binary</td>
</tr>
<tr>
<td>date</td>
<td>xsd:dateTime</td>
</tr>
<tr>
<td>guid</td>
<td>SOAP-ENC:string</td>
</tr>
<tr>
<td>uuid</td>
<td>SOAP-ENC:string</td>
</tr>
<tr>
<td>void (operation returns nothing)</td>
<td></td>
</tr>
<tr>
<td>struct</td>
<td>Map</td>
</tr>
<tr>
<td>query</td>
<td>QueryBean</td>
</tr>
<tr>
<td>any</td>
<td>complex type</td>
</tr>
<tr>
<td>component definition</td>
<td>complex type</td>
</tr>
</tbody>
</table>

In most cases, consumers of ColdFusion web services can easily pass data to and return results from component functions by mapping their data types to the WSDL data types shown in the preceding table.

**Note:** Document-literal web services use XML schema data types, not SOAP-ENC data types. For more information, see “Publishing document-literal style web services” on page 916.

For ColdFusion structures and queries, clients might have to perform some processing to map their data to the correct type. For more information, see “Publishing web services that use complex data types” on page 923.

You can also define a data type in one ColdFusion component based on another component definition. For more information on using components to specify a data type, see “Using ColdFusion components to define data types for web services” on page 915.

**Producing WSDL files**

ColdFusion automatically creates a WSDL file for any component referenced as a web service. For example, if you have a component named echo.cfc in your web root directory, you can view its corresponding WSDL file by requesting the component as follows:

http://localhost/echo.cfc?wsdl

The `cfcomponent` tag includes optional attributes that you can use to control the WSDL that ColdFusion generates. You can use these attributes to create meaningful WSDL attribute names, as the following example shows:
For complete control of the WSDL, advanced users can specify the `cfcomponent wsdlFile` attribute to use a predefined WSDL file.

The following example defines a ColdFusion component that can be invoked as a web service:

```xml
<cfcomponent>
<cffunction name="echoString" returnType="string" output="no" access="remote">
<cfargument name="input" type="string">
<cfreturn #arguments.input#>
</cffunction>
</cfcomponent>

If you register the component in Dreamweaver, it appears in the Components tab of the Application panel.

Requesting the WSDL file in a browser returns the following:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<wsdl:definitions targetNamespace="http://ws"
xmlns="http://schemas.xmlsoap.org/wsdl/"
xmlns:apachesoap="http://xml.apache.org/xml-soap"
xmlns:impl="http://ws"
xmlns:intf="http://ws"
xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
xmlns:tns1="http://rpc.xml.coldfusion"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
xmlns:wsdlsoap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
<!--WSDL created by ColdFusion -->
<wsdl:types>
<schema targetNamespace="http://rpc.xml.coldfusion"
xmlns="http://www.w3.org/2001/XMLSchema">
<import namespace="http://schemas.xmlsoap.org/soap/encoding/">
<complexType name="CFCInvocationException">
<sequence/>
</complexType>
</schema>
<wsdl:message name="CFCInvocationException">
<part name="fault" type="tns1:CFCInvocationException"/>
</wsdl:message>
<wsdl:message name="echoStringResponse">
<part name="echoStringReturn" type="xsd:string"/>
</wsdl:message>
<wsdl:message name="echoStringRequest">
<part name="input" type="xsd:string"/>
</wsdl:message>
<wsdl:portType name="echo">
<operation name="echoString" parameterOrder="input">
<wsdl:input message="impl:echoStringRequest" name="echoStringRequest"/>
<wsdl:output message="impl:echoStringResponse"/>
</operation>
</wsdl:portType>
</wsdl:types>
</wsdl:definitions>
```
Publish a web service

1  Create a ColdFusion page with the following content:

```coldfusion
<cfcomponent output="false">
  <cffunction
    name = "echoString"
    returnType = "string"
    output = "no"
    access = "remote">
    <cfargument name = "input" type = "string">
    <cfreturn #arguments.input#>
  </cffunction>
</cfcomponent>
```

2  Save this file as echo.cfc in your web root directory.

3  Create a ColdFusion page with the following content:

```coldfusion
<cfinvoke webservice="http://localhost/echo.cfc?wsdl"
  method = "echoString"
  input = "hello"
  returnVariable="foo">
<cfoutput>#foo#</cfoutput>
</cfinvoke>
```

4  Save this file as echoclient.cfm in your web root directory.

5  Request echoclient.cfm in your browser.

The following string appears in your browser:

`hello`
You can also invoke the web service using the following code:

```cfcscript
ws = CreateObject("webservice", "http://localhost/echo.cfc?wsdl");
wsresults = ws.echoString("hello");
writeoutput(wsresults);
</cfcscript>

Using ColdFusion components to define data types for web services

ColdFusion lets you define components that contain only properties. Once defined, you can use components to define data types for web services. The following code defines a component in the file address.cfc that contains properties that represent a street address:

```cfc
<cfcomponent>
  <cfproperty name="AddrNumber" type="numeric"/>
  <cfproperty name="Street" type="string"/>
  <cfproperty name="City" type="string"/>
  <cfproperty name="State" type="string"/>
  <cfproperty name="Country" type="string"/>
</cfcomponent>
```

The following code defines a component in the filename.cfc that defines first and last name properties:

```cfc
<cfcomponent>
  <cfproperty name="Firstname" type="string"/>
  <cfproperty name="Lastname" type="string"/>
</cfcomponent>
```

You can then use address and name to define data types in a ColdFusion component created to publish a web service, as the following example shows:

```cfc
<cfcomponent>
  <cffunction name="echoName" returnType="name" access="remote" output="false">
    <cfargument name="input" type="name"/>
    <cfreturn #arguments.input#>
  </cffunction>
  
  <cffunction name="echoAddress" returnType="address" access="remote" output="false">
    <cfargument name="input" type="address"/>
    <cfreturn #arguments.input#>
  </cffunction>
</cfcomponent>
```

**Note:** If the component files are not in a directory under your web root, you must create a web server mapping to the directory that contains them. You cannot use ColdFusion mappings to access web services.

The WSDL file for the web service contains data definitions for the complex types name and address. Each definition consists of the elements that define the type as specified in the ColdFusion component file for that type. For example, the following example shows the definition for name:

```xml
<complexType name="name">
  <sequence>
    <element name="firstname" nillable="true" type="soapenc:string"/>
    <element name="lastname" nillable="true" type="soapenc:string"/>
  </sequence>
</complexType>
```

You can also specify an array of CFCs in the `returnType` attribute, as the following example shows:
When you invoke the web service, it returns an array of CFCs. Access the properties in the CFC by using dot notation, as the following example shows:

```coldfusion
<cfinvoke webservice ="http://localhost:8500/ws/cfcarray.cfc?wsdl"
method ="allNames"
returnVariable="thearray">
    <cfif IsArray(thearray)>
        <h1>loop through the employees</h1>
        <p>thearray has #ArrayLen(thearray)# elements.</p>
        <cfloop index ="i" from ="1" to ="#ArrayLen(thearray)#">
            <cfoutput>#thearray[i].firstname#, #thearray[i].lastname# </cfoutput><br>
        </cfloop>
    </cfif>
    <cfelse>
        <h1>Error: thearray is not an array</h1>
    </cfelse>
</cfinvoke>
```

**Publishing document-literal style web services**

In addition to RPC-oriented operations, for which consumers specify a method and arguments, ColdFusion also lets you publish web services using the document-literal style. When you use document-literal style, the WSDL for the web service tells the client to use XML schemas rather than RPC calling conventions.

In most cases, the publisher of a web services identifies it as document-literal or RPC style. To identify the type, open the WSDL document and find the `soap:binding` element and examine its `style` attribute, as the following example shows:

```xml
<wsdl:binding name="WeatherForecastSoap" type="tns:WeatherForecastSoap">
    <soap:binding transport="http://schemas.xmlsoap.org/soap/http" style="document" />
</wsdl:binding>
```

In this example, the style is document-literal. You must further examine the WSDL to determine the methods you can call and the parameters for each method.

On the client side, the `cfinvoke` tag and other ColdFusion methods for calling web services handle this automatically. In most cases, no modifications are necessary. Similarly, when publishing CFCs as document-literal style web services, ColdFusion automatically creates and manages the appropriate WSDL.

To publish CFCs as document-literal style web services, specify `cfcomponent style="document"`, along with the other attributes required for document-literal style web services. For example, ColdFusion publishes the following CFC using document-literal style:
<cffunction>
name = "getEmp"
returntype = "string"
output = "no"
access = "remote">
  <cfargument name="empid" required="yes" type="numeric">
  <cfset var fullname = "">
  <cfquery name="empinfo" datasource="cfdocexamples">
    SELECT emp_id, firstname, lastname
    FROM employee
    WHERE emp_id = <cfqueryparam cfsqltype="cf_sql_integer" value="#arguments.empid#">
  </cfquery>
  <cfif empinfo.recordcount gt 0>
    <cfset fullname = empinfo.lastname &", " & empinfo.firstname>
  </cfif>
  <cfelse>
    <cfset fullname = "not found">
  </cfelse>
  <cfreturn #fullname#>
</cffunction>
</cfcomponent>

Securing your web services
You can restrict access to your published web services to control the users allowed to invoke them. You can use your web server to control access to the directories containing your web services, or you can use ColdFusion security in the same way that you would to control access to any ColdFusion page.

Controlling access to component CFC files
To browse the HTML description of a CFC file, you request the file by specifying a URL to the file in your browser. By default, ColdFusion secures access to all URLs that directly reference a CFC file, and prompts you to enter a password upon the request. Use the ColdFusion RDS password to view the file.

To disable security on CFC file browsing, use the ColdFusion Administrator to disable the RDS password.

For more information, see "Building and Using ColdFusion Components" on page 158.

Using your web server to control access
Most web servers, including IIS and Apache, implement directory access protection using the basic HTTP authentication mechanism. When a client attempts to access one of the resources under a protected directory, and has not properly authenticated, the web server automatically sends back an authentication challenge, typically an HTTP Error 401 Access Denied error.

In response, the client's browser opens a login prompt containing a user name and password field. When the user submits this information, the browser sends it back to the web server. If authentication passes, the web server allows access to the directory. The browser also caches the authentication data as long as it is open, so subsequent requests automatically include the authentication data.

Web service clients can also pass the user name and password information as part of the request. The cfinvoke tag includes the user name and password attributes that let you pass login information to a web server using HTTP basic authentication. You can include these attributes when invoking a web service, as the following example shows:

```cf<cfinvoke
  webservice = "http://some.cfc?wsdl"
  returnVariable = "foo"
...```
ColdFusion inserts the user name/password string in the authorization request header as a base64 binary encoded string, with a colon separating the user name and password. This method of passing the user name/password is compatible with the HTTP basic authentication mechanism used by web servers.

The ColdFusion Administrator lets you predefine web services. As part of defining the web service, you can specify the user name and password that ColdFusion includes as part of the request to the web service. Therefore, you do not have to encode this information using the cfinvoke tag. For information on defining a web service in the ColdFusion Administrator, see “Configuring web services in the ColdFusion Administrator” on page 908.

Using ColdFusion to control access
Instead of letting the web server control access to your web services, you can handle the user name/password string in your Application.cfc or Application.cfm file as part of your own security mechanism. In this case, you use the cflogin tag to retrieve the user name/password information from the authorization header, decode the binary string, and extract the user name and password, as the following excerpt from an Application.cfc onRequestStart method shows:

```coldfusion
<cflogin>
<cfset isAuthorized = false>
<cfif isDefined("cflogin")
 <!--- Verify user name from cflogin.name and password from cflogin.password using your authentication mechanism. --->
<cfset isAuthorized = true>
</cfif>
</cflogin>
<cfif not isAuthorized>
 <!--- If the user does not pass a user name/password, return a 401 error. The browser then prompts the user for a user name/password. --->
<cfheader statuscode="401">
<cfheader name="WWW-Authenticate" value="Basic realm="Test"">-
<cfabort>
</cfif>
```

This example does not show how to perform user verification. For more information on verification, see "Securing Applications" on page 311.

Best practices for publishing web services
ColdFusion web services provide a powerful mechanism for publishing and consuming application functionality. However, before you produce web services for publication, you might want to consider the following best practices:

1. Minimize the use of ColdFusion complex types, such as query and struct, in the web services you create for publication. These types require consumers, especially those consuming the web service using a technology other than ColdFusion, to create special data structures to handle complex types.
2. Locally test the ColdFusion components implemented for web services before publishing them over the Internet.
Using request and response headers

ColdFusion includes a set of functions that enable your web service to get and set request and response headers. You use these functions to retrieve the response headers from a web service request and to create SOAP headers in a request that has the `mustUnderstand` attribute set to be True.

You typically use different functions in web services clients and in the web service CFC, itself:

**In the client:**
- **`, called before the request to set a SOAP header.**
- **`, called after the request to retrieve a SOAP header.**

**In the web service CFC:**
- **`, called to determine whether the CFC method is being called as a web service.**
- **`, called to retrieve a SOAP header set by the client.**
- **`, called to set a SOAP header that is returned to the client.**

*Note: When used in a CFC, you can only use these functions in CFC methods if they are being used as web services. Use the `IsSOAPRequest` function to determine whether the CFC method is being called as a web service.*

The following example CFM page uses the `AddSOAPRequestHeader`, `getSOAPRequest`, and `GetSOAPResponse` functions:

```cfsavecontent variable="my_xml">
<Request xmlns="http://www.oasis-open.org/asap/0.9/asap.xsd">
  <SenderKey>ss</SenderKey>
  <ReceiverKey>zz</ReceiverKey>
  <ResponseRequired>Yes</ResponseRequired>
  <RequestID>id</RequestID>
</Request>
</cfsavecontent>
```

```cfscript>
addSOAPRequestHeader(ws, "http://www.cfdevguide.com/", "testrequestheader", ",my_xml",");
</cfscript>
```

```cfscript>
ret=ws.showSOAPHeaders();
inxml = getSOAPRequest(ws);
outxml = getSOAPResponse(ws);
</cfscript>
```

```cfoutput>
<h2>Return Value</h2>
<!---- This is XML, so use HTMLCodeFormat. ---->
The return value was #ret#
</cfoutput>
```

The following example CFC uses the `IsSOAPRequest` and `AddSOAPResponseHeader` functions:

```cfcomponent>
```
Handling complex data types

When dealing with web services, handling complex types falls into the following categories:

- Mapping the data types of a web service to consume to ColdFusion data types
- Understanding how clients will reference your ColdFusion data types when you publish a web service

This section describes both categories.

Consuming web services that use complex data types

The following table shows how WSDL data types are converted to ColdFusion data types:

<table>
<thead>
<tr>
<th>ColdFusion data type</th>
<th>WSDL data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>numeric</td>
<td>SOAP-ENC:double</td>
</tr>
<tr>
<td>boolean</td>
<td>SOAP-ENC:boolean</td>
</tr>
<tr>
<td>string</td>
<td>SOAP-ENC:string</td>
</tr>
<tr>
<td>array</td>
<td>SOAP-ENC:Array</td>
</tr>
<tr>
<td>numeric</td>
<td>SOAP-ENC:float</td>
</tr>
<tr>
<td>binary</td>
<td>xsd:base64Binary</td>
</tr>
</tbody>
</table>
This table shows that complex data types map to ColdFusion structures. ColdFusion structures offer a flexible way to represent data. You can create structures that contain single-dimension arrays, multi-dimensional arrays, and other structures.

The ColdFusion mapping of complex types to structures is not automatic. You have to perform some processing on the data in order to access it as a structure. The next sections describe how to pass complex types to web services, and how to handle complex types returned from web services.

**Passing input parameters to web services as complex types**

A web service can take a complex data type as input. In this situation, you can construct a ColdFusion structure that models the complex data type, then pass the structure to the web service.

For example, the following excerpt from a WSDL file shows the definition of a complex type named Employee:

```
<s:complexType name="Employee">
  <s:sequence>
    <s:element minOccurs="1" maxOccurs="1" name="fname" type="s:string" />
    <s:element minOccurs="1" maxOccurs="1" name="lname" type="s:string" />
    <s:element minOccurs="1" maxOccurs="1" name="active" type="s:boolean" />
    <s:element minOccurs="1" maxOccurs="1" name="age" type="s:int" />
    <s:element minOccurs="1" maxOccurs="1" name="hiredate" type="s:dateTime" />
    <s:element minOccurs="1" maxOccurs="1" name="number" type="s:double" />
  </s:sequence>
</s:complexType>
```

The Employee data type definition includes six elements, the data type of each element, and the name of each element.

Another excerpt from the WSDL file shows a message definition using the Employee data type. This message defines an input parameter, as the following code shows:

```
<message name="updateEmployeeInfoSoapIn">
  <part name="thestuct" type="s0:Employee" />
</message>
```

A third excerpt from the WSDL file shows the definition of an operation, named updateEmployeeInfo, possibly one that updates the employee database with the employee information. This operation takes as input a parameter of type Employee, as the following code shows:

```
<operation name="updateEmployeeInfo">
  <input message="s0:updateEmployeeInfoSoapIn" />
</operation>
```

To call the updateEmployeeInfo operation, create a ColdFusion structure, initialize six fields of the structure that correspond to the six elements of Employee, and then call the operation, as the following code shows:

```
<!--- Create a structure using CFScript, then call the web service. --->
<cfscript>
  stUser = structNew();
  stUser.active = TRUE;
  stUser.fname = "John";
  stUser.lname = "Smith";
</cfscript>
```
You can use structures for passing input parameters as complex types in many situations. However, to build a structure to model a complex type, you have to inspect the WSDL file for the web service to determine the layout of the complex type. This can take some practice.

Handling return values as complex types
When a web service returns a complex type, you can write that returned value directly to a ColdFusion variable.

The previous section used a complex data type named Employee to define an input parameter to an operation. A WSDL file can also define a return value using the Employee type, as the following code shows:

```
<message name="updateEmployeeInfoSoapOut">
  <part name="updateEmployeeInfoResult" type="s0:Employee" />
</message>
<operation name="updateEmployeeInfo">
  <input message="s0:updateEmployeeInfoSoapIn" />
  <output message="s0:updateEmployeeInfoSoapOut" />
</operation>
```

In this example, the operation updateEmployeeInfo takes a complex type as input and returns a complex type as output. To handle the input parameter, you create a structure. To handle the returned value, you write it to a ColdFusion variable, as the following example shows:

```
<!--- Create a structure using CFScript, then call the web service. --->
<!--- Write the returned value to a ColdFusion variable. --->
<cfscript>
stUser = structNew();
stUser.active = TRUE;
stUser.fname = "John";
stUser.lname = "Smith";
stUser.age = 23;
stUser.hiredate = createDate(2002,02,22);
stUser.number = 123.321;
ws = createObject("webservice", "http://somehost/EmployeeInfo.asmx?wsdl");
ws.updateEmployeeInfo(stUser);
</cfscript>

<!--- Output the returned values. --->
<cfoutput>
  <br>Name of employee is: #myReturnVar.fname##myReturnVar.lname#
  <br>Active status: #myReturnVar.active#
  <br>Age:#myReturnVar.age#
  <br>Hire Date: #myReturnVar.hiredate#
  <br>Favorite Number: #myReturnVar.number#
</cfoutput>
```

You access elements of the variable myReturnVar using dot notation in the same way that you access structure fields. If a complex type has nested elements, in the way a structure can have multiple levels of nested fields, you use dot notation to access the nested elements, as in a.b.c.d, to whatever nesting level is necessary.
However, the variable myReturnVar is not a ColdFusion structure. It is a container for the complex type, but has none of the attributes of a ColdFusion structure. Calling the ColdFusion function isStruct on the variable returns False.

You can copy the contents of the variable to a ColdFusion structure, as the following example shows:

```cfscript
<cfscript>
...
ws = createObject("webservice", "http://somehost/echosimple.asmx?wsdl");
myReturnVar = ws.echoStruct(stUser);
realStruct = structNew();
realStruct.active = #myReturnVar.active#;
realStruct.fname = "#myReturnVar.fname#";
realStruct.lname = "#myReturnVar.lname#";
realStruct.age = #myReturnVar.age#;
realStruct.hiredate = #myReturnVar.hiredate#;
realStruct.number = #myReturnVar.number#;
</cfscript>

Calling IsStruct on realStruct returns True and you can use all ColdFusion structure functions to process it.

This example shows that ColdFusion variables and structures are useful for handling complex types returned from web services. To understand how to access the elements of a complex type written to a ColdFusion variable, you have to inspect the WSDL file for the web service. The WSDL file defines the API to the web service and will provide you with the information necessary to handle data returned from it.

**Publishing web services that use complex data types**

The two ColdFusion data types that do not map exactly to WSDL data types are struct and query. When you publish a ColdFusion web service that uses parameters of type struct or query, the consuming application needs to be able to handle the data.

Note: If the consumer of a ColdFusion web service is another ColdFusion application, you do not have to perform any special processing. ColdFusion correctly maps struct and query data types in the web service publisher with the consumer. For more information, see “Consuming ColdFusion web services” on page 910.

**Publishing structures**

A ColdFusion structure can hold an unlimited number of key-value pairs where the values can be of any ColdFusion data type. While it is a very useful and powerful way to represent data, it cannot be directly mapped to any XML data types defined in the SOAP 1.1 encoding and XML Schema specification. Therefore, ColdFusion structures are treated as a custom type and the complex type XML schema in WSDL looks like the following:

```xml
<complexType name="mapItem">
  <sequence>
    <element name="key" nillable="true" type="xsd:anyType"/>
    <element name="value" nillable="true" type="xsd:anyType"/>
  </sequence>
</complexType>
<complexType name="Map">
  <sequence>
    <element maxOccurs="unbounded" minOccurs="0" name="item" type="apachesoap:mapItem"/>
  </sequence>
</complexType>
```

This complex type defines a representation of a structure, where the structure keys and values can be any type.
In the WSDL mapping of a ColdFusion structure, each key-value pair in the structure points to the next element in the structure except for the final field, which contains a value. Use dot notation to access the key-value pairs.

### Publishing queries

ColdFusion publishes query data types as the WSDL type QueryBean. The QueryBean data type contains two elements, as the following excerpt from a WSDL file shows:

```xml
<complexType name="QueryBean">
  <all>
    <element name="data" nillable="true" type="intf:ArrayOf_SOAP-ENC_Array" />
    <element name="ColumnList" nillable="true" type="intf:ArrayOf_SOAP-ENC_string" />
  </all>
</complexType>
```

The following table describes the elements of QueryBean:

<table>
<thead>
<tr>
<th>Element name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColumnList</td>
<td>String array that contains column names</td>
</tr>
<tr>
<td>data</td>
<td>Two-dimensional array that contains query data</td>
</tr>
</tbody>
</table>

The WSDL file for a QueryBean defines these elements as follows:

```xml
<complexType name="ArrayOf_SOAP-ENC_Array">
  <complexContent>
    <restriction base="SOAP-ENC:Array">
      <attribute ref="SOAP-ENC:arrayType" wsdl:arrayType="SOAP-ENC:Array[]" />
    </restriction>
  </complexContent>
</complexType>

<complexType name="ArrayOf_SOAP-ENC_string">
  <complexContent>
    <restriction base="SOAP-ENC:Array">
      <attribute ref="SOAP-ENC:arrayType" wsdl:arrayType="xsd:string[]" />
    </restriction>
  </complexContent>
</complexType>
```

### Troubleshooting SOAP requests and responses

ColdFusion provides the following facilities for troubleshooting SOAP requests and responses:

- The `getSOAPRequest` and `getSOAPResponse` functions.
- The TCP monitor.

#### Viewing SOAP requests and responses

You can use the `getSOAPRequest` and `getSOAPResponse` functions to retrieve and display the XML passed to and from a web service. Although advanced users may use this information for custom functionality, you typically use these functions for debugging.

Use these functions in the following places:
• GetSOAPRequest  Clients call this function after the web service request; web service CFCs call this function in the web service CFC method.

• GetSOAPResponse  Clients call this function after the web service request completes; web service CFCs cannot use this method.

The following example uses the GetSOAPRequest and GetSOAPResponse functions in a web service client:

```cfscript>
addSOAPRequestHeader(ws, "http://mynamespace/", "username", "randy");
ret = ws.echo_me("value");
</cfscript>

<cfset soapreq = GetSOAPRequest(ws)>
<h2>SOAP Request</h2>
<cfdump var="#soapreq#">

<cfset soapresp = GetSOAPResponse(ws)>
<h2>SOAP Response</h2>
<cfdump var="#soapresp#">
```

The following example uses the GetSOAPRequest function in a web service CFC method:

```cfcomponent displayname="testerdebug" hint="Test for underscores">
<cffunction access="remote" name="echo_me" output="false" returntype="string" displayname="Echo Test" hint="Header test">
<cfargument name="in_here" required="true" type="string">
<cfset var soapreq = ">
<cfif IsSOAPRequest()>
<cfset soapreq = GetSOAPRequest()>
<cflog text="#soapreq#" log="APPLICATION" type="Information">
...```

**Using the TCP monitor**

TCPMonitor is a swing-based application that lets you watch the request and response flow of HTTP traffic. You can also watch the request and response flow of SOAP traffic. TCPMonitor replaces the Sniffer service formerly used in Macromedia JRun.

**Run TCPMonitor**

❖ On Windows and Unix platforms, you can execute the TCPMonitor by launching the sniffer utility in the `jrun_root/bin` directory.

The TCP Monitor main window appears.

TCPMonitor is a swing-based application that lets you watch the request and response flow of HTTP traffic. However, you can also use it to watch the request and response flow of SOAP traffic.

**To run TCPMonitor:**

1 On Windows and Unix platforms, you can execute the TCPMonitor by launching the sniffer utility in the `cf_root/bin` (server configuration) or `jrun_root/bin` (multiserver configuration) directory.

The TCP Monitor main window appears.
Note: In the J2EE configuration, run the utility directly out of the JAR file by using the following command:

```
java -cp cf_webapp_root/WEB-INF/cfusion/lib/axis.jar java org.apache.axis.utils.tcpmon
[listening_port] [target_host] [target_port]
```

2 Enter the values in the main window as described in the following table:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listen Port#</td>
<td>Enter a local port number, such as 8123, to monitor for incoming connections. Instead of requesting the usual port on which your server runs, you request this port. TCPMonitor intercepts the request and forwards it to the Target Port.</td>
</tr>
<tr>
<td>Listener</td>
<td>Select Listener to use TCPMonitor as a sniffer service in JRun.</td>
</tr>
<tr>
<td>Proxy</td>
<td>Select Proxy to enable proxy support for TCPMonitor.</td>
</tr>
<tr>
<td>Target Hostname</td>
<td>Enter the target host to which incoming connections are forwarded. For example, if you are monitoring a service running on a local server, the hostname is localhost.</td>
</tr>
<tr>
<td>Target Port#</td>
<td>Enter the port number on the target machine to which TCPMonitor connects. For example, if you are monitoring a service running on your local ColdFusion server in the server configuration, the default port number is 8500.</td>
</tr>
<tr>
<td>HTTP Proxy Support</td>
<td>Select this check box only to configure proxy support for TCPMonitor.</td>
</tr>
</tbody>
</table>

You can optionally specify the Listen Port#, Target Hostname and Target Port# values when invoking TCPMonitor on the command line. The following is the syntax for TCPMonitor:

```
java org.apache.axis.utils.tcpmon [listening_port] [target_host] [target_port]
```

3 To add this profile to your TCPMonitor session, click Add.
A tab appears for your new tunneled connection.

4 Select the new tab. If there are port conflicts, TCPMonitor alerts you in the Request panel.

5 Request a page using the Listen Port defined in this TCPMonitor session. For example, if you entered 8123 for the Listen Port, enter the following URL in your browser:

```
http://localhost:8123/
```

TCPMonitor displays the current request and response information:

For each connection, the request appears in the Request panel and the response appears in the Response panel. TCPMonitor keeps a log of all request-response pairs and lets you view any particular pair by selecting an entry in the top panel.

6 To save results to a file for later viewing, click Save. To clear the top panel of older requests that you do not want to save, click Remove Selected and Remove All.

7 To resend the request that you are currently viewing and view a new response, click Resend. You can edit the request in the Request panel before resending, and test the effects of different requests.

8 To change the ports, click Stop, change the port numbers, and click Start.

9 To add another listener, click the Admin tab and enter the values as described previously.

10 To end this TCPMonitor session, click Close.
Chapter 49: Integrating J2EE and Java Elements in CFML Applications

You can integrate J2EE elements, including JSP pages and servlets; JSP tags; and Java objects, including Enterprise JavaBeans (EJBs); into your ColdFusion application.

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About ColdFusion, Java, and J2EE ................................................................. 927
Using JSP tags and tag libraries ................................................................. 930
Interoperating with JSP pages and servlets .............................................. 931
Using Java objects ....................................................................................... 936

About ColdFusion, Java, and J2EE

ColdFusion is built on a J2EE-compliant Java technology platform. This lets ColdFusion applications take advantage of, and integrate with, J2EE elements. ColdFusion pages can do any of the following:

• Include JavaScript and client-side Java applets on the page.
• Use JSP tags.
• Interoperate with JSP pages.
• Use Java servlets.
• Use Java objects, including JavaBeans and Enterprise JavaBeans.

About ColdFusion and client-side JavaScript and applets

ColdFusion pages, like HTML pages, can incorporate client-side JavaScript and Java applets. To use JavaScript, you write the JavaScript code just as you do on any HTML page. ColdFusion ignores the JavaScript and sends it to the client.

The `cfapplet` tag simplifies using Java client-side applets.

Use an applet on a ColdFusion page

1. Register the applet .class file in ColdFusion Administrator Java Applets Extensions page. (For information on registering applets, see the ColdFusion Administrator online Help.)

2. Use the `cfapplet` tag to call the applet. The `appletSource` attribute must be the Applet name assigned in the ColdFusion Administrator.

For example, ColdFusion includes a Copytext sample applet that copies text from one text box to another. The ColdFusion Setup automatically registers the applet in the Administrator. To use this applet, incorporate it on your page. For example:

```cfc
<cfform action = "copytext.cfm">
   <cfapplet appletsource = "copytext" name = "copytext">
</cfform>
```
About ColdFusion and JSP

ColdFusion supports JSP tags and pages in the following ways:

• Interoperates with JSP pages: ColdFusion pages can include or forward to JSP pages, JSP pages can include or forward to ColdFusion pages, and both types of pages can share data in persistent scopes.
• Imports and uses JSP tag libraries: the cfimport tag imports JSP tag libraries and lets you use its tags.

ColdFusion pages are not JSP pages, however, and you cannot use most JSP syntax on ColdFusion pages. In particular you cannot use the following features on ColdFusion pages:

Include, Taglib, and Page directives: Instead, you use CFML import tag to import tag libraries, and the include (or forward) method of the page context object returned by the ColdFusion GetPageContext function to include pages. For more information, see "Using JSP tags and tag libraries" on page 930 and "Interoperating with JSP pages and servlets" on page 931.

Expression, Declaration, and Scriptlet JSP scripting elements: Instead, you use CFML elements and expressions.

JSP comments: Instead, you use CFML comments. (ColdFusion ignores JSP comments and passes them to the browser.)

Standard JSP tags: Such as jsp:plugin, unless your J2EE server provides access to these tags in a JAR file. Instead, you use ColdFusion tags and the PageContext object.

About ColdFusion and servlets

Some Java servlets are not exposed as JSP pages; instead they are Java programs. You can incorporate JSP servlets in your ColdFusion application. For example, your enterprise might have an existing servlet that performs some business logic. To use a servlet, the ColdFusion page specifies the servlet by using the ColdFusion GetPageContext function.

When you access the servlet with the GetPageContext function, the ColdFusion page shares the Request, Application, and Session scopes with the servlet, so you can use these scopes for shared data.

ColdFusion pages can also access servlets by using the cfservertag, use the servlet URL in a form tag, or access an SHTML page that uses a servlet tag.

Note: The cfservertag, which provides access to servlets on JRun servers, is deprecated since ColdFusion MX.

About ColdFusion and Java objects

Java objects include the following:

• Standard Java classes and methods that make up the J2EE API
• Custom-written Java objects, including the following:
  • Custom classes, including JavaBeans
  • Enterprise JavaBeans

ColdFusion pages use the cfobject tag to access Java objects.

ColdFusion searches for the objects in the following order:

1 The ColdFusion Java Dynamic Class Load directories:
  • Java archive (.jar) files in web_root/WEB-INF/lib
  • Class (.class) files in web_root/WEB-INF/classes
ColdFusion reloads classes from these directories, as described in the next section, "About class loading."

2. The classpath specified on the JVM and Java Settings page in the ColdFusion Administrator.

3. The default JVM classpath.

About class loading
ColdFusion dynamically loads classes that are either .class files in the web_root/WEB-INF/classes directory or in JAR files in the web_root/WEB-INF/lib directory. ColdFusion checks the time stamp on the file when it creates an object that is defined in either directory, even when the class is already in memory. If the file that contains the class is newer than the class in memory, ColdFusion loads the class from that directory.

To use this feature, make sure that the Java implementation classes that you modify are not in the general JVM classpath.

To disable automatic class loading of your classes, put the classes in the JVM classpath. Classes located on the JVM classpath are loaded once per server lifetime. To reload these classes, stop and restart ColdFusion.

Note: Because you put tag libraries in the web_root/WEB-INF/lib directory, ColdFusion automatically reloads these libraries if necessary when you import the library.

About GetPageContext and the PageContext object
Because ColdFusion pages are J2EE servlet pages, all ColdFusion pages have an underlying Java PageContext object. CFML includes the GetPageContext function that you can then use in your ColdFusion page.

The PageContext object exposes a number of fields and methods that can be useful in J2EE integration. In particular, it includes the include and forward methods that provide the equivalent of the corresponding standard JSP tags.

This chapter describes how to use the include and forward PageContext methods for calling JSP pages and servlets. It does not discuss the PageContext object in general. For more information on the object, see Java documentation. You can find the Javadoc description of this class at http://java.sun.com/j2ee/1.4/docs/api/javax/servlet/jsp/PageContext.html.

About CFML variables and Java variables
Because ColdFusion variables are case-independent and Java variables are case-dependent, you must be careful about variable names. Use the following rules and guidelines when sharing data between ColdFusion and Java code, including JSP pages and servlets.

Rules
- If you use mixed case variables, all variable names must be unique, independent of case. For example, you must not have two Java variables, MyVariable and MYVARIABLE. ColdFusion cannot distinguish between the two.
- If you share Request scope variables between a CFML page and a JSP page or servlet, all shared Request scope variable names must be all-lowercase in the JSP page or servlet. Mixed case or all-uppercase variables will cause null pointer exceptions if CFML refers to these variables.
- If you share Application or Session scope variables between a CFML page and a JSP page or servlet and use a named ColdFusion application (the common usage), the variables on the JSP page or servlet are case-independent.
- If you share the Application or Session scope variables between a CFML page and a JSP page or servlet, and use an unnamed ColdFusion application, the variable names in the JSP page or servlet must be all lowercase.
- When you specify a class name in the cfobject tag or CreateObject function, the name must be case-correct.
Guidelines

- You can prevent problems by consistently using all-lowercase variable names.
- In your CFML, use the same case as you do in your Java or JSP. Doing so does not change how the application works, but does help prevent confusion.

Using JSP tags and tag libraries

You can use JSP tags from any JSP tag library. For example, you can use any of the custom tags in the open-source Apache Jakarta Project Taglibs project tag libraries, located at http://jakarta.apache.org/taglibs/index.html. This project consists of a number of individual JSP custom tag libraries for purposes ranging from JNDI access to generating random text strings.

Using a JSP tag in a ColdFusion page

JSP pages use a standard set of tags, such as jsp:forward and jsp:include. You can also import custom JSP tag libraries into a JSP application. You can use both the standard JSP tags and custom JSP tags in ColdFusion pages, as the following sections describe.

Standard JSP tags and ColdFusion

ColdFusion tags provide equivalent features to most standard JSP tags. For example, the cfapplet tag provides the same service as the jsp:plugin tag, and cfobject tag lets you use JavaBeans, as does the jsp:usebean tag. Similarly, you do not use the jsp:getproperty tag because ColdFusion automatically gets properties when you reference them. Therefore, ColdFusion does not support the use of standard JSP tags directly.

However, two standard JSP tags provide functionality that is useful in ColdFusion pages: the forward and include tags invoke JSP pages and Java servlets. The PageContext object described in “About GetPageContext and the PageContext object” on page 929 has forward and include methods that provide the same operations. For more information about using these methods see “Accessing a JSP page or servlet from a ColdFusion page” on page 931.

Using custom JSP tags in a ColdFusion page

Follow these steps to use a custom JSP tag on a ColdFusion page:

Use a custom tag

1. Put the tag library, consisting of the taglibname.jar file, and the taglibname.tld file, if one is supplied, in the web_root/WEB-INF/lib directory. The JSP custom tag library must be in this directory for you to use the cfimport tag.

2. Restart ColdFusion.

3. In the ColdFusion page that uses a JSP tag from the tag library, specify the tag library name in a cfimport tag; for example:

   `<cfimport taglib="/WEB-INF/lib/random.jar" prefix="random">`

   If the TLD file is not included in the JAR file, use the .tld extension in place of the .jar extension.

   **Note:** The cfimport tag must be on the page that uses the imported tag. You cannot put the cfimport tag in Application.cfm.

4. Use the custom tag using the form prefix:tagName; for example:

   `<random:number id="myNum" range="000000-999999" />`
**Note:** You cannot use the `cfsavecontent` tag to suppress output of a custom JSP tag.

**Example: using the random tag library**
The following example uses the random tag library from the Apache Jakarta Taglibs project and calls the library’s `number` tag, which initializes a random number generator that uses a secure algorithm to generate a six-digit random number. You get a new random number each time you reference the variable `randPass.random`.

```cfml
<cfimport taglib="/WEB-INF/lib/taglibs-random.jar" prefix="myrand">
<myrand:number id="randPass" range="000000-999999" algorithm="SHA1PRNG" provider="SUN" />
<cfset myPassword = randPass.random>
<cfoutput>
    Your password is #myPassword#<br>
</cfoutput>
```

For more information on the Jakarta random tag library and how to use its tags, see the documentation at the Apache Jakarta Taglibs project website, http://jakarta.apache.org/taglibs/index.html. The Taglibs project includes many open source custom tag libraries.

**Interoperating with JSP pages and servlets**

ColdFusion pages and JSP pages can interoperate in several ways:

- ColdFusion pages can invoke JSP pages and servlets.
- JSP pages can invoke ColdFusion pages.
- ColdFusion pages, JSP pages, and servlets can share data in three scopes.

**Integrating JSP and servlets in a ColdFusion application**

You can integrate JSP pages and servlets in your ColdFusion application. For example, you can write some application pages in JSP and write others in CFML. ColdFusion pages can access JSP pages by using the JSP `include` and `forward` methods to call the page. As with any web application, you can use `href` links in ColdFusion pages to open JSP pages.

The ability to use JSP lets you incorporate legacy JSP pages in your ColdFusion application, or conversely, use CFML to expand an existing JSP application using ColdFusion pages.

If you have a JSP page that must call a ColdFusion page, you also use a `jsp:forward` or `jsp:include` tag to call the ColdFusion page. For an example of calling a ColdFusion page from a JSP page, see “Calling a JSP page from a ColdFusion page” on page 933.

**Accessing a JSP page or servlet from a ColdFusion page**

To access a JSP page or servlet from a ColdFusion page, you use the `GetPageContext` function with the `forward` or the `include` method. For example, to include a JSP “Hello World” page in your ColdFusion application, use the following line:

```cfml
GetPageContext().include("hello.jsp");
```

To pass parameters to the JSP page, include the parameters in the page URL.
For example, you might want to integrate an existing JSP customer response component into a new ColdFusion order processing application. The order processing application provides the order number, total cost, and expected shipping date, and the customer response component sends the response to the e-mail address on file for the particular customer number. The ColdFusion application might use the following CFScript code to call the response JSP:

```csharp
urlParams = "UID=#order.uid#&cost=#order.total#&orderNo=#order.orderNo#&shipDate=#order.shipDateNo#"
getPageContext().forward(URLEncodedFormat("/responsegen/responsegen.jsp?#urlParams#"));
```

To access a servlet that exposes the same functionality, you use the same code, although the URL would change. For example, to run a servlet called HelloWorldServlet, you put the servlet .java or .class file in the `serverroot/WEB-INF/classes` directory and refer to the servlet with the URL `/servlet/HelloWorldServlet`.

**Sharing data between ColdFusion pages and JSP pages or servlets**

If an application includes ColdFusion pages and JSP pages or servlets, they can share data in the Request, Session and Application scopes. The following table lists the ways that you can access JSP pages with which you want to share the scope data:

<table>
<thead>
<tr>
<th>Scope</th>
<th>Can share data using</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request</td>
<td>forward, include</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Shared Request scope variable names in the JSP page or servlet must be all-lowercase.</td>
</tr>
<tr>
<td>Session</td>
<td>href, cfhttp, forward, include</td>
</tr>
<tr>
<td>Application</td>
<td>href, cfhttp, forward, include</td>
</tr>
</tbody>
</table>

**Note:** When you share data between ColdFusion pages and JSP pages, you must be careful about data type conversion issues. For more information, see “Java and ColdFusion data type conversions” on page 940.

To share session variables, you must specify J2EE session management in the ColdFusion Administrator. For more information on configuring and using J2EE Session scope management, see “ColdFusion and J2EE session management” on page 283.

For example, you could put the customer order structure used in the previous example in the Session scope. Then, you would not have to pass the order values as a set of parameters. Instead, the JSP pages could access the Session scope variables directly, and the ColdFusion page would only require a line like the following to call the JSP page:

```csharp
getPageContext().forward(URLEncodedFormat("/responsegen/responsegen.jsp"));
```

For examples of using the Request, Session, and Application scopes to share data between ColdFusion pages and JSP pages, including samples of the appropriate JSP code, see the following section, “Examples: using JSP with CFML” on page 933.

**Note:** When running in the server configuration, ColdFusion also shares the Form scope when calling a JSP or servlet. In the J2EE configuration, however, sharing the Form scope is dependant on the J2EE application server. For example, JRun shares the Form scope, IBM WebSphere does not. ColdFusion always shares the Request, Session, and Application scopes.

**Accessing ColdFusion application and session variables in JSP pages**

ColdFusion runs as a J2EE application on the J2EE application server. The J2EE application ServletContext is a data structure that stores objects as attributes. A ColdFusion Application scope is represented as an attribute named by the Application scope name. The attribute contains the scope values as a hash table. Therefore, you access ColdFusion Application scope variable in a JSP page or servlet using the following format:
Similarly, the ColdFusion Session scope is a structure within the J2EE session. Because ColdFusion identifies sessions by the application name, the session structure is contained in an attribute of the J2EE session that is identified by the application name. Therefore, you access ColdFusion session variables as follows:

```cfml
((Map)(session.getAttribute("CFApplicationName"))).get("sessionVarName")
```

### Unnamed ColdFusion Application and Session scopes

If you do not specify an application name in the `This.name` variable in the Application.cfc initialization code or by using the ColdFusion `cfapplication` tag, the application is unnamed, and the Application scope corresponds to the ColdFusion J2EE servlet context. ColdFusion, therefore, supports only a single unnamed application. If multiple `cfapplication` tags and Application.cfc files do not specify an application name, all pages in these applications share the servlet context as their Application scope.

All sessions of unnamed applications correspond directly to the J2EE application server's session object. (If you do not use J2EE session variables, ColdFusion ensures that the J2EE session lasts at least as long as the session time-out.)

You access an Application scope variable from a ColdFusion unnamed application in a JSP page using the following format:

```cfml
application.getAttribute("applicationVariableName")
```

You access Session scope variables in a ColdFusion unnamed application as follows:

```cfml
session.getAttribute("sessionVariableName")
```

**Note:** When you use application and session variables for the unnamed ColdFusion application in JSP pages and servlets, the variable names must be case-correct. That is, the characters in the variable name must have the same case as you used when you created the variable in ColdFusion. You do not have to use case-correct application and session variable names for named ColdFusion applications.

### Examples: using JSP with CFML

The following simple examples show how you can integrate JSP pages, servlets, and ColdFusion pages. They also show how you can use the Request, Application, and Session scopes to share data between ColdFusion pages, JSP pages, and servlets.

#### Calling a JSP page from a ColdFusion page

The following page sets Request, Session, and application variables and calls a JSP page, passing it a name parameter:

```cfml
<cfapplication name="myApp" sessionmanagement="yes">
  <cfscript>
    Request.myVariable = "This";
    Session.myVariable = "is a";
    Application.myVariable = "test.";
    GetPageContext().include("hello.jsp?name=Bobby");
  </cfscript>
</cfapplication>
```

**Reviewing the code**

The following table describes the CFML code and its function:
The hello.jsp page is called by the ColdFusion page. It displays the name parameter in a header and the three variables in the remainder of the body.

```jsp
<%@page import="java.util.*" %>
<h2>Hello <%= request.getParameter("name")%>!</h2>
<br>Request.myVariable: <%= request.getAttribute("myVariable")%>
<br>session.myVariable: <%= ((Map)(session.getAttribute("myApp"))).get("myVariable")%>
<br>Application.myVariable: <%= ((Map)(application.getAttribute("myApp"))).get("myVariable")%>
```

Reviewing the code
The following table describes the JSP code and its function (line breaks added for clarity):

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfapplication name=&quot;myApp&quot; sessionmanagement=&quot;yes&quot;&gt;</code></td>
<td>Specifies the application name as myApp and enables session management. In most applications, this tag is in the Application.cfm page.</td>
</tr>
<tr>
<td><code>&lt;cfscript&gt;</code>&lt;br&gt;          Request.myVariable = &quot;This&quot;;&lt;br&gt;          Application.myVariable = &quot;test.&quot;;</td>
<td>Sets ColdFusion Request, Session, and Application, scope variables. Uses the same name, myVariable, for each variable.</td>
</tr>
<tr>
<td><code>GetPageContext().include (&quot;hello.jsp?name=Bobby&quot;);</code></td>
<td>Uses the GetPageContext function to get the current servlet page context for the ColdFusion page. Uses the include method of the page context object to call the hello.jsp page. Passes the name parameter in the URL.</td>
</tr>
<tr>
<td><code>&lt;%@page import=&quot;java.util.*&quot; %&gt;</code></td>
<td>Imports the java.util package. This contains methods required in the JSP page.</td>
</tr>
<tr>
<td><code>&lt;h2&gt;Hello &lt;%= request.getParameter(&quot;name&quot;)%&gt;!&lt;h2&gt;</code></td>
<td>Displays the name passed as a URL parameter from the ColdFusion page. The parameter name is case-sensitive.</td>
</tr>
<tr>
<td><code>&lt;br&gt;Request.myVariable: &lt;%= request.getAttribute(&quot;myVariable&quot;)%&gt;</code></td>
<td>Uses the <code>getAttribute</code> method of the JSP request object to display the value of the Request scope variable myVariable. The JSP page must use all lowercase characters to refer to all request scope variables that it shares with CFML pages. You can use any case on the CFML page, but if you use mixed case to all uppercase on the JSP page, the variable will not get its value from the ColdFusion page.</td>
</tr>
<tr>
<td><code>&lt;br&gt;session.myVariable: &lt;%= ((Map)(session.getAttribute(&quot;myApp&quot;))).get(&quot;myVariable&quot;)%&gt;</code></td>
<td>Uses the <code>getAttribute</code> method of the JSP session object to get the myApp object (the Application scope). Casts this to a Java Map object and uses the get method to obtain the myVariable value for display. CFML pages and JSP pages share Session variables independent of the variable name case. The variable on the JSP page can have any case mixture and still receive the value from the ColdFusion page. For example, instead of myVariable, you could use MYVARIABLE or myvariable on this line.</td>
</tr>
<tr>
<td><code>&lt;br&gt;Application.myVariable: &lt;%= ((Map)(application.getAttribute(&quot;myApp&quot;))).get(&quot;myVariable&quot;)%&gt;</code></td>
<td>Uses the <code>getAttribute</code> method of the JSP myApp application object to obtain the value of myVariable in the Application scope. CFML pages and JSP pages share Application variables independent of the variable name case. The variable on the JSP page can have any case mixture and still receive the value from the ColdFusion page. For example, instead of myVariable, you could use MYVARIABLE or myvariable on this line.</td>
</tr>
</tbody>
</table>
Calling a ColdFusion page from a JSP page

The following JSP page sets Request, Session, and application variables and calls a ColdFusion page, passing it a name parameter:

```jsp
<%@page import="java.util.*" %>

<% request.setAttribute("myvariable", "This");%>
<% ((Map)session.getAttribute("myApp")).put("myVariable", "is a");%>
<% ((Map)application.getAttribute("myApp")).put("myVariable", "test.");%>

<jsp:include page="hello.cfm">
    <jsp:param name="name" value="Robert" />
</jsp:include>
```

Reviewing the code

The following table describes the JSP code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;%@page import=&quot;java.util.*&quot; %&gt;</code></td>
<td>Imports the java.util package. This contains methods required in the JSP page.</td>
</tr>
<tr>
<td><code>&lt;% request.setAttribute(&quot;myvariable&quot;,&quot;This&quot;);%&gt;</code></td>
<td>Uses the <code>setAttribute</code> method of the JSP request object to set the value of the Request scope variable <code>myVariable</code>. The JSP page must use all lowercase characters to refer to all request scope variables that it shares with CFML pages. You can use any case on the CFML page, but if you use mixed case to all uppercase on the JSP page, the JSP page will not share it with the ColdFusion page.</td>
</tr>
<tr>
<td><code>&lt;% ((Map)session.getAttribute(&quot;myApp&quot;)).put(&quot;myVariable&quot;,&quot;is a&quot;);%&gt;</code></td>
<td>Uses the <code>getAttribute</code> method of the JSP session object to get the <code>myApp</code> object (the Application scope). Casts this to a Java Map object and uses the <code>set</code> method to set the <code>myVariable</code> value. CFML pages and JSP pages share Session variables independent of the variable name case. The variable on the JSP page can have any case mixture and still share the value with the ColdFusion page. For example, instead of <code>myVariable</code>, you could use <code>MYVARIABLE</code> or <code>myvariable</code> on this line.</td>
</tr>
<tr>
<td><code>&lt;% ((Map)application.getAttribute(&quot;myApp&quot;)).put(&quot;myVariable&quot;,&quot;test.&quot;);%&gt;</code></td>
<td>Uses the <code>getAttribute</code> method of the JSP application object to get the <code>myApp</code> object (the Application scope) and casts it to a Map object. It then sets the value of <code>myVariable</code> in the <code>myApp</code> application scope object. CFML pages and JSP pages share Application variables independent of the variable name case. The variable on the JSP page can have any case mixture and still share the value with the ColdFusion page. For example, instead of <code>myVariable</code>, you could use <code>MYVARIABLE</code> or <code>myvariable</code> on this line.</td>
</tr>
</tbody>
</table>
| `<jsp:include page="hello.cfm">
    <jsp:param name="name" value="Robert" />
</jsp:include>` | Sets the name parameter to Robert and calls the ColdFusion page `hello.cfm`. |

The following `hello.cfm` page is called by the JSP page. It displays the Name parameter in a heading and the three variables in the remainder of the body.

```cfapplication name="myApp" sessionmanagement="yes">
<coutput>
<h2>Hello #URL.name#!</h2>
Request.myVariable: #Request.myVariable#<br />
Session.myVariable: #Session.myVariable#<br />
Application.myVariable: #Application.myVariable#<br />
</coutput>
```
Reviewing the code

The following table describes the CFML code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfapplication name=&quot;myApp&quot; sessionmanagement=&quot;yes&quot;&gt;</code></td>
<td>Specifies the application name as myApp and enables session management. In most applications, this tag is in the Application.cfm page.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;h2&gt;Hello #URL.name#!&lt;/h2&gt;</code></td>
<td>Displays the name passed using the jsp:param tag on the JSP page. The parameter name is not case-sensitive.</td>
</tr>
<tr>
<td><code>Request.myVariable: #Request.myVariable#&lt;br&gt;</code></td>
<td>Displays the Request.myVariable, Session.myVariable, and Application.myVariable values. Note that all variable names on CFML pages are case independent.</td>
</tr>
<tr>
<td><code>Session.myVariable:</code></td>
<td></td>
</tr>
<tr>
<td><code>#Session.myVariable#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>Application.myVariable:</code></td>
<td></td>
</tr>
<tr>
<td><code>#Application.myVariable#&lt;br&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

Using Java objects

You use the `cfobject` tag to create an instance of a Java object. You use other ColdFusion tags, such as `cfset` and `cfoutput`, or CFScript to invoke properties (attributes), and methods (operations) on the object.

Method arguments and return values can be any valid Java type; for example, simple arrays and objects. ColdFusion does the appropriate conversions when strings are passed as arguments, but not when they are received as return values. For more information on type conversion issues, see “Java and ColdFusion data type conversions” on page 940.

The examples in the following sections assume that the `name` attribute in the `cfobject` tag specified the value `obj`, and that the object has a property called `Property`, and methods called `Method1`, `Method2`, and `Method3`.

**Note:** The `cfdump` tag displays an object’s public methods and data.

Using basic object techniques

The following sections describe how to invoke Java objects.

Invoking objects

The `cfobject` tag makes Java objects available in ColdFusion. It can access any Java class that is available on the JVM classpath or in either of the following locations:

- In a Java archive (.jar) file in `web_root/WEB-INF/lib`
- In a class (.class) file in `web_root/WEB-INF/classes`

For example:

```
<cfobject type="Java" class="MyClass" name="myObj">
```

Although the `cfobject` tag loads the class, it does **not** create an instance object. Only static methods and fields are accessible immediately after the call to `cfobject`.

If you call a public non-static method on the object without first calling the `init` method, there ColdFusion makes an implicit call to the default constructor.

To call an object constructor explicitly, use the special ColdFusion `init` method with the appropriate arguments after you use the `cfobject` tag; for example:
<cfobject type="Java" class="MyClass" name="myObj">
<cfset ret=myObj.init(arg1, arg2)>

**Note:** The `init` method is not a method of the object, but a ColdFusion identifier that calls the `new` function on the class constructor. So, if a Java object has an `init` method, a name conflict exists and you cannot call the object’s `init` method.

To have persistent access to an object, you must use the `init` function, because it returns a reference to an instance of the object, and `cfobject` does not.

An object created using `cfobject` or returned by other objects is implicitly released at the end of the ColdFusion page execution.

**Using properties**

Use the following coding syntax to access properties if the object does either of the following actions:

- Exposes the properties as public properties.
- Does not make the properties public, but is a JavaBean that provides public getter and setter methods of the form `getPropertyName()` and `setPropertyType(value)`. For more information, see the following section, “Calling JavaBean get and set methods” on page 937.

**•** To set a property: `<cfset obj.property = "somevalue">`
**•** To get a property: `<cfset value = obj.property>`

**Note:** ColdFusion does not require that property and method names be consistently capitalized. However, you should use the same case in ColdFusion as you do in Java to ensure consistency.

**Calling methods**

Object methods usually take zero or more arguments. Some methods return values, while others might not. Use the following techniques to call methods:

1. If the method has no arguments, follow the method name with empty parentheses, as in the following `cfset` tag:
   ```
   <cfset retVal = obj.Method1()> 
   ```
2. If the method has one or more arguments, put the arguments in parentheses, separated by commas, as in the following example, which has one integer argument and one string argument:
   ```
   <cfset x = 23>
   <cfset retVal = obj.Method1(x, "a string literal")>
   ```

**Note:** When you invoke a Java method, the type of the data being used is important. For more information see “Java and ColdFusion data type conversions” on page 940.

**Calling JavaBean get and set methods**

ColdFusion can automatically invoke `getPropertyName()` and `setPropertyType(value)` methods if a Java class conforms to the JavaBeans pattern. As a result, you can set or get the property by referencing it directly, without having to explicitly invoke a method.

For example, if the `myFishTank` class is a JavaBean, the following code returns the results of calling the `getTotalFish()` method on the `myFish` object:

```
<cfoutput>
  There are currently #myFish.TotalFish# fish in the tank.
</cfoutput>
```

The following example adds one guppy to a `myFish` object by implicitly calling the `setGuppyCount(int number)` method:
<cfset myFish.GuppyCount = myFish.GuppyCount + 1>

Note: You can use the direct reference method to get or set values in some classes that have getProperty and setProperty methods but do not conform fully to the JavaBean pattern. However, you cannot use this technique for all classes that have getProperty and setProperty methods. For example, you cannot directly reference any of the following standard Java classes, or classes derived from them: Date, Boolean, Short, Integer, Long, Float, Double, Char, Byte, String, List, Array.

Calling nested objects
ColdFusion supports nested (scoped) object calls. For example, if an object method returns another object and you must invoke a property or method on that object, you can use the following syntax:

<cfset prop = myObj.X.Property>.

Similarly, you can use code such as the following CFScript line:

GetPageContext().include("hello.jsp?name=Bobby");

In this code, the ColdFusion GetPageContext function returns a Java PageContext object, and the line invokes the PageContext object's include method.

Creating and using a simple Java class
Java is a strongly typed language, unlike ColdFusion, which does not enforce data types. As a result, there are some subtle considerations when calling Java methods. The following sections create and use a Java class to show how to use Java effectively in ColdFusion pages.

The Employee class
The Employee class has four data members: FirstName and LastName are public, and Salary and JobGrade are private. The Employee class has three overloaded constructors and a overloaded SetJobGrade method.

Save the following Java source code in the file Employee.java, compile it, and place the resulting Employee.class file in a directory that is specified in the classpath:

```java
public class Employee {
    public String FirstName;
    public String LastName;
    private float Salary;
    private int JobGrade;

    public Employee() {
        FirstName = "";
        LastName = "";
        Salary = 0.0f;
        JobGrade = 0;
    }

    public Employee(String First, String Last) {
        FirstName = First;
        LastName = Last;
        Salary = 0.0f;
        JobGrade = 0;
    }

    public Employee(String First, String Last, float salary, int grade) {
        FirstName = First;
        LastName = Last;
```
Salary = salary;
JobGrade = grade;

public void SetSalary(float Dollars) {
    Salary = Dollars;
}

public float GetSalary() {
    return Salary;
}

public void SetJobGrade(int grade) {
    JobGrade = grade;
}

public void SetJobGrade(String Grade) {
    if (Grade.equals("CEO")) {
        JobGrade = 3;
    }
    else if (Grade.equals("MANAGER")) {
        JobGrade = 2;
    }
    else if (Grade.equals("DEVELOPER")) {
        JobGrade = 1;
    }
}

public int GetJobGrade() {
    return JobGrade;
}

A CFML page that uses the Employee class

Save the following text as JEmployee.cfm:

```html
<html>
<body>
<cfobject action="create" type="java" class="Employee" name="emp">
<!--- <cfset emp.init()> --->
<cfset emp.firstname="john">
<cfset firstname=emp.firstname>
<cfset emp.lastname="doe">
<cfset lastname=emp.lastname>
</body>
</html>

When you view the page in your browser, you get the following output:
Employee name is john doe

Reviewing the code

The following table describes the CFML code and its function:
Java considerations

Keep the following points in mind when you write a ColdFusion page that uses a Java class object:

- The Java class name is case-sensitive. You must ensure that the Java code and the CFML code use Employee as the class name.
- Although Java method and field names are case-sensitive, ColdFusion variables are not case-sensitive, and ColdFusion does any necessary case conversions. As a result, the sample code works even though the CFML uses emp.firstname and emp.lastname; the Java source code uses FirstName and LastName for these fields.
- If you do not call the constructor (or, as in this example, comment it out), ColdFusion automatically invokes the default constructor when it first uses the class.

Using an alternate constructor

The following ColdFusion page explicitly calls one of the alternate constructors for the Employee object:

```html
<html>
<body>
  <cfobject action="create" type="java" class="Employee" name="emp">
    <cfset emp.init("John", "Doe", 100000.00, 10)>
    <cfset firstname=emp.firstname>
    <cfset lastname=emp.lastname>
  <cfoutput>
    Employee name is #firstname# #lastname#<br>
    Employee salary #DollarFormat(Salary)#<br>
    Employee Job Grade #grade#
  </cfoutput>
</cfobject>
</body>
</html>
```

In this example, the constructor takes four arguments: the first two are strings, the third is a float, and the fourth is an integer.

Java and ColdFusion data type conversions

ColdFusion does not use explicit types for variables, while Java is strongly typed. However, ColdFusion data does use a number of underlying types to represent data.

---

### Table: Java and ColdFusion Data Type Conversions

<table>
<thead>
<tr>
<th>Code Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loads the Employee Java class and gives it an object name of emp.</td>
<td><code>&lt;cfobject action=create type=java class=Employee name=emp&gt;</code></td>
</tr>
<tr>
<td>Does not call a constructor. ColdFusion invokes the default constructor when it first uses the class; in this case, when it processes the next line.</td>
<td><code>&lt;cfset emp.init()&gt;</code></td>
</tr>
</tbody>
</table>
| Sets the public fields in the emp object to your values. | `<cfset emp.firstname="john">
<cfset emp.lastname="doe">` |
| Gets the field values back from emp object. | `<cfset firstname=emp.firstname>
<cfset lastname=emp.lastname>` |
| Displays the retrieved values. | `<cfoutput>
  Employee name is #firstname# #lastname#` |
| Employee salary #DollarFormat(Salary)#<br>
  Employee Job Grade #grade#` |
Under most situations, when the method names are not ambiguous, ColdFusion can determine the data types that are required by a Java object, and often it can convert ColdFusion data to the required types. For example, ColdFusion text strings are implicitly converted to the Java String type. Similarly, if a Java object contains a doIt method that expects a parameter of type int, and CFML is issuing a doIt call with a CFML variable x that contains an integer value, ColdFusion converts the variable x to Java int type. However, ambiguous situations can result from Java method overloading, where a class has multiple implementations of the same method that differ only in their parameter types.

The following sections describe how ColdFusion handles the unambiguous situations, and how it provides you with the tools to handle ambiguous ones.

**Default data type conversion**
Whenever possible, ColdFusion automatically matches Java types to ColdFusion types.

The following table lists how ColdFusion converts ColdFusion data values to Java data types when passing arguments. The left column represents the underlying ColdFusion representation of its data. The right column indicates the Java data types into which ColdFusion can automatically convert the data:

<table>
<thead>
<tr>
<th>CFML</th>
<th>Java</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integer</td>
<td>short, int, long (short and int might result in a loss of precision).</td>
</tr>
<tr>
<td>Real number</td>
<td>float double (float might result in a loss of precision).</td>
</tr>
<tr>
<td>Boolean</td>
<td>boolean</td>
</tr>
<tr>
<td>Date-time</td>
<td>java.util.Date</td>
</tr>
<tr>
<td>String, including lists</td>
<td>String</td>
</tr>
<tr>
<td></td>
<td>short, int, long, float, double, java.util.Date, when a CFML string represents a number or date. boolean, for strings with the value Yes, No, True, and False (case-insensitive).</td>
</tr>
<tr>
<td>Array</td>
<td>java.util.Vector (ColdFusion Arrays are internally represented using an instance of a java.util.Vector object.) ColdFusion can also map a CFML array to any of the following when the CFML array contains consistent data of a type that can be converted to the Java array's data type: byte[], char[], boolean[], int[], long[], float[], double[], String[], or Object[]. When a CFML array contains data of different of types, the conversion to a simple array type might fail.</td>
</tr>
<tr>
<td>Structure</td>
<td>java.util.Map</td>
</tr>
<tr>
<td>Query object</td>
<td>java.util.Map</td>
</tr>
<tr>
<td>XML document object</td>
<td>Not supported.</td>
</tr>
<tr>
<td>ColdFusion component</td>
<td>Not applicable.</td>
</tr>
</tbody>
</table>

The following table lists how ColdFusion converts data returned by Java methods to ColdFusion data types:

<table>
<thead>
<tr>
<th>Java</th>
<th>CFML</th>
</tr>
</thead>
<tbody>
<tr>
<td>boolean/Boolean</td>
<td>Boolean</td>
</tr>
<tr>
<td>byte/Byte</td>
<td>String</td>
</tr>
<tr>
<td>char/Char</td>
<td>String</td>
</tr>
<tr>
<td>short/Short</td>
<td>Integer</td>
</tr>
</tbody>
</table>
Resolving ambiguous data types with the JavaCast function

You can overload Java methods so a class can have several identically named methods. At runtime, the JVM resolves the specific method to use based on the parameters passed in the call and their types.

In the section “The Employee class” on page 938, the Employee class has two implementations for the SetJobGrade method. One method takes a string variable, the other an integer. If you write code such as the following, which implementation to use is ambiguous:

<cfset emp.SetJobGrade("1")>

The “1” could be interpreted as a string or as a number, so there is no way to know which method implementation to use. When ColdFusion encounters such an ambiguity, it throws a user exception.

The ColdFusion JavaCast function helps you resolve such issues by specifying the Java type of a variable, as in the following line:

<cfset emp.SetJobGrade(JavaCast("int", "1"))>

The JavaCast function takes two parameters: a string representing the Java data type, and the variable whose type you are setting. You can specify the following Java data types: boolean, int, long, float, double, and String.

For more information about the JavaCast function, see the CFML Reference.

Handling Java exceptions

You handle Java exceptions just as you handle standard ColdFusion exceptions, with the cftry and cfcatch tags. You specify the name of the exception class in the cfcatch tag that handles the exception. For example, if a Java object throws an exception named myException, you specify myException in the cfcatch tag.

Note: To catch any exception generated by a Java object, specify java.lang.Exception for the cfcatch type attribute. To catch any Throwable errors, specify java.lang.Throwable in the cfcatch tag type attribute.

The following sections show an example of throwing and handling a Java exception.
For more information on exception handling in ColdFusion, see “Handling Errors” on page 246.

**Example: exception-throwing class**
The following Java code defines the testException class that throws a sample exception. It also defines a myException class that extends the Java built-in Exception class and includes a method for getting an error message.

The myException class has the following code. It throws an exception with a message that is passed to it, or if no argument is passed, it throws a canned exception.

```java
//class myException
public class myException extends Exception
{
    public myException(String msg) {
        super(msg);
    }
    public myException() {
        super("Error Message from myException");
    }
}
```

The testException class contains one method, doException, which throws a myException error with an error message, as follows:

```java
public class testException {
    public testException ()
    {
    }
    public void doException() throws myException {
        throw new myException("Throwing an exception from testException class");
    }
}
```

**Example: CFML Java exception handling code**
The following CFML code calls the testException class doException method. The `cfcatch` block handles the resulting exception.

```cfml
<cfobject action=create type=java class=testException name=Obj>
<cftry>
<cfset Obj.doException()>
<cfcatch type="myException">
<cfoutput>
<br>The exception message is: #cfcatch.Message#<br>
</cfoutput>
</cfcatch>
</cftry>
```

**Examples: using Java with CFML**
The following sections show several examples of using Java objects in CFML. They include examples of using a custom Java class, a standard Java API class in a user-defined function, a JavaBean, and an EnterpriseJavaBean (EJB).

**Using a Java API in a UDF**
The following example of a user-defined function (UDF) is functionally identical to the `GetHostAddress` function from the NetLib library of UDFs from the Common Function Library Project, www.cflib.org. It uses the `InetAddress` class from the standard Java 2 java.net package to get the Internet address of a specified host:

```cfscript
function GetHostAddress(host) {
    // Define the function local variables.
```
Using an EJB

ColdFusion can use EJBs that are served by JRun 4.0 servers. The JRun server jrun.jar file must have the same version as the jrun.jar file in ColdFusion.

To call an EJB, you use $c.object type="Java" to create and call the appropriate objects. Before you can use an EJB you must do the following:

1. Have a properly deployed EJB running on a J2EE server. The bean must be registered with the JNDI server.
2. Have the following information:
   • Name of the EJB server
   • Port number of the JNDI naming service on the EJB server
   • Name of the EJB, as registered with the naming service
3. Install the EJB home and component interface compiled classes on your ColdFusion web server, either as class files in the web_root/WEB-INF/classes directory or packaged in a JAR file the web_root/WEB-INF/lib directory.

Note: To use an EJB served by a JRUN server, your ColdFusion installation and the JRun server that hosts the EJB must have the same version of the jrun.jar file (located in cf_root\runtime\lib directory in ColdFusion).

Although the specific steps for using an EJB depend on the EJB server and on the EJB itself, they generally correspond to the following order.

Using an EJB

1. Use the $c.object tag to create an object of the JNDI naming context class (javax.naming.Context). You will use fields from this class to define the information that you use to locate the EJB. Because you only use fields, you do not initialize the object.
2. Use the $c.object tag to create a java.util.Properties class object that will contain the context object properties.
3. Call the init method to initialize the Properties object.
4. Set the Properties object to contain the properties that are required to create an initial JNDI naming context. These include the INITIAL_CONTEXT_FACTORY and PROVIDER_URL properties. You might also need to provide SECURITY_PRINCIPAL and SECURITY_CREDENTIALS values required for secure access to the naming context. For more information on these properties, see the JNDI documentation.
5. Use the $c.object tag to create the JNDI InitialContext (javax.naming. InitialContext) object.
6. Call the init method for the InitialContext object with the Properties object values to initialize the object.
7. Call the InitialContext context object’s lookup method to get a reference to the home interface for the bean that you want. Specify the JNDI name of the bean as the lookup argument.
8. Call the create method of the bean’s home object to create a new instance of the bean. If you are using Entity beans, you typically use a finder method instead. A finder method locates one or more existing entity beans.
9  Now you can use the bean's methods as required by your application.

10  When finished, call the context object's close method to close the object.

The following code shows this process using a simple Java Entity bean on a JRun 4.0 server. It calls the bean's getMessage method to obtain a message.

```html
<html>
<head>
<title>cfobject Test</title>
</head>

<body>
<H1>cfobject Test</H1>

<!--- Create the Context object to get at the static fields. --->
<CFOBJECT
    action=create
    name=ctx
    type="JAVA"
    class="javax.naming.Context">

<!--- Create the Properties object and call an explicit constructor--->
<CFOBJECT
    action=create
    name=prop
    type="JAVA"
    class="java.util.Properties">

<!--- Call the init method (provided by cfobject) to invoke the Properties object constructor. --->
<cfset prop.init()>

<!--- Specify the properties These are required for a remote server only --->
<cfset prop.put(ctx.INITIAL_CONTEXT_FACTORY, "jrun.naming.JRunContextFactory")>
<cfset prop.put(ctx.PROVIDER_URL, "localhost:2908")>
<!--- <cfset prop.put(ctx.SECURITY_PRINCIPAL, "admin")>
<cfset prop.put(ctx.SECURITY_CREDENTIALS, "admin")>
--->

<!--- Create the InitialContext --->
<CFOBJECT
    action=create
    name=initContext
    type="JAVA"
    class="javax.naming.InitialContext">

<!--- Call the init method (provided through cfobject) to pass the properties to the InitialContext constructor. --->
<cfset initContext.init(prop)>

<!--- Get reference to home object. --->
<cfset home = initContext.lookup("SimpleBean")>

<!--- Create new instance of entity bean. (hard-wired account number). Alternatively, you would use a find method to locate an existing entity bean. --->
<cfset mySimple = home.create()>

<!--- Call a method in the entity bean. --->
<cfset myMessage = mySimple.getMessage()>

<cfoutput>
```
Using a custom Java class
The following code provides a more complex custom class than in the example “Creating and using a simple Java class” on page 938. The Example class manipulates integer, float, array, Boolean, and Example object types.

The Example class
The following Java code defines the Example class. The Java class Example has one public integer member, mPublicInt. Its constructor initializes mPublicInt to 0 or an integer argument. The class has the following public methods:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReverseString</td>
<td>Reverses the order of a string.</td>
</tr>
<tr>
<td>ReverseStringArray</td>
<td>Reverses the order of elements in an array of strings.</td>
</tr>
<tr>
<td>Add</td>
<td>Overloaded: Adds and returns two integers or floats or adds the mPublicInt members of two Example class objects and returns an Example class object.</td>
</tr>
<tr>
<td>SumArray</td>
<td>Returns the sum of the elements in an integer array.</td>
</tr>
<tr>
<td>SumObjArray</td>
<td>Adds the values of the mPublicInt members of an array of Example class objects and returns an Example class object.</td>
</tr>
<tr>
<td>ReverseArray</td>
<td>Reverses the order of an array of integers.</td>
</tr>
<tr>
<td>Flip</td>
<td>Switches a Boolean value.</td>
</tr>
</tbody>
</table>

```java
public class Example {
    public int mPublicInt;

    public Example() {
        mPublicInt = 0;
    }

    public Example(int IntVal) {
        mPublicInt = IntVal;
    }

    public String ReverseString(String s) {
        StringBuffer buffer = new StringBuffer(s);
        return new String(buffer.reverse());
    }

    public String[] ReverseStringArray(String[] arr) {
        String[] ret = new String[arr.length];
        for (int i=0; i < arr.length; i++) {
            ret[arr.length-i-1]=arr[i];
        }
        return ret;
    }
}
```
public int Add(int a, int b) {
    return (a+b);
}

public float Add(float a, float b) {
    return (a+b);
}

public Example Add(Example a, Example b) {
    return new Example(a.mPublicInt + b.mPublicInt);
}

static public int SumArray(int[] arr) {
    int sum=0;
    for (int i=0; i < arr.length; i++) {
        sum += arr[i];
    }
    return sum;
}

static public Example SumObjArray(Example[] arr) {
    Example sum= new Example();
    for (int i=0; i < arr.length; i++) {
        sum.mPublicInt += arr[i].mPublicInt;
    }
    return sum;
}

static public int[] ReverseArray(int[] arr) {
    int[] ret = new int[arr.length];
    for (int i=0; i < arr.length; i++) {
        ret[arr.length-i-1]=arr[i];
    }
    return ret;
}

static public boolean Flip(boolean val) {
    System.out.println("calling flipboolean");
    return val?false:true;
}

The useExample ColdFusion page
The following useExample.cfm page uses the Example class to manipulate numbers, strings, Booleans, and Example objects. The CFML JavaCast function ensures that CFML variables convert into the appropriate Java data types.

<html>
<head>
<title>CFOBJECT and Java Example</title>
</head>
<body>

<!---- Create a reference to an Example object ---->
<cfobject action=create type=java class=Example name=obj>
<!---- Create the object and initialize its public member to 5 ---->
<cfset x=obj.init(JavaCast("int",5))>

<!---- Create an array and populate it with string values, then use the Java object to reverse them. ---->
<cfset myarray=ArrayNew(1)>
<cfset myarray[1]="First"
<cfset myarray[2]="Second">
<cfset myarray[3]="Third">
<cfset ra=obj.ReverseStringArray(myarray)>

<!---- Display the results --->
<cfoutput>
<br>
original array element 1: #myarray[1]#
original array element 2: #myarray[2]#
original array element 3: #myarray[3]#
after reverseelement 1: #ra[1]#
after reverseelement 2: #ra[2]#
after reverseelement 3: #ra[3]#
<br>
</cfoutput>

<!---- Use the Java object to flip a Boolean value, reverse a string, add two integers, and add two float numbers --->
<cfset c=obj.Flip(true)>
<cfset StringVal=obj.ReverseString("This is a test")>
<cfset IntVal=obj.Add(JavaCast("int",20),JavaCast("int",30))>
<cfset FloatVal=obj.Add(JavaCast("float",2.56),JavaCast("float",3.51))>

<!---- Display the results --->
<cfoutput>
<br>
StringVal: #StringVal#
IntVal: #IntVal#
FloatVal: #FloatVal#
<br>
</cfoutput>

<!---- Create a two-element array, sum its values, and reverse its elements --->
<cfset intarray=ArrayNew(1)>
<cfset intarray[1]=1>
<cfset intarray[2]=2>
<cfset IntVal=obj.SumArray(intarray)>
<cfset reversedarray=obj.ReverseArray(intarray)>

<!---- Display the results --->
<cfoutput>
<br>
IntVal1 :#IntVal#
array1: #reversedarray[1]#
array2: #reversedarray[2]#
<br>
</cfoutput><br>

<!---- Create a ColdFusion array containing two Example objects. Use the SumObjArray method to add the objects in the array Get the public member of the resulting object---->
<cfset oa=ArrayNew(1)>
<cfobject action=create type=java class=Example name=obj1>
<cfset VOID=obj1.init(JavaCast("int",5))>
<cfobject action=create type=java class=Example name=obj2>
<cfset VOID=obj2.init(JavaCast("int",10))>
<cfset oa[1] = obj1>
<cfset oa[2] = obj2>
<cfset result = obj.SumObjArray(oa)>
<cfset intval = result.mPublicInt>

<!--- Display the results --->
<cfoutput>
<br>
   intval1: #intval#<br>
<br>
</cfoutput><br>
</body>
</html>
Chapter 50: Using Microsoft .NET Assemblies

You can use ColdFusion to call local or remote Microsoft .NET assembly class methods and access assembly fields. This topic describes how to configure and run the ColdFusion .NET extension software and how to access and use .NET classes in your ColdFusion code. For information about .NET technology or how to develop .NET applications, see Microsoft .NET documentation.

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- About ColdFusion and .NET ............................................. 950
- Accessing .NET assemblies ........................................... 953
- Using .NET classes ..................................................... 957
- .NET Interoperability Limitations ................................. 965
- Example: Using a custom class to access Microsoft Word ......................................................... 966
- Advanced tools ......................................................... 968

About ColdFusion and .NET

ColdFusion lets you access and use Microsoft .NET assembly classes as CFML objects. CFML applications can use .NET assemblies in the following ways:

- Directly access and control Microsoft products, such as Word, Excel, or PowerPoint.
- Use existing .NET components.
- Use .NET assemblies that you create to leverage features that are difficult to use or not available in ColdFusion or Java. (Because ColdFusion is a J2EE application, if you cannot code a feature in CFML, it is more efficient to create it in Java than to use .NET.)

The .NET classes that your application uses do not have to be local; your ColdFusion application can access .NET components that are located on remote systems, even systems that are located outside your firewall. Also, the ColdFusion system does not require .NET run-time software installed to use remote .NET components, so ColdFusion running on a UNIX, Linux, Solaris, or OS-X system can access and use .NET assemblies.

You can use the cfobject tag or CreateObject function to create a reference to a .NET class object, by specifying either .NET or dotnet as the object type. You use the reference to access the .NET class fields and call the .NET class methods. This technique provides a tightly coupled, stateful, efficient method for accessing .NET classes from ColdFusion. As an alternative, your .NET application can make the class methods available as web services; however, using a web service is less reliable, has lower performance, and is less scalable than using ColdFusion objects for the .NET classes.

Note: .NET applications cannot access ColdFusion component functions directly. You can make the functions available as web services by specifying remote access. For more information on creating ColdFusion web services, see "Using Web Services" on page 900.
Because you use the .NET assembly classes the same way that you use any other ColdFusion object, you do not have
to understand the details of .NET technology; you only have to understand how to use the specific .NET class that
you are accessing. Code that uses a .NET method can be as simple as the following lines:

```coldfusion
<cfobject type = "NET" name = "mathInstance" class = "mathClass"
   assembly = "C:/Net/Assemblies/math.dll">
<cfset myVar = mathInstance.multiply(1,2)>
```

ColdFusion .NET access has the following additional features:

- If you make a change in the .NET assembly, ColdFusion automatically recognizes the change and uses that
  version for the next invocation.
- Your application can access .NET assemblies running on multiple machines.
- You can secure the communication between ColdFusion and .NET by using SSL.
- Primitive data types are automatically mapped between ColdFusion and .NET data types.

**How .NET access works**

For ColdFusion to access .NET assemblies, ColdFusion .NET extension software must run on the system that hosts
the assemblies. A ColdFusion system that accesses only remote assemblies does not require the .NET extension. The
.NET extension software provides the .NET-side connectivity features that enable access to .NET assemblies,
including a .NET-side agent (which normally runs as the ColdFusion 8 .NET service) that listens for and handles
requests from the ColdFusion system.

On the ColdFusion system, the ColdFusion objects use Java proxies that act as local representatives of the .NET
classes. These proxies use binary TCP or SOAP-based HTTP communication to access a .NET-side agent. The agent
then uses a DLL to invoke the .NET assembly classes. This communication is required in all cases, even if ColdFusion
and the .NET assemblies are on the same system.

The following image shows how CFML-to-.NET access works:
If your .NET assemblies are on the local system, ColdFusion automatically creates and manages all required proxies and configuration information. You must ensure only that the .NET extension is installed on your system and that the ColdFusion 8 .NET Service is running; you can use the `cfobject` tag or `CreateObject` function to access the assemblies without any additional steps.

If the assemblies are on a remote system, you install and use the ColdFusion 8 .NET extension software on the .NET system to create Java proxies for the .NET classes, and then move or copy them to the ColdFusion system. You must also edit the JNBDotNetSide.exe.config file on the remote system to specify the .NET classes you use. The .NET system requires the following .NET extension software:

- JNBDotNetSide.exe, the .NET-side agent that communicates with the ColdFusion system (normally run as the ColdFusion 8 .NET service).
- JNBDotNetSide.exe.config, a configuration file that identifies the .NET assemblies that can be accessed by ColdFusion.
- jnbproxy.exe and jnbproxyGui.exe, command-line and GUI-based programs that generate the Java proxies that represent the .NET assemblies.
- Additional support files, including JNBShare.dll, which invoke the .NET assembly classes.

For information on installing the ColdFusion .NET extension, see *Installing and Using ColdFusion*.

**Note:** When you install a new .NET version, you must reinstall the ColdFusion .NET extension.
Accessing .NET assemblies

ColdFusion provides two methods for accessing .NET assemblies:

- A local access method for .NET objects that are installed on the ColdFusion system
- A remote access method for .NET objects located on other systems.

For both methods, you must install the ColdFusion .NET extension and run the ColdFusion 8 .NET service on the system that hosts the assemblies. You do not need to install the extension or run the service on a ColdFusion system that accesses only remote assemblies. For information on installing the ColdFusion .NET extension, see Installing and Using ColdFusion.

Accessing local assemblies

For local access, ColdFusion automatically generates and uses proxies for the required .NET assemblies when you first use the *cfobject* tag or *CreateObject* function. ColdFusion caches the proxies for future use, so it does not generate assembly proxies each time.

Usually when you are accessing local .NET assemblies, you do not have to override the default communication configuration settings. Sometimes you might have to specify these settings, however. If other software on your system uses the default 6086 port, for example, you must change the port number specification in the `jnbridge\DotNetSide.exe.config` file, and you must specify the changed port number in your *cfobject* tag or *CreateObject* tag. For information on changing the port number specification, see “Configuring the .NET-side system” on page 956.

To use the local access method, you need only to use the *cfobject* tag or *CreateObject* function to create and access the proxy. You can use the resulting ColdFusion object to construct the .NET object, call the .NET object’s methods, and access its fields. For detailed information on using .NET classes, see “Using .NET classes” on page 957.

Accessing remote assemblies

The remote access technique accesses .NET assemblies by using TCP or HTTP to communicate with a .NET-side agent on a remote system. You create proxy instances and call assembly methods as you do in the Local access method, but you must first configure the remote .NET-side agent and, in most cases, the proxy classes that represent the remote .NET classes.

Configure remote .NET access

1. On the remote system, install the ColdFusion 8 .NET integration software and run the .NET-side agent (see Installing and Using ColdFusion).

2. If the .NET assemblies reside only on the remote system, generate proxy JAR files on that system that represent the assemblies (see “Generating the Java proxy classes” on page 954). Then copy or move the proxy files to the local system. If identical .NET assemblies also reside on the local system, you can skip this step.

3. Configure the .NET-side system for remote access (see “Configuring the .NET-side system” on page 956).
Generating the Java proxy classes

The Java proxy generation code requires direct access to the .NET assemblies to generate the proxy classes. Therefore, if the system that runs your ColdFusion application does not have the assemblies installed, you must run a tool on the .NET-side system to create the Java proxies. ColdFusion installs two proxy generation programs, jnbproxyGui.exe and jnbproxy.exe in the jnbridge directory when you install the .NET services. The jnbproxyGui.exe program is a Windows UI application, and the jnbproxy.exe program is a command line application. Both programs have identical capabilities.

Note: If the system running the ColdFusion application has the assemblies installed, but must access remote versions of the assemblies (for example, because of configuration differences), you do not need to manually generate the proxy classes, and you can skip this step. Instead, specify the paths to the local .exe or .dll files in the assembly attribute of the cfobject tag (or CreateObject function) and specify the remote server in the server attribute. You must configure the remote system for access, however.

On a ColdFusion system, the jnbproxyGui and jnbproxy programs are located in the cfroot\jnbridge directory. When you use the stand-alone installer, the programs are located in the installDir\jnbridge directory.

This topic provides the basic information necessary to generate a proxy JAR file using the jnbproxyGui tool. Additional information is available in the following locations:

- The jnbridge directory includes a jnbproxy.chm Windows Help file with more complete documentation on the JNBridge technology that powers the ColdFusion .NET feature, including detailed information on both the jnbproxyGui and jnbproxy programs.
- The jnbridge\docs subdirectory includes additional documentation, including users guide.pdf, a PDF version of the information in the Help file.

Note: The JNBridge documentation includes information on features that are not supported in ColdFusion. ColdFusion, for example, does not support access from .NET assemblies to ColdFusion or memory-only communication.

Using the jnbproxyGui tool

You use the jnbproxyGui program to generate a proxy JAR file.

Generate and install a proxy JAR

1. Start JNBProxyGui.exe.

2. The first time you run the program, it displays the Enter Java Options dialog box. Configure the options, and click OK.

   You can change the configuration settings at a later time by selecting Project > Java Options.

On a system with ColdFusion: If ColdFusion is currently running on this system, ensure that the Start Java Automatically option, located on the right side of the JNBProxy Enter Java Options (Project > Java Options) dialog box is cleared. Leave the default values for the other settings.

When you open an existing project, you might get a Restart Java Side pop-up warning with the message “You must stop and restart the Java side before these changes to the classpath can take effect.” You can ignore this message and click OK to proceed.

When you start the program, the Java Options dialog box might appear. You do not have to make any changes; click OK or Cancel to open the Launch JNBProxy dialog box.

In some cases, JNBProxyGui might behave as follows when the Start Java Automatically option is not selected.

On a system without ColdFusion: If ColdFusion is not currently running on the system, ensure the following options, which are located on the right side of the interface, are set. Leave the default values for the other settings.
• Ensure that the Start Java Automatically option is selected.
• Specify the java.exe file to use to compile the JAR file. You can use a Java 1.4 or 1.5 (J2SE 5.0) version of this file.
• Specify the jnbcore.jar file. The ColdFusion server installer puts this file in the cfroot\lib directory. The J2EE installer puts the file in the cf_webapp_root\WEB-INF\cfusion\lib directory.
• Specify the bcel.jar file. The ColdFusion server installer puts this file in the cfroot\lib directory. The J2EE installer puts the file in the cf_webapp_root\WEB-INF\cfusion\lib directory.

3 In the Launch JNBProxy dialog box, select Create New Java > .NET Project, and click OK.

4 In the main Java proxy generation interface, set up and build a project:
   a If you have not already done so, you must add the directory that contains your assemblies to the JNBProxy project. Select Project > Edit Assembly List. In the Assembly List dialog box, click the Add button. In the New Assembly List Element dialog box, navigate to the directory that contains your assemblies. Select the directory (or directories) in the tree, and click OK. Then click OK in the Edit Assembly List dialog box.
   b Open the Locate Assembly File dialog box (Project > Add Classes From Assembly File) and navigate to the directory that you added to the assembly list in step a. Select the assembly file or files that contain classes that require proxies and click OK.
   c The classes in the selected file, and other .NET core classes on which they depend, appear in the Environment pane. Select all classes for which you want proxies in your JAR file, and click the Add+ button to add the selected classes and all supporting classes.
   d In the Exposed Proxies list, select the classes to include in the JAR file. Normally, you should select all the listed classes, which ensures that all required classes are included.
   e Select Project > Build from the main menu. In the Save Generated Proxies dialog box, specify the location and JAR file in which to save the generated proxies, and click Save.
   f After the project is built, select File > Save Project and specify the file in which to save your project.

The next time you run the jnbproxyGui program, you can select your project and reuse your previous settings, including the Assembly List.

5 Copy the JAR file to a directory on your ColdFusion system. You specify this path in the cfobject tag assembly attribute.

Supporting classes
JNBProxy can generate proxies not only for the .NET classes that are explicitly listed, but also for supporting classes. A supporting class for a given .NET class is any class that might be needed as a direct or indirect result of using that .NET class. For a given .NET class, supporting classes include all of the following:
• The class.
• The class's superclass or superinterface (if it exists) and all of its supporting classes.
• The class's implemented interfaces (if any) and all of their supporting classes.
• For each field in the class:
  • The field's class and all of its supporting classes.
  • For each of the field's index parameters, the parameter's class and all of its supporting classes.
• For each method in the class:
  • The method's return value's class (if any) and all of its supporting classes.
• For each of the method's parameters, the parameter's class and all of its supporting classes.
• For each constructor in the class, for each of the constructor's parameters, the parameter's class and all of its supporting classes.

Unlike Java, where supporting classes include exceptions declared to be thrown by methods, .NET supporting classes don't include thrown exceptions, because they are not declared in advance.

The number of supporting classes depends on the classes explicitly listed, but there are often 200-250 classes. Usually you generate all supporting classes. However, there are situations where, to save time or space, you can generate only those classes explicitly specified, without supporting classes.

If a proxy for a supporting class has not been generated, and a proxy for such a class is later needed when the proxies are used, the proxy for the nearest superclass to the required class is used instead. If that proxy hasn't been generated, the proxy for that superclass's superclass will be used if it has been generated, and so forth, until the proxy for System.Object (which is always generated) is encountered. Thus, even with an incomplete set of proxies, code will execute, although functionality and other information may be lost.

In the jnbproxyGui tool, when you click the Add button, the list includes only the explicitly listed classes. When you click the Add+ button, the list also includes the supporting classes. In the jnbproxy command line program, the default command generates proxies for the supporting classes; use the /ns option to override this default.

Configuring the .NET-side system

To configure the .NET-side system, you edit the jnbridge\JNBDotNetSide.exe.config configuration file in the following ways:

• For local assemblies, you must edit this file only if you do not use the default port, or if you use SSL security.
• For a .NET assembly on a remote machine, you must register the assemblies in this file to make it accessible to ColdFusion.

Edit the configuration file

1 Ensure the following lines are in the <configSections> subsection of the <configuration> section:

    <jnbridge>
        <javaToDotNetConfig scheme="Protocol" port="local port number"
            useSSL="true|false" certificateLocation="server certificate path"/>
    </jnbridge>

• The scheme attribute specifies the communications protocol, and must be jtcp or http.
• The port number is the port of the .NET-side agent, normally 6086.
• The useSSL attribute specifies whether to use SSL for secure communications. The attribute is optional; the default is to not use SSL.
• The certificateLocation attribute specifies the location of the server SSL certificate. It is required only if the useSSL attribute is true.

These settings must be the same as the corresponding attributes in your cfobject tag.

2 If the .NET assemblies are on a remote system, specify the assemblies that ColdFusion will access by adding the following elements inside the <jnbridge> section.

    <assemblyList>
        <assembly file="path to assembly or fully qualified name"/>
        ...
    </assemblyList>
Stop and restart the .NET-side agent, if it is running. For example, on a ColdFusion system, restart the ColdFusion 8 .NET Service. Your ColdFusion application can now access the .NET classes that you configured.

The following example is a bare-bones JNBDotNetSide.exe.config file that specifies a .NET-side TCP server configuration. The server communicates by using TCP binary mode and listens on port 6086. Java clients can access classes from the C:\F\x.dll assembly and from System.Windows.Forms, which is in the GAC:

```xml
<?xml version="1.0" encoding="utf-8"?>
<configuration>
  <sectionGroup name="jnbridge">
    <section name="dotNetToJavaConfig" type="System.Configuration.SingleTagSectionHandler"/>
    <section name="javaToDotNetConfig" type="System.Configuration.SingleTagSectionHandler"/>
    <section name="tcpNoDelay" type="System.Configuration.SingleTagSectionHandler"/>
    <section name="javaSideDeclarations" type="System.Configuration.NameValueCollectionHandler"/>
    <section name="assemblyList" type="com.jnbridge.jnbcore.AssemblyListHandler, JNBShare"/>
  </sectionGroup>
  <jnbridge>
    <javaToDotNetConfig scheme="jtcp" port="6086"/>
    <assemblyList>
      <assembly file="C:\F\x.dll"/>
      <assembly file="System.Windows.Forms, Version=1.0.5000.0, Culture=neutral, PublicKeyToken=b77a5c561934e089"/>
    </assemblyList>
  </jnbridge>
</configuration>
```

Using .NET classes

You use .NET assembly classes the same way you use Java and other objects that you create using the `cfobject` tag or `CreateObject` function. In the simplest case, your application code only has to use the following format to include a local .NET class method:

```cfobject type = ".NET" name = "mathInstance" class = "mathClass"
    assembly = "C:/Net/Assemblies/math.dll">
  <cfset myVar = mathInstance.multiply(1,2)>
</cfobject>
```

Using CFScript and the `CreateObject` function, you can do the following:

```cfscript
  mathInstance = CreateObject(".NET", "mathClass",
    "C:/Net/Assemblies/math.dll");
  myVar = mathInstance.multiply(1,2);
</cfscript>
```

**Note:** You cannot load two DLLs with same fully qualified name. ColdFusion always uses the first DLL that it accesses until the server is restarted. For example, if page1.cfm uses `c:\dev\a.dll` and page2.cfm uses `c:\dev2\a.dll`, and both DLLs have the same fully qualified name, the first DLL file to be loaded remains loaded, and both CFML pages use it.

When you create objects and access class methods and fields, and convert data types between ColdFusion and .NET, you must be aware of the considerations and limitations described in the following sections:
Instantiating objects and calling class constructors

When you use the `cfobject` tag to create a .NET object, ColdFusion does not create an instance of the object. ColdFusion creates the object instance in either of the following cases:

- If the class has a default constructor, ColdFusion automatically calls the constructor when you first invoke a non-static method of the object.
- If the class does not have a default constructor, or if the class has multiple constructors and you do not want to use the default, call the special `init` method of the ColdFusion object. The `cfobject` tag automatically creates `init` methods for all class constructors. Using the `init` method causes ColdFusion to call the class constructor with the corresponding number and types of parameters. For example, the following tags cause ColdFusion to call the `MyClass` constructor that takes two integer parameters:

  ```
  <cfobject type=".NET" name="myObj" class="com.myCo.MyClass"
    assembly="c:\assemblies\myLib.dll">
  <cfset myObj.init(10, 5)>
  ```

  **Note:** ColdFusion does not create instances of objects if you use only their static methods.

Calling methods

You call .NET methods in the same way that you use any other ColdFusion object methods. For example, if the `MyClass` class has a `getName` method that takes a numeric ID and returns a name, you would call the method as follows:

```
<cfset theID="2343">
<cfset userName=mObj.getName(theID)>
```

Getting and setting fields

You can access and change public fields of any .NET class by calling the following methods:

- `GetFieldName()`
- `SetFieldName(value)`

For example, if the .NET class has a public field named `accountID`, you can access and change its value by using the `Get_accountID()` and `Set_accountID()` methods, as follows:

```
<cfobject type=".NET" class="com.myCo.MyClass"
    assembly="c:\assemblies\myLib.dll" name="myObj">
<cfset theAccount=mObj.Get_accountID()>
<cfset myObj.Set_accountID(theAccount + 1)>
```

You can access, but not modify final fields, so you can only call `Get_fieldName()` for these fields.

Converting between .NET and ColdFusion data types

Accessing .NET classes requires a Java proxy on the ColdFusion system and .NET code on the target system, so data must be converted among ColdFusion, Java, and .NET (to be exact, Microsoft Intermediate Language, or MSIL) data types. ColdFusion converts data types automatically. Usually, you do not have to take any special steps to ensure correct conversion. There are some conversion limitations, and in some cases you must explicitly specify a data type when you call a method in a .NET proxy object.
The following paragraphs describe some the data conversion issues and how to handle them. For a detailed specification of how ColdFusion converts among ColdFusion data, Java data types, and .NET data types, see cfobject:.NET object in the CFML Reference.

**Data type conversion rules and techniques**

ColdFusion converts data automatically among ColdFusion, Java, and CLR data types. The following table indicates how ColdFusion converts among .NET Common Language Runtime (CLR) primitive and standard data types, the Java data types used in the proxies to represent CLR data types, and ColdFusion data types in your CFML application.

<table>
<thead>
<tr>
<th>.NET type</th>
<th>Java type</th>
<th>ColdFusion type</th>
</tr>
</thead>
<tbody>
<tr>
<td>sbyte</td>
<td>byte</td>
<td>Integer</td>
</tr>
<tr>
<td>byte</td>
<td>short</td>
<td>Integer</td>
</tr>
<tr>
<td>short</td>
<td>short</td>
<td>Integer</td>
</tr>
<tr>
<td>ushort</td>
<td>int</td>
<td>Integer</td>
</tr>
<tr>
<td>int</td>
<td>int</td>
<td>Integer</td>
</tr>
<tr>
<td>uint</td>
<td>long</td>
<td>Number</td>
</tr>
<tr>
<td>char</td>
<td>char</td>
<td>Integer or string</td>
</tr>
<tr>
<td>long</td>
<td>long</td>
<td>Number</td>
</tr>
<tr>
<td>ulong</td>
<td>float</td>
<td>Number</td>
</tr>
<tr>
<td>float</td>
<td>float</td>
<td>Number</td>
</tr>
<tr>
<td>double</td>
<td>double</td>
<td>Number</td>
</tr>
<tr>
<td>bool</td>
<td>boolean</td>
<td>Boolean</td>
</tr>
<tr>
<td>enum</td>
<td>Not converted</td>
<td>But enumerator elements can be accessed directly by using the format Enumerator_variable.enumerator, as in MyColor.Red</td>
</tr>
<tr>
<td>array</td>
<td>array</td>
<td>Array</td>
</tr>
<tr>
<td>string</td>
<td>String</td>
<td>String</td>
</tr>
<tr>
<td>System.Collections.ArrayList</td>
<td>java.util.ArrayList</td>
<td>Array</td>
</tr>
<tr>
<td>System.Collections.Hashtable</td>
<td>java.util.Hashtable</td>
<td>Structure</td>
</tr>
<tr>
<td>System.Data.DataTable</td>
<td>Query</td>
<td>Note: ColdFusion converts from .NET type to ColdFusion type only, it does not convert ColdFusion Structures to .NET Hashtables</td>
</tr>
</tbody>
</table>

The returned number retains greater precision than is normally displayed in ColdFusion. Use the PrecisionEvaluate function to access and display the full precision of a returned double value. You can also pass a value with full double precision to a .NET method.
Using decimal numbers
You must use the JavaCast function to convert ColdFusion data into BigDecimal format before you pass the value to a .NET function, as in the following example:

```
<cfset netObj.netFunc(javacast("bigdecimal","439732984732048"))>
```

ColdFusion automatically converts returned decimal and System.Decimal values to ColdFusion string representations.

Ensuring decimal and date/time conversions
ColdFusion converts .NET decimal or System.Decimal types only if the proxy for System.Decimal is a value type proxy. Similarly, it converts .NET System.DateTime values to ColdFusion Date-time values only if the proxy for System.DateTime is a value type proxy. The ColdFusion server always uses value proxies when it generates these proxies. If you use the JNBProxyGUI.exe tool to generate the proxy, however, you must make sure to generate the proxy for System.Decimal as value type.

Converting data to System.Object type
When a .NET method specifies System.Object (as opposed to a specific Object subclass, such as System.Boolean) as the argument type, and you want to pass primitive values as arguments to that method, you must use the javacast function to identify the data conversion. Once ColdFusion knows the data type, it automatically converts to the appropriate .NET type. Here is the table that describes the conversion rule from ColdFusion type to .NET type.

<table>
<thead>
<tr>
<th>.NET type</th>
<th>Java type</th>
<th>ColdFusion type</th>
</tr>
</thead>
<tbody>
<tr>
<td>System.DateTime</td>
<td>java.util.Date</td>
<td>Date/time</td>
</tr>
<tr>
<td>decimal</td>
<td>java.math.BigDecimal</td>
<td>String representation of the decimal number.</td>
</tr>
<tr>
<td>System.Decimal</td>
<td></td>
<td>For details on using decimal numbers, see &quot;Using decimal numbers&quot; on page 960.</td>
</tr>
<tr>
<td>System.Object</td>
<td></td>
<td>If a .NET argument is of type System.Object, ColdFusion Strings are converted directly. Other types require using the JavaCast function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ColdFusion cannot convert System.object instances returned by .NET methods to ColdFusion types, but you can access them using the Object methods.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For detailed information, see &quot;Converting data to System.Object type&quot; on page 960.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>.NET Type</th>
<th>Type used in javacast</th>
</tr>
</thead>
<tbody>
<tr>
<td>bool / System.Boolean</td>
<td>boolean</td>
</tr>
<tr>
<td>bool[] / System.Boolean[]</td>
<td>boolean[]</td>
</tr>
<tr>
<td>char / System.Char</td>
<td>char</td>
</tr>
<tr>
<td>char[] / System.Char[]</td>
<td>char[]</td>
</tr>
<tr>
<td>double / System.Double</td>
<td>double</td>
</tr>
<tr>
<td>double[] / System.Double[]</td>
<td>double[]</td>
</tr>
<tr>
<td>float / System.Single</td>
<td>float</td>
</tr>
<tr>
<td>float[] / System.Single[]</td>
<td>float[]</td>
</tr>
<tr>
<td>int / System.Int32</td>
<td>int</td>
</tr>
<tr>
<td>int[] / System.Int32[]</td>
<td>int[]</td>
</tr>
<tr>
<td>long / System.Int64</td>
<td>long</td>
</tr>
<tr>
<td>long[] / System.Int64[]</td>
<td>long[]</td>
</tr>
</tbody>
</table>
You do not need to use a JavaCast function to convert ColdFusion string variables. They are automatically be converted to .NET System.String.

You must create special objects for .NET primitive unsigned data types, such as byte (unsigned byte), ushort (unsigned short), uint (unsigned int) and ulong (unsigned long), for which there are no corresponding java types. The following table lists the .NET primitive types and the corresponding class you must use.

<table>
<thead>
<tr>
<th>.NET type</th>
<th>Class used in cfobject/createObject</th>
</tr>
</thead>
<tbody>
<tr>
<td>byte / System.Byte</td>
<td>System.BoxedByte</td>
</tr>
<tr>
<td>ushort / System.UInt16</td>
<td>System.BoxedUShort</td>
</tr>
<tr>
<td>uint / System.UInt32</td>
<td>System.BoxedUInt</td>
</tr>
<tr>
<td>ulong / System.UInt64</td>
<td>System.BoxedULong</td>
</tr>
<tr>
<td>sbyte / System.Sbyte</td>
<td>byte</td>
</tr>
<tr>
<td>sbyte[] / System.Sbyte[]</td>
<td>byte[]</td>
</tr>
<tr>
<td>short / System.Int16</td>
<td>short</td>
</tr>
<tr>
<td>short[] / System.Int16[]</td>
<td>short[]</td>
</tr>
<tr>
<td>System.Decimal</td>
<td>bigdecimal</td>
</tr>
</tbody>
</table>

You must use the createObject function or cfobject tag to create these special objects, in the same manner as you create other .NET classes, before you use them in your assignment statement. For example, the following line creates a ushort representation of the value 100:

```coldfusion
cfset boxedUShort = createObject(".NET", "System.BoxedUShort").init(100)
```

The following example creates a System.Hashtable object and populates it with examples of all types of primitives.

```coldfusion
<cfset table = createObject(".NET", "System.Collections.Hashtable")>
<cfset table.add("shortVar", javacast("short", 10))>
<cfset table.add("sbyteVar", javacast("byte", 20))>
<cfset table.add("intVar", javacast("int", 123))>
<cfset table.add("longVar", javacast("long", 1234))>
<cfset table.add("floatVar", javacast("float", 123.4))>
<cfset table.add("doubleVar", javacast("double", 123.4))>
<cfset table.add("charVar", javacast("char", 'c'))>
<cfset table.add("booleanVar", javacast("boolean", "yes"))>
<cfset table.add("StringVar", "Hello World")>
<cfset table.add("decimalVar", javacast("bigdecimal", 123234234.505))>
```

```coldfusion
<cfset boxedByte = createObject(".NET", "System.BoxedByte").init(100)>
<cfset boxedUShort = createObject(".NET", "System.BoxedUShort").init(100)>
<cfset boxedUInt = createObject(".NET", "System.BoxedUInt").init(123)>
<cfset boxedULong = createObject(".NET", "System.BoxedULong").init(123123)>
```
Any other .NET objects can be passed as it is.

**Handling ambiguous type conversions**

ColdFusion cannot determine the correct data type conversion if a method has multiple signatures with the same number of parameters that differ only in the parameter data types. In this case, use the `JavaCast` method to convert the ColdFusion data to the Java type that corresponds to the .NET type.

For example, if a .NET class has methods `myFunc(ulong)` and `myFunc(int)`, use the `JavaCast` method to convert your ColdFusion variable to the Java float or int data type, as the following line shows:

```cfm
myFunc(JavaCast(int, MyVar));
```

Similarly, if a .NET class has methods `myFunc(int)` and `myFunc(String)`, use the `JavaCast` method to convert your ColdFusion variable to the Java int or String data type, as shown in the following line:

```cfm
myFunc(JavaCast(String, "123");
```

In some cases, the `JavaCast` function cannot eliminate ambiguity because a single Java type corresponds to multiple .NET types. In these cases, ColdFusion creates a proxy with only one method, which uses the .NET data type that corresponds directly to a Java type.

For example, if the .NET class has methods `myFunc(ulong)` and `myFunc(float)`, the generated proxy has only one method. This method calls `myFunc(float)`, because the Java float type used to handle ColdFusion floating point numbers corresponds directly to the .NET float type. In this case, you can never call the .NET `myFunc(ulong)` method.

**Working with complex .NET data types**

When you use complex .NET data such as Hashtable, ArrayList and DataTable, ColdFusion normally automatically converts the data to the corresponding ColdFusion datatype: structure, array and query, respectively. When you work with this data you take specific actions to enable the proper access and conversion of the data, as follows:

- You must use associative array notation to properly access .NET Hashtable data from ColdFusion.
- You cannot use ColdFusion variables directly in parameters that take Hashtable, ArrayList or DataTable input.
- You can disable automatic conversion of complex .NET data to ColdFusion types.
- You can manually convert complex .NET data to ColdFusion types.

**Using Hashtable data in ColdFusion**

.NET Hashtables are case sensitive, but most methods of ColdFusion structure access are case insensitive. Only associative array notation of the form `structName["keyName"]` is case sensitive. When .NET Hashtables are converted to CF structure, the entire data set is converted, even if the element keys differ only in case. Therefore, to get the values of the keys that differ only in case, you must use associative array notation.

The following example shows this issue. It creates a Hashtable object with three entries whose key values vary only in case. In the example, output using dot-delimited structure notation always returns the same value, corresponding to the all-uppercase key, but associative array notation returns the correct result.

```cfm
<cfset table = createObject(".NET", "System.Collections.Hashtable")>
<cfset table.add("Key", "Value1")>
<cfset table.add("KEY", "Value2")>
<cfset table.add("key", "Value3")>
```
<cfset cftable = DotNetToCFType(table)>

<cfdump var="cftable"/>

<h3>Using dot notation</h3>
Key : <cfoutput>#cftable.Key#</cfoutput><br>
KEY : <cfoutput>#cftable.KEY#</cfoutput><br>
key : <cfoutput>#cftable.key#</cfoutput><br>
<p>

<h3>Using associative array notation</h3>
Key : <cfoutput>#cftable["Key"]#</cfoutput><br>
KEY : <cfoutput>#cftable["KEY"]#</cfoutput><br>
key : <cfoutput>#cftable["key"]#</cfoutput><br>

Using .Net ArrayList in ColdFusion
ColdFusion converts System.Collections.ArrayList objects to ColdFusion arrays, and you can perform all standard ColdFusion array operations on them. The following example shows this usage:

.Net Code:

```csharp
public ArrayList getList(){
    ArrayList myAL = new ArrayList();
    myAL.Add("Hello");
    myAL.Add(1);
    myAL.add(true);
    Return AL;
}
```

ColdFusion Code:

```cfm
<cfset cflist = netObject.getList()>
<cfloop array="#cflist#" index="#item#">
     <cfoutput>#item#</cfoutput><br>
</cfloop>
<cfif cflist[3]>
     <cfoutput>3rd element in the list is true</cfoutput>
</cfif>
```

Using ADO.Net DataTable in ColdFusion
ColdFusion converts System.Data.DataTable objects to ColdFusion query objects, and you can perform all standard ColdFusion query operations on them. The following example shows this usage:

.Net code:

```csharp
public DataTable datasetMethod()
{
    //conn string
    string connectionString = "...";

    //connection
    using (SqlConnection connection = new SqlConnection(connectionString))
    {
        SqlCommand cmd = new SqlCommand("SELECT * FROM [tblEmployees]", connection);
        connection.Open();
        SqlDataReader reader = cmd.ExecuteReader();
        DataTable dt = new DataTable();
        dt.Load(reader);
        return dt;
    }
}
```
ColdFusion code:

```coldfusion
<cfset query1 = netObject.datasetMethod()>
<cfoutput query="query1">
    Query1.CurrentRow = #query1.CurrentRow#<br>
</cfoutput>
```

**Using ColdFusion complex types in .NET input parameters**
When a .NET method returns an ArrayList, Hashtable or DataTable, ColdFusion automatically converts it to a ColdFusion array, structure or query, respectively. However ColdFusion does not automatically convert from ColdFusion data types to these .NET types. (ColdFusion does automatically convert ColdFusion arrays to .Net array types.) Therefore, you cannot use ColdFusion variables directly as input parameters to .NET object instance methods that require .NET System.Collections.ArrayList, System.Collections.Hashtable, or System.Data.DataTable types. Instead you must create instances of these .NET types and populate them with the required data before you pass them to the .NET method. For an example of creating and populating a System.Collection.Hashtable object, see the example at the end of the “Converting data to System.Object type” section.

**Disabling automatic conversion of complex .NET data**
You can disable automatic conversion of .NET System.Collections.Hashtable, System.Collections.ArrayList or System.Data.DataTable objects to the corresponding ColdFusion structure, array or query objects. You might want to do this under the following circumstances:

- If a collection or DataTable returned by a .NET method is very large and you only want a small subset of the data. If auto conversion is enabled, ColdFusion creates a data structure with all the object's fields. This might take significant time and resources, because ColdFusion must invoke .NET methods internally to get each of the fields. You can disable the automatic conversion and retrieve the fields or data from .NET objects like any other objects.

- If you invoke a .NET method that returns a complex variable, and then pass the variable to another .NET method as argument. If automatic conversion is enabled, you cannot pass the Hashtable object from the first method directly to the second method.

To disable automatic conversion, set the JVM coldfusion.dotnet.disableautoconversion system property to true. For example, in a ColdFusion stand-alone server, or if you use JRun as your J2EE server, include the following setting in the JVM.config file:

```
-Dcoldfusion.dotnet.disableautoconversion=true
```

**Manually converting complex .NET objects**
Use the DotNetToCFTType function to convert a System.Collections.Hashtable, System.Collections.ArrayList or System.Data.DataTable object to a ColdFusion structure, array or query respectively when either of the following circumstances are true:

- You have set the coldfusion.dotnet.disableautoconversion system property to true.

- Automatic conversion is enabled, you created the complex .NET object by using the createObject function or cfobject tag, and you want to convert this object into the corresponding ColdFusion representation.

For an example of using the function, see DotNetToCFTType in the CFML Reference.

**Using .NET objects**
.NET fields and return values with class types are available in ColdFusion as .NET objects. You can use the object's methods to access object data and make it available to ColdFusion using supported data types.
The following example gets information about a system's drives. It calls the System.IO.DriveInfo.GetDrives() method to get an array of System.IO.DriveInfo objects, one per drive. It then calls the object methods to get specific information about the drives, and displays the information. The example uses a cfdump tag to simplify the code.

**Note:** The System.IO.DriveInfo is not included in the .NET 1.0 framework. It is included in .NET 2.0 and later frameworks. For information on determining the .NET framework, see "Determining and changing the .NET version" on page 971.

```cfml
<!--- Create a query for the drive information results. --->
<cfset result=QueryNew("name,type,isready(format,label,totalsize,freespace"
,"varchar,varchar,bit,varchar,varchar,double,double")>

<!--- Create a .NET System.IO.DriveInfo object. --->
<cfobject type=".NET" name="sidiClass" class="System.IO.DriveInfo">

<!--- Get the drives. --->
<cfset drives=sidiClass.GetDrives()>

<!--- Loop through drives. --->
<cfloop from="1" to="#ArrayLen(drives)#" index="i">  
<!--- Add a row to the query. --->
<cfset QueryAddRow(result)>  
<!--- Get the drive name, type, and ready flag. --->
<cfset QuerySetCell(result, "name", drives[i].Get_Name())>
<cfset QuerySetCell(result, "type", drives[i].Get_DriveType().ToString())>
<cfset QuerySetCell(result, "isready", drives[i].Get_IsReady())>
<!--- Get extra details ONLY if the drive is ready. --->
<cfif drives[i].Get_IsReady()>
  <cfset QuerySetCell(result, "format", drives[i].Get_DriveFormat())>
  <cfset QuerySetCell(result, "label", drives[i].Get_VolumeLabel())>
  <cfset QuerySetCell(result, "totalsize", drives[i].Get_TotalSize())>
  <cfset QuerySetCell(result, "freespace", drives[i].Get_AvailableFreeSpace())>
</cfif>
</cfloop>

<cfdump var="#result#">
```

**.NET Interoperability Limitations**

ColdFusion .NET interoperability has the following limitations

- You cannot invoke methods with pointers as arguments or the return type.
- You cannot invoke methods that take Out parameters.
- ColdFusion can only convert from System.Data.DataTable, System.Collection.Hashtable and System.Collection.ArrayList to ColdFusion data types. ColdFusion cannot convert from ColdFusion queries, structures, and arrays to these System data types; however, it can convert from ColdFusion arrays to the CLR array type. Therefore, you cannot pass structures or queries directly to .NET methods.
- You cannot access .NET UI components.
- You cannot use callbacks (events and Delegates) from .NET side.
- ColdFusion cannot determine the correct data type conversion if a method has multiple signatures that have the same number of parameters and differ only in the parameter data types. In this case, use the JavaCast method to convert the ColdFusion data to the Java type that corresponds to the .NET type.
• If the JavaCast function cannot eliminate ambiguity between functions with the same number of parameters because a single Java type corresponds to multiple .NET types, ColdFusion creates a single proxy that uses the .NET data type that corresponds directly to a Java type.

For more information on how to handle type conversions, see “Converting between .NET and ColdFusion data types” on page 958.

• Assemblies registered in the DotNetSide.exe.config file must have unique class names. If two or more assemblies have the same class name, method invocation can result in an error or can give the wrong result. For example, you should not have two DLLs, a.dll and b.dll, that contain the same class name, nam1.name2.MyClass. If you use one dll and later want to use another dll that contains a class that clashes with first, you must restart the ColdFusion .NET Service if ColdFusion and .NET both are on the same machine. If they are on the different machines, you must remove the first DLL’s entry from the DotNetSide.exe.config file and restart the ColdFusion .NET Service on the Windows machine hosting the .NET service.

Example applications

The first application example uses a Microsoft .NET system class method directly. The second application example uses a custom C# class to access Microsoft Word.

Example: Using a .NET class directly
The following example uses the Microsoft .NET System.Net.NetworkInformation.Ping class method directly to ping servers. This class is supported in .NET version 2.0 and later.

```cfml
<!--- This function pings the specified host. --->
<cffunction name="Ping" returntype="string" output="false">
   <cfargument name="host" type="string" required="yes">
   <!--- Local vars --->
   <cfset var pingClass="">
   <cfset var pingReply="">
   <!--- Get Ping class --->
   <cfobject type=".NET" name="pingClass" class="System.Net.NetworkInformation.Ping">
   <!--- Perform synchronous ping (using defaults) --->
   <cfset pingReply=pingClass.Send(Arguments.host)>
   <!--- Return result --->
   <cfreturn pingReply.Get_Status().ToString()>
</cffunction>

<h3>Ping Test</h3>
<cfoutput>
  127.0.0.1: #Ping("127.0.0.1")#<br>
  www.adobe.com: #Ping("www.adobe.com")#<br>
</cfoutput>
```

Example: Using a custom class to access Microsoft Word
The following ColdFusion application uses a custom C# WordCreator class, and supporting classes in Microsoft Office and Word DLLs, to create a Word document. The application opens Microsoft Word, writes five copies of the text specified by the someText variable, and saves the document in the file specified by the filename variable. The application leaves the instance of Word open.
Note: For an example that uses a .NET System class directly and does not require any cousin .NET code, see the “Limitations” section of cfobject: .NET object in the CFML Reference.

The second listing shows the WordCreator C# source code. To run this application locally, you must compile this class and the Microsoft Interop.Word.dll file, and place them in the C:\dotnet directory. (Alternatively, you can put them elsewhere and change the paths in the cfobject assembly attribute.) You might need additional or different Microsoft DLL files, depending on the version of Microsoft Office that you have installed.

The ColdFusion application contains the following code:

```coldfusion
<cfset filename="C:\dotNet\demo.doc">
<cfif fileexists(filename)>
   <cffile action="delete" file="#filename#">
</cfif>
<cfobject type=".NET" assembly="C:\dotNetApp\WordApp.dll,C:\dotNet\Interop.Office.dll"
          name="wordCreator" class="WordApp.WordCreator">
<cfdump label="WordCreator Class Dump" var="#wordCreator#">
<cfset someText = "ColdFusion created this sample document using Windows .NET class methods. The text is long enough to appear in the Word file on multiple lines."">
<cfloop from=1 to=5 index =i>
   <cfset wordCreator.addText(someText)>
   <cfset wordCreator.newParagraph()>
   <cfset wordCreator.addText("Starting a new paragraph. It should start a new line.")>
   <cfset wordCreator.newParagraph()>
</cfloop>
<cfset wordCreator.save()>

The C# source for the WordCreator class is as follows:

```csharp
using System;
using System.IO;
using System.Collections.Generic;
using System.Text;

// The commented-out lines may be needed on some systems in place of,
// or in addition to, the line that follows them.
// using Microsoft.Office.Core;
// using Word;
// using Microsoft.Office;
// using Microsoft.Office.Interop;
namespace WordApp {
    public class WordCreator {
        object readOnly = false;
        object isVisible = true;
        object missing = System.Reflection.Missing.Value;
        object docType = 0;
        object newTemplate = false;
        object template = "normal.dot";
        object format = WdSaveFormat.wdFormatDocument;
        ApplicationClass app = new ApplicationClass();
        private object fileName;
        private Document doc;
        private bool isNewDoc = false;
    }
}```
public WordCreator(String fileName) {
    this.fileName = fileName;
    app.Visible = true;
    if (File.Exists(fileName))
        doc = app.Documents.Open(ref this.fileName, ref missing, ref
            readOnly, ref missing, ref missing, ref missing, ref missing,
            ref missing, ref missing, ref missing, ref missing, ref
            isVisibile, ref missing, ref missing, ref missing, ref missing,
            ref missing, ref missing, ref missing, ref missing, ref missing);
    else {
        doc = app.Documents.Add(ref template, ref newTemplate,
            ref docType, ref isVisible);
        isNewDoc = true;
    }
    doc.Activate();
}

public void addText(String text) {
    app.Selection.TypeText(text);
}

public void newParagraph() {
    app.Selection.TypeParagraph();
}

public void save() {
    if (!isNewDoc)
        doc.Save();
    else doc.SaveAs(ref fileName, ref format, ref missing, ref missing,
        ref missing, ref missing, ref missing, ref missing, ref missing,
        ref missing, ref missing, ref missing, ref missing, ref missing,
        ref missing, ref missing, ref missing, ref missing, ref missing);    
}


Advanced tools

Occasionally, the use of additional tools for generating proxies and running the .NET extension software can be helpful in some workflows.

Using the jnbproxy command

You can use the jnbproxy command-line tool as an alternative to the jnbproxyGui program, to generate Java proxies. For more information, see “Generating the Java proxy classes” on page 954.

For example, you can use this command in a batch file to generate multiple proxy JAR files in a single operation.

The jnbproxy command has the following format:

jnbproxy options... classes...

For example:

jnbproxy /al C:\dotNet\netdll\PrimitiveTypes.dll /d C:\dotNet\MyJavaJars
/host localhost /n PrimitiveTypes /nj /pd j2n /port 6085 /pro b
/pp C:\ColdFusion8\lib CSharpDatatypes.PrimitiveTypes
Options
The following table lists the options that you can use. To create proxies on a system that is running ColdFusion, use the /nj option and do not specify the /bp, /java, or /jp options.

<table>
<thead>
<tr>
<th>Option</th>
<th>Req/Opt</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/al assemblylist</td>
<td>Required</td>
<td></td>
<td>Specifies a semicolon-separated series of file paths of .NET assemblies (DLL and EXE files) that contain the required .NET classes.</td>
</tr>
<tr>
<td>/bp bcelpath</td>
<td>Optional</td>
<td></td>
<td>Use the CLASSPATH environment variable to locate the file.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the path to the folder that contains the bcel.jar file.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ignored if you use the /nj option.</td>
</tr>
<tr>
<td>/cf</td>
<td>Required</td>
<td></td>
<td>Use the ColdFusion software license. If you do not include this option, your proxies are limited to a 30-day trial period.</td>
</tr>
<tr>
<td>/d directory</td>
<td>Optional</td>
<td></td>
<td>The current execution directory.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the directory in which to write a JAR file with the generated proxies.</td>
</tr>
<tr>
<td>/f classfile</td>
<td>Optional</td>
<td></td>
<td>Reads the classes from the specified text file, not the command line.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For more information, see the JNBridge documentation.</td>
</tr>
<tr>
<td>/h</td>
<td>Optional</td>
<td></td>
<td>Lists the options and usage information. Typing the command jnbproxy with no options or arguments results in the same information.</td>
</tr>
<tr>
<td>/host hostname</td>
<td>Required</td>
<td></td>
<td>Specifies the host on which the .NET code is located. This option can be a host name or an IP address. Normally, you specify localhost.</td>
</tr>
<tr>
<td>/java javapath</td>
<td>Optional</td>
<td></td>
<td>Use the first java.exe file found using the system PATH environment variable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the path of the directory that contains the java.exe program to use when automatically starting Java.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ignored if you use the /nj option.</td>
</tr>
<tr>
<td>/jp jnbcorepath</td>
<td>Optional</td>
<td></td>
<td>Use, the CLASSPATH environment variable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the path of the folder containing the file jnbcore.jar.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ignored if you use the /nj option.</td>
</tr>
<tr>
<td>/ls</td>
<td>Optional</td>
<td></td>
<td>Generate and list the proxies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lists all classes to be generated in support of the specified classes (see “Supporting classes” on page 955), but don’t generate the proxies.</td>
</tr>
<tr>
<td>/n name</td>
<td>Optional</td>
<td></td>
<td>Create a file named jnbproxies.jar.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the name of the JAR file in which to put the proxies. Do not specify the .jar extension; the tool automatically adds it.</td>
</tr>
<tr>
<td>/nj</td>
<td>Optional</td>
<td></td>
<td>Start Java automatically.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Does not start Java automatically. If you use this option, Java must be running, and the /bp, /java, /jp, and /wd options, if present, are ignored.</td>
</tr>
<tr>
<td>/ns</td>
<td>Optional</td>
<td></td>
<td>Generate proxies for all supporting classes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Generates proxies for the classes specified on the command line (or class file) only, not for any supporting classes.</td>
</tr>
<tr>
<td>/pd</td>
<td>Required</td>
<td></td>
<td>Specifies the direction in which the proxies operate. Must be \j2n.</td>
</tr>
<tr>
<td>/port portNum</td>
<td>Required</td>
<td></td>
<td>Specifies the port on which the .NET side listens when generating the proxies. Must be an integer. Normally this value is 6085.</td>
</tr>
<tr>
<td>/pro protocol</td>
<td>Required</td>
<td></td>
<td>Specifies the communication mechanism between the .NET and Java sides. The valid values are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• b TCP/binary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• h (HTTP/SOAP</td>
</tr>
<tr>
<td>/wd dir</td>
<td>Optional</td>
<td></td>
<td>The system's default working directory.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the working directory for the JVM.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ignored if the /nj option is present.</td>
</tr>
</tbody>
</table>
Classes
A space-separated sequence of fully qualified .NET class names (for example, CSharpDatatypes.PrimitiveTypes) for which proxies should be generated. The proxies for System.Object and System.Type are always generated, even if they are not listed in the class list.

Passing data by reference and value
The proxy generators let you specify whether to pass parameters and return values by reference or by value.

About passing by reference and value
When you pass data by reference, the information transferred between the Java Proxy and the .NET side is a logical pointer to the underlying .NET object, which continues to reside on the .NET side. When you pass data by value, the transferred information contains a copy of the contents of the .NET object, which might or might not continue to reside on the .NET side after a function call. Passing by reference and value have different advantages.

When you pass data by reference, only changed values are passed between the Java proxy and the .NET object directly. All other information is passed as reference to its representation in the corresponding objects. Because the reference is typically much smaller than the actual object, passing by reference is typically very fast. Also, because the reference points to a .NET object that continues to exist on the .NET side, if that .NET object is updated, the updates are immediately accessible to the proxy object on the Java side. The disadvantage of reference proxies is that any access to data in the underlying object (e.g., field or method accesses) requires a round trip from the Java side to the .NET side (where the information resides) and back to the Java side.

When you pass data by value, a copy of the data is passed between .NET and Java. Because the data object itself is typically bigger than a reference, passing an object by value takes longer than passing it by reference. Also, the value that is passed is a snapshot of the object taken at the time that it was passed. The passed object maintains no connection to the underlying .NET object, therefore, the passed value does not reflect any updates to the underlying .NET object that are made after the object is passed. The advantage of passing data by value proxies is that all data in the object is local to the Java side, and field accesses are very fast, because they do not require a round trip to the .NET side and back to get the data.

The choice of whether to use reference or value proxies depends on the desired semantics of the generated proxies, and on performance.

• In general, you should use reference proxies (the default), because they maintain the normal parameter-passing semantics of Java and C#.
• In general, you should use value proxies in any of the following cases:
  • The class functions always must pass parameter values and return values back and forth.
  • The class object contains little data.
  • There will be frequent modification of the object data, and the object is either relatively small or the frequency of accesses to data outweighs the time taken to transfer the object.

Specifying the data passing method
When you use the JNBProxy gui tool to generate proxies, you can designate which proxies should be reference and which should be value. The default proxy type is reference.

To set the data passing method for a class, right-click on the class in the Exposed Proxies pane. Select the desired passing method from the list that appears. After you select the passing method, the color of the proxy class changes, to indicate its type: black for reference, or blue for value (public fields/properties style).
Set the passing method for multiple proxy classes simultaneously
1. Select Project > Pass By Reference / Value from the menu bar.
2. The Pass by Reference / Value dialog box lists all proxy classes in the Exposed Proxies pane. Select the classes whose passing value you want to set.
3. Click the Reference or Value (Public fields/properties) button to associate the selected classes to the desired type.
4. Repeat steps 2 and 3 to select multiple groups of classes and set their passing methods.
5. Click OK.

Determining and changing the .NET version
If you get errors when using a .NET object in your application, you may have version issues. For example, many Microsoft system classes were added in .NET Version 2.0, including System.IO.DriveInfo and System.Net.NetworkInformation.Ping. For examples of these classes in applications, see “Using .NET objects” on page 964 and “Example: Using a .NET class directly” on page 966, respectively.

Use the following function to get the current .NET version:

```cfml
<cffunction name="GetDotNetVersion" returntype="string">
    <cfset var seClass="">
    <cfobject type=".NET" name="seClass" class="System.Environment">
    <cfreturn seClass.Get_Version().ToString()>
</cffunction>
```

If the function reports that the active version is not the one you require, install or reinstall the correct version of the .NET framework redistributable package on the system that runs ColdFusion. Then reinstall the ColdFusion .NET extension so that it uses the correct .NET version.

Running the .NET extension agent as an application
The ColdFusion 8 .NET extension installer configures the .NET-side extension agent to run automatically as the ColdFusion 8 .NET service. You can also run the .NET extension agent as an application.

Run the .NET extension agent as an application
1. Ensure you stopped the ColdFusion 8 .NET service, if it was running.
2. Open a command prompt window and navigate to the jnbridge directory. On a stand-alone ColdFusion server configuration, this directory is `installDir\jnbridge`. On a system with a stand-alone .NET extension installation, or a J2EE or multiserver configuration, it is in the `.NETInstallDir\jnbridge` directory, and the default installation directory is C:\ColdFusionDotNetExtension.
3. Enter the following command:

```
JNBDotNetSide
```
Chapter 51: Integrating COM and CORBA Objects in CFML Applications

You can invoke COM (Component Object Model) or DCOM (Distributed Component Object Model) and CORBA (Common Object Request Broker) objects.

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About COM and CORBA

This section provides some basic information on COM and CORBA objects supported in ColdFusion and provides resources for further inquiry.

About objects

COM and CORBA are two of the object technologies supported by ColdFusion. Other object technologies include Java and ColdFusion components. For more information on ColdFusion components see “Building and Using ColdFusion Components” on page 158.

An object is a self-contained module of data and its associated processing. An object is a building block that you can put together with other objects and integrate into ColdFusion code to create an application.

An object is represented by a handle, or name. Objects have properties that represent information. Objects also provide methods for manipulating the object and getting data from it. The exact terms and rules for using objects vary with the object technology.

You create instances of objects using the cfobject tag or the CreateObject function. You then use the object and its methods in ColdFusion tags, functions, and expressions. For more information on the ColdFusion syntax for using objects, see “Creating and using objects” on page 973.

About COM and DCOM

COM (Component Object Model) is a specification and a set of services defined by Microsoft to enable component portability, reusability, and versioning. DCOM (Distributed Component Object Model) is an implementation of COM for distributed services, which allows access to components residing on a network.

COM objects can reside locally or on any network node. COM is supported on Microsoft Windows platforms.

For more information on COM, go to the Microsoft COM website, www.microsoft.com/com.
About CORBA

CORBA (Common Object Request Broker Architecture) is a distributed computing model for object-oriented applications defined by the Object Management Group (OMG). In this model, an object is an encapsulated entity whose services are accessed only through well-defined interfaces. The location and implementation of each object is hidden from the client requesting the services. ColdFusion supports CORBA 2.3 on both Windows and UNIX.

CORBA uses an Object Request Broker (ORB) to send requests from applications on one system to objects executing on another system. The ORB allows applications to interact in a distributed environment, independent of the computer platforms on which they run and the languages in which they are implemented. For example, a ColdFusion application running on one system can communicate with an object that is implemented in C++ on another system.

CORBA follows a client-server model. The client invokes operations on objects that are managed by the server, and the server replies to requests. The ORB manages the communications between the client and the server using the Internet Inter-ORB Protocol (IIOP).

Each CORBA object has an interface that is defined in the CORBA Interface Definition Language (IDL). The CORBA IDL describes the operations that can be performed on the object, and the parameters of those operations. Clients do not have to know anything about how the interface is implemented to make requests.

To request a service from the server, the client application gets a handle to the object from the ORB. It uses the handle to call the methods specified by the IDL interface definition. The ORB passes the requests to the server, which processes the requests and returns the results to the client.

For information about CORBA, see the following OMG website, which is the main web repository for CORBA information: www.omg.com.

Creating and using objects

You use the cfobject tag or the CreateObject function to create a named instance of an object. You use other ColdFusion tags, such as cfset and cfoutput, to invoke the object’s properties and methods.

The following sections provide information about creating and using objects that applies to both COM and CORBA objects. The examples assume a sample object named “obj”, and that the object has a property called “Property”, and methods called “Method1”, “Method2”, and “Method3”.

Creating objects

You create, or instantiate (create a named instance of) an object in ColdFusion with the cfobject tag or CreateObject function. The specific attributes or parameters that you use depend on the type of object you use, and are described in detail in “Creating and using COM objects” on page 977 and “Creating CORBA objects” on page 986. The following examples use a cfobject tag to create a COM object and a CreateObject function to create a CORBA object:

```
<cfobject type="COM" action="Create" name="obj" class="sample.MyObject">
obj = CreateObject("CORBA", "d:\temp\tester.ior", "IOR", "Visibroker")
```

ColdFusion releases any object created by cfobject or CreateObject, or returned by other objects, at the end of the ColdFusion page execution.

Using properties

Use standard ColdFusion statements to access properties as follows:
1 To set a property, use a statement or `cfset` tag, such as the following:
   `<cfset obj.property = "somevalue">`

2 To get a property, use a statement or `cfset` tag, such as the following:
   `<cfset value = obj.property>`

As shown in this example, you do not use parentheses on the right side of the equation to get a property value.

**Calling methods**

Object methods usually take zero or more arguments. You send In arguments, whose values are not returned to the caller by value. You send Out and In,Out arguments, whose values are returned to the caller, by reference. Arguments sent by reference usually have their value changed by the object. Some methods have return values, while others might not.

Use the following techniques to call methods:

- If the method has no arguments, follow the method name with empty parentheses, as in the following `cfset` tag:
  `<cfset retVal = obj.Method1()>`

- If the method has one or more arguments, put the arguments in parentheses, separated by commas, as in the following example, which has one integer argument and one string argument:
  `<cfset x = 23>
  <cfset retVal = obj.Method1(x, "a string literal")>`

- If the method has reference (Out or In,Out) arguments, use double quotation marks ("”) around the name of the variable you are using for these arguments, as shown for the variable x in the following example:
  `<cfset x = 23>
  <cfset retVal = obj.Method2("x","a string literal")>
  <cfoutput> #x#</cfoutput>`

  In this example, if the object changes the value of x, it now contains a value other than 23.

**Calling nested objects**

ColdFusion supports nested (scoped) object calls. For example, if an object method returns another object, and you must invoke a property or method on that object, you can use the syntax in either of the following examples:

```
<cfset prop = myObj.X.Property>
```

or

```
<cfset objX = myObj.X>
<cfset prop = objX.Property>
```

**Getting started with COM and DCOM**

ColdFusion is an automation (late-binding) COM client. As a result, the COM object must support the IDispatch interface, and arguments for methods and properties must be standard automation types. Because ColdFusion is a typeless language, it uses the object's type information to correctly set up the arguments on call invocations. Any ambiguity in the object's data types can lead to unexpected behavior.
In ColdFusion, you should only use server-side COM objects, which do not have a graphical user interface. If your ColdFusion application invokes an object with a graphical interface in a window, the component might appear on the web server desktop, not on the user's desktop. This can take up ColdFusion server threads and prevent further web server requests from being serviced.

ColdFusion can call Inproc, Local, or Remote COM objects. The attributes specified in the \texttt{cfobject} tag determine which type of object is called.

**COM requirements**

To use COM components in your ColdFusion application, you need at least the following items:

- The COM objects (typically DLL or EXE files) that you want to use in your ColdFusion application pages. These components should allow late binding; that is, they should implement the IDispatch interface.
- Microsoft OLE/COM Object Viewer, available from Microsoft at \url{www.microsoft.com/com/resources/oleview.asp}. This tool lets you view registered COM objects.

Object Viewer lets you view an object's class information so that you can properly define the \texttt{class} attribute for the \texttt{cfobject} tag. It also displays the object's supported interfaces, so you can discover the properties and methods (for the IDispatch interface) of the object.

**Registering the object**

After you acquire an object, you must register it with Windows for ColdFusion (or any other program) to find it. Some objects have setup programs that register objects automatically, while others require manual registration.

You can register Inproc object servers (.dll or .ocx files) manually by running the regsvr32.exe utility using the following form:

```
regsvr32 \c:\\path\\servername.dll
```

You typically register Local servers (.exe files) either by starting them or by specifying a command line parameters, such as the following:

```
\c:\path\\servername.exe -register
```

**Finding the component ProgID and methods**

Your COM object supplier should provide documentation that explains each of the component's methods and the ProgID. If you do not have documentation, use either the ColdFusion \texttt{cfdump} tag or the OLE/COM Object Viewer to view the component's interface.

**Using the \texttt{cfdump} tag to view COM object interfaces**

Effective with ColdFusion, the ColdFusion \texttt{cfdump} tag displays the following information about a COM object:

- Public methods
- Put properties
- Get properties

The method and property information includes the parameter or property types and whether they are in, out, optional, or retval values. The \texttt{cfdump} tag output does not include the object's ProgID.

**Note:** The dump header indicates the ColdFusion object class, which is \texttt{coldfusion.runtime.com.ComProxy}, and the COM object CLSID.
Using the OLE/COM Object Viewer

The OLE/COM Object Viewer installation installs the executable, by default, as \mstools\bin\oleview.exe. You use the Object Viewer to retrieve a COM object’s ProgID, as well as its methods and properties.

To find an object in the Object Viewer, it must be registered, as described in “Registering the object” on page 975. The Object Viewer retrieves all COM objects and controls from the Registry, and presents the information in a simple format, sorted into groups for easy viewing.

By selecting the category and then the component, you can see the ProgID of a COM object. The Object Viewer also provides access to options for the operation of the object.

To view an object’s properties:

1. Open the Object Viewer and scroll to the object that you want to examine.

2. Select and expand the object in the left pane of the Object Viewer.

3. Right-click the object to view it, including the TypeInfo.

If you view the TypeInfo, you see the object’s methods and properties, as shown in the following figure. Some objects do not have access to the TypeInfo area, which is determined when an object is built and by the language used.
Creating and using COM objects

You must use the `cfobject` tag or the `CreateObject` function to create an instance of the COM object (component) in ColdFusion before your application pages can invoke any methods or assign any properties in the component.

For example, the following code uses the `cfobject` tag to create the Windows CDO (Collaborative Data Objects) for NTS NewMail object to send mail:

```html
<cfobject type="COM" action="Create" name="Mailer" class="CDONTS.NewMail">
```

The following line shows how to use the corresponding `CreateObject` function in CFScript:

```javascript
Mailer = CreateObject("COM", "CDONTS.NewMail");
```

The examples in later sections in this chapter use this object.

**Note:** CDO is installed by default on all Windows NT and 2000 operating systems that have installed the Microsoft SMTP server. In Windows NT Server environments, the SMTP server is part of the Option Pack 4 setup. In Windows 2000 Server and Workstation environments, it is bundled with the operating system. For more information on CDO for NTS, see [http://msdn.microsoft.com/library/default.asp?url=/library/psdk/cdo/_olemsg_overview_of_cdo.htm](http://msdn.microsoft.com/library/default.asp?url=/library/psdk/cdo/_olemsg_overview_of_cdo.htm).

The CDO for NTS NewMail component includes a number of methods and properties to perform a wide range of mail-handling tasks. (In the OLE/COM Object Viewer, methods and properties might be grouped together, so you could find it difficult to distinguish between them at first.)

The CDO for NTS NewMail object includes the following properties:

- Body [String]
- Cc [String]
- From [String]
- Importance [Long]
- Subject [String]
- To [String]

You use these properties to define elements of your mail message. The CDO for NTS NewMail object also includes a `send` method which has a number of optional arguments to send messages.

Connecting to COM objects

The `action` attribute of the `cfobject` tag provides the following two ways to connect to COM objects:

**Create method:** (`cfobject action="Create"`) Takes a COM object, typically a DLL, and instantiates it prior to invoking methods and assigning properties.

**Connect method:** (`cfobject action="Connect"`) Links to an object, typically an executable, that is already running on the server.

You can use the optional `cfobject context` attribute to specify the object context. If you do not specify a context, ColdFusion uses the setting in the Registry. The following table describes the `context` attribute values:
Setting properties and invoking methods

The following example, which uses the sample Mailer COM object, shows how to assign properties to your mail message and how to execute component methods to handle mail messages.

In the example, form variables contain the method parameters and properties, such as the name of the recipient, the desired e-mail address, and so on:

```cfml
<!--- First, create the object --->
<cfobject type="COM" action="Create"
    name="Mailer"
    class="CDONTS.NewMail">

    <!--- Second, use the form variables from the user entry form to populate a number of properties necessary to create and send the message. --->
    <cfset Mailer.From = "#Form.fromName#">
    <cfset Mailer.To = "#Form.to#">
    <cfset Mailer.Subject = "#Form.subject#">
    <cfset Mailer.Importance = 2>
    <cfset Mailer.Body = "#Form.body#">
    <cfset Mailer.Cc = "#Form.cc#">

    <!--- Last, use the Send() method to send the message. Invoking the Send() method destroys the object. --->
    <cfset Mailer.Send()>

    Note: Use the cftry and cfcatch tags to handle exceptions thrown by COM objects. For more information on exception handling, see "Handling runtime exceptions with ColdFusion tags" on page 258.

Releasing COM objects

By default, COM object resources are released when the Java garbage collector cleans them. You can use the ReleaseCOMObject function to immediately release resources if an object is no longer needed.

Use the ReleaseCOMObject function to release COM objects that are launched as an external process, such as Microsoft Excel. The garbage collector might not clean these processes in a short time, resulting in multiple external processes running, which drains system resources.

If the COM object has an end method, such as a quit method that terminates the program, call this method before you call the ReleaseCOMObject function. If you use the ReleaseCOMObject function on an object that is in use, the object is prematurely released and your application will get exceptions.

Example

The following example creates a Microsoft Excel application object, uses it, then releases the object when it is no longer needed:

```cfml
<h3>ReleaseCOMObject Example</h3>
```
<cfscript>
obj = CreateObject("Com", "excel.application.9");
//code that uses the object goes here
obj.quit();
ReleaseComObject(obj);
</cfscript>

General COM object considerations
When you use COM objects, consider the following to prevent and resolve errors:

- Ensuring correct threading
- Using input and output arguments
- Understanding common COM-related error messages

Ensuring correct threading
Improper threading can cause serious problems when using a COM object in ColdFusion. Make sure that the object is thread-safe. An object is thread-safe if it can be called from many programming threads simultaneously, without causing errors.

Visual Basic ActiveX DLLs are typically not thread-safe. If you use such a DLL in ColdFusion, you can make it thread-safe by using the OLE/COM Object Viewer to change the object’s threading model to the Apartment model.

If you are planning to store a reference to the COM object in the Application, Session, or Server scope, do not use the Apartment threading model. This threading model is intended to service only a single request. If your application requires you to store the object in any of these scopes, keep the object in the Both threading model, and lock all code that accesses the object, as described in “Locking code with cflock” on page 289.

Change the threading model of a COM Object
1. Open the OLE/COM Object Viewer.
2. Select All Objects under Object Classes in the left pane.
3. Locate your COM object. The left pane lists these by name.
4. Select your object.
5. Select the Implementation tab in the right pane.
6. Select the Inproc Server tab, below the App ID field.
7. Select the Threading Model drop down menu and select Apartment or Both, as appropriate.

Using input and output arguments
COM object method in arguments are passed by value. The COM object gets a copy of the variable value, so you can specify a ColdFusion variable without surrounding it with quotation marks.

COM object out method arguments are passed by reference. The COM object modifies the contents of the variable on the calling page, so the calling page can use the resulting value. To pass a variable by reference, surround the name of an existing ColdFusion variable with quotation marks. If the argument is a numeric type, assign the variable a valid number before you make the call. For example:

```coldfusion
<cfset inStringArg="Hello Object">
<cfset outNumericArg=0>
<cfset result=myCOMObject.calculate(inStringArg, "outNumericArg")>
```
The string “Hello Object” is passed to the object’s calculate method as an input argument. The value of outNumericArg is set by the method to a numeric value.

Understanding common COM-related error messages
The following table described some error messages you might encounter when using COM objects:

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error Diagnostic Information&lt;br&gt;Error trying to create object specified in the tag.&lt;br&gt;COR error 0x800401F3. Invalid class string.</td>
<td>The COM object is not registered or does not exist.</td>
</tr>
<tr>
<td>Error Diagnostic Information&lt;br&gt;Error trying to create object specified in the tag.&lt;br&gt;COR error 0x80040154. Class not registered.</td>
<td>The COM object is not registered or does not exist. This error usually occurs when an object existed previously, but was uninstalled.</td>
</tr>
<tr>
<td>Error Diagnostic Information&lt;br&gt;Failed attempting to find &quot;SOMEMETHOD&quot; property/method on the object COR error 0x80020006. Unknown name.</td>
<td>The COM object was instantiated correctly, but the method you specified does not exist.</td>
</tr>
</tbody>
</table>

Accessing Complex COM Objects using Java proxies
ColdFusion supports Java proxies to access COM objects. If you do not create Java proxies in advance, ColdFusion must dynamically discover the COM interface. This technique can have two disadvantages:

- Dynamic discovery takes time and can reduce server performance with frequently used complex COM objects.
- Dynamic discovery uses the IDispatcher interface to determine the COM object features, and might not handle some complex COM interfaces.

To overcome these problems, ColdFusion includes a utility, com2java.exe, that creates static Java stub proxy classes for COM objects. ColdFusion can use these Java stubs to access COM objects more efficiently than when it creates the proxies dynamically. Additionally, the com2java.exe utility can create stubs for features that the dynamic proxy generator might miss.

ColdFusion ships with pregenerated stubs for the Windows XP, Windows 2000, and Windows 97 editions of Microsoft Excel, Microsoft Word, and Microsoft Access. ColdFusion is configured to automatically use these stubs.

If you create Java stub files for a COM object, you continue to use the cfobject tag with a type attribute value of COM, or the CreateObject function with a first argument of COM, and you access the object properties and methods as you normally do for COM objects in ColdFusion.

Use the following steps to use the com2java.exe utility. This procedure uses Microsoft Outlook as an example.

To create Java stub files for COM objects:
1. Configure your system as follows:
   - Ensure that a JDK (Java Development Kit) is correctly installed, including proper configuration of the CLASSPATH and the command prompt PATH variable.
   - Add CF_root\lib\jintegra.jar to your CLASSPATH.
2. Make a new directory for the Java stub files; for example:

   ```bash
   mkdir C:\src\outlookXP
   ```
This directory can be temporary. You add files from the directory to a ColdFusion JAR file.

3 Run the CF_root\Jintegra\bin\com2java.exe program from a command line or the Windows Start Menu. A window appears.
   a If a COM class implements multiple interfaces that define methods with the same names, click the Options button and clear the Implement interfaces that may conflict option. The generated Java stub classes do not implement the additional, conflicting, interfaces. You can still access the interfaces using the getAsXXX method that is generated. See the generated comments in the Java files.
   b Click on the Select button.
   c Select your COM object’s Type Library or DLL. For Microsoft Outlook in Windows XP, it is normally Program Files\Microsoft Office\Office10\MSOUTL.OLB.
   d Enter a package name (for example, outlookXP) in the Java package field in the com2java dialog box. This package will contain all the classes for the Java stubs for the COM object.

   Note: Adobe uses a package name that starts with coldfusion.runtime.com.com2java for the packages that contain the preinstalled Java stubs for Microsoft Excel, Microsoft Word, and Microsoft Access. For example, the name for the package containing the Microsoft Word XP Java stub classes is coldfusion.runtime.com.com2java.wordXP. This package name hierarchy results in the wordXP classes having a path inside the msapps.jar file of coldfusion\runtime\com\com2java\wordXP\className.class. Although this naming convention is not necessary, consider using a similar package naming convention for clarity, if you use many COM objects.
   e Click the Generate Proxies button to display the File browser. Select the directory you created in step 2., and click the file browser OK button to generate the stub files.
   f Click Close to close the com2java.exe utility.

The files generated in your directory include the following:
   • A Java interface and proxy class for each COM interface
   • A Java class for each COM class
   • A Java interface for each ENUM (a set of constant definitions)

4 Compile your Java code. In a command prompt, do the following:
   a Make the directory that contains the Java stubs (in this example, C:\src\outlookXP) your working directory.
   b Enter the following line:

```
javac -J-mx100m -J-ms100m *.java
```

The compiler switches ensure that you have enough memory to compile all the necessary files.

   Note: If you did not put jintegra.jar on your CLASSPATH in step 1b, add the switch -classpath:/cf_root/lib/jintegra.jar, where cf_root is the directory where ColdFusion is installed, to the command.

5 Ensure that the ColdFusion server is not running. To stop the ColdFusion server, open the Services control panel, select ColdFusion application server, and click Stop.

6 Add your .class files to the ColdFusion Microsoft application Java stubs file by doing the following:
   a In the Windows Command prompt, make the parent directory of the directory that contains your class files your working directory. In this example, make c:\src your working directory by entering cd .. in the Command prompt from step 4.
   b Enter the following command:
jar -uvf cf_root\lib\msapps.jar directoryName\*.class

Where \textit{cf_root} is the directory where ColdFusion is installed and \textit{directoryName} is the name of the directory that contains the class files. For the OutlookXP example, enter the following line:

jar -uvf C:\CFusion\lib\msapps.jar outlookXP\*.class

7 Update the \textit{cf_root}/lib/neo-comobjmap.xml file by appending your object definition to the list. The object definition consists of the following lines:

\begin{verbatim}
<var name="progID">
<string>PackageName.mainClass</string>
</var>
\end{verbatim}

Use the following values in these lines:

- **ProgID**: The COM object's ProgID, as displayed in the OLE/COM object viewer.
- **PackageName**: The package name you specified in step 3c.
- **mainClass**: The main class of the COM object. The main class contains the methods you invoke. For many Microsoft applications, this class is Application. In general, the largest class file created in step 4 is the main class.

For example, to add outlookXP to neo-comobjmap.xml, add the lines in bold text above the \textit{</struct>} end tag:

\begin{verbatim}
<var name="access.application.9">
<string>coldfusion.runtime.com.com2java.access2k.Application</string>
</var>

<var name="outlook.application.10">
<string>outlookXP.Application</string>
</var>
\end{verbatim}

In this example, \textit{outlook.application.10} is the ProgID of the Outlook COM object, \textit{outlookXP} is the package name you specified in step 3c, and \textit{Application} is the COM object's main class.

8 Restart the ColdFusion server: Open the Services control panel, select ColdFusion application server, and click the Start button.

9 After you have installed the stubs, you can delete the directory you created in step 2, including all its contents.

**Using the Application Scope to improve COM performance**

The Java call to create a new COM object instance can take substantial time. As a result, creating COM objects in ColdFusion can be substantially slower than in ColdFusion 5. For example, on some systems, creating a Microsoft Word application object could take over one second using ColdFusion, while on the same system, the overhead of creating the Word object might be about 200 milliseconds.

Therefore, in ColdFusion, you can improve COM performance substantially if you can share a single COM object in the Application scope among all pages.

Use this technique only if the following are true:

- The COM object does not need to be created for every request or session. (For session-specific objects, consider using the technique described in this section with the Session scope in place of the Application scope.)
- The COM object is designed for sharing.

Because the object can be accessed from multiple pages and sessions simultaneously, you must also consider the following threading and locking issues:
• For best performance, the object should be multithreaded. Otherwise, only one request can access the object at a time.

• Lock the code that accesses and modifies common data. In general, you do not have to lock code that modifies a shared object’s data, including writable properties or file contents, if the data (as opposed to the object) is not shared by multiple requests. However, specific locking needs depend on the COM object’s semantics, interface, and implementation.

• All cflock tags in the application that use an Application scope lock share one lock. Therefore, code that accesses a frequently used COM object inside an Application scope lock can become a bottleneck and reduce throughput if many users request pages that use the object. You might be able to avoid some contention by putting code that uses the COM object in named locks; you must put the code that creates the object in an Application scope lock.

**Note:** You can also improve the performance of some COM objects by creating Java stubs, as described in “Accessing Complex COM Objects using Java proxies” on page 980. Using a Java stub does not improve performance as much as sharing the COM object, but the technique works with all COM objects. Also, you must generate Java stubs to correctly access complex COM objects that do not properly make all their features available through the COM IDispatcher interface. Therefore, to get the greatest performance increase and prevent possible problems, use both techniques.

**Example 1: Using the FileSystem object**

The following example uses the Microsoft FileSystem Scripting object in the Application scope. This code creates a user-defined function that returns a structure that consists of the drive letters and free disk space for all hard drives on the system.

```
<cfapplication name="comtest" clientmanagement="No" Sessionmanagement="yes">
<!--- Uncomment the following line if you must delete the object from the Application scope during debugging. Then restore the comments. This technique is faster than stopping and starting the ColdFusion server. --->
<!--- <cfset structdelete(Application, "fso")> --->

<!--- The getFixedDriveSpace user-defined function returns a structure with the drive letters as keys and the drive's free space as data for all fixed drives on a system. The function does not take any arguments --->

<cffunction name="getFixedDriveSpace" returnType="struct" output=True>
<!--- If the FileSystemObject does not exist in the Application scope, create it. --->
<!--- For information on the use of initialization variables and locking in this code, see “Locking application variables efficiently” in Chapter 15, “Using Persistent Data and Locking” --->
<cfset fso_is_initialized = False>
<cflock scope="application" type="readonly" timeout="120">
<cfset fso_is_initialized = StructKeyExists(Application, "fso")>
</cflock>
<cfif not fso_is_initialized >
<cflock scope="Application" type="EXCLUSIVE" timeout="120">
<cfif NOT StructKeyExists(Application, "fso")>
<cfobject type="COM" action="create" class="Scripting.FileSystemObject" name="Application.fso" server="\localhost">
</cfif>
</cflock>
</cfif>
<cflock>
<cfset drives=Application.fso.drives()>
```

```
<cfset driveSpace=StructNew()> 
<cfloop collection="#drives#" item="curDrive"> 
  <!--- A DriveType of 2 indicates a fixed disk ---> 
  <cfif curDrive.DriveType IS 2> 
  <!--- Use dynamic array notation with the drive letter for the struct key ---> 
  <cfset driveSpace["#curDrive.DriveLetter#"] = curDrive.availspace> 
  </cfif> 
</cfloop>  
<cfreturn driveSpace> 
</cffunction> 

<!---- Test the function. Get the execution time for running the function ---> 
<cfset start = getTickCount()> 
<cfset DriveInfo = getFixedDriveSpace()> 
<h3>Getting fixed drive available space</h3> 
<cfoutput>Execution Time: #int(getTickCount()-start)# milliseconds</cfoutput> 
<br><br> 
<cfdump label="Drive Free Space" var="#driveInfo#"> 

Example 2: Using the Microsoft Word application object 

The following example uses the Microsoft Word application COM object in the Application scope to convert a Word document to HTML. This example works with Word 2000 as written. To work with Word 97, change "Val(8)" to "Val(10)". 

This example uses an Application scope lock to ensure that no other page interrupts creating the object. Once the Word object exists, the example uses a named lock to prevent simultaneous access to the file that is being converted. 

<cfapplication name="comtest" clientmanagement="No" Sessionmanagement="yes"> 
<!---- Uncomment the following line if you need to delete the object from the Application scope ---> 
<!---- <cfset structdelete(Application, "MyWordObj"> --->

<!---- use the GetTickCount function to get a current time indicator, used for displaying the total processing time. ---> 
<!---- If necessary, create the Word.application object and put it in the Application scope ---> 
<cfset WordObj_is_initialized = False> 
<cflock scope="application" type="readonly" timeout=120> 
  <cfset WordObj_is_initialized = StructKeyExists(application, "MyWordObj")> 
</cflock> 
<!cfif not WordObj_is_initialized> 
  <!cflock scope="Application" type="exclusive" timeout=120> 
    <!cfif not StructKeyExists(application, "MyWordObj")> 
      <!cftry> 
        <cfobject type="com" action="connect" class="Word.application" name="Application.MyWordobj" context="local"> 
      <!cfcatch> 
        <!cfif not WordObj_is_initialized> 
          <!cflock scope="Application" type="exclusive" timeout=120> 
            <!cfif not StructKeyExists(application, "MyWordObj")> 
              <!cftry> 
                <cfobject type="com" action="Create" class="Word.application" name="Application.MyWordobj" context="local"> 
              <!cfcatch> 
                </cfobject> 
              </cfif> 
            </cfif> 
          </cflock> 
        </cfif> 
      </cfcatch> 
    </cfif> 
  </cflock> 
</cfif> 
<!---- First try to connect to an existing Word object ---> 
<!cftry> 
  <cfobject type="com" action="connect" class="Word.application" name="Application.MyWordobj" context="local"> 
<!cfcatch> 
<!---- There is no existing object, create one ---> 
<!cfobject type="com" action="Create" class="Word.application" name="Application.MyWordobj" context="local"> 
</cfcatch>
Getting started with CORBA

The ColdFusion cfobject tag and CreateObject function support CORBA through the Dynamic Invocation Interface (DII). As with COM, the object's type information must be available to ColdFusion. Therefore, an IIOP-compliant Interface Repository (IR) must be running on the network, and the object's Interface Definition Language (IDL) specification must be registered in the IR. If your application uses a naming service to get references to CORBA objects, a naming service must also be running on the network.

ColdFusion loads ORB runtime libraries at startup using a connector, which does not tie ColdFusion customers to a specific ORB vendor. ColdFusion currently includes connectors for the Borland Visibroker 4.5 ORB. The source necessary to write connectors for other ORBs is available under NDA to select third-party candidates and ORB vendors.

You must take several steps to configure and enable CORBA access in ColdFusion. For detailed instructions, see Installing and Using ColdFusion.

Note: When you enable CORBA access in ColdFusion, one step requires you to start the Interface Repository using an IDL file. This file must contain the IDL for all the CORBA objects that you invoke in ColdFusion applications on the server.

Creating and using CORBA objects

The following sections describe how to create, or instantiate, a CORBA object and how to use it in your ColdFusion application.
Creating CORBA objects

In ColdFusion, the `cfobject` tag and `CreateObject` function create a stub, or proxy object, for the CORBA object on the remote server. You use this stub object to invoke the remote object.

The following table describes the attributes you use in the `cfobject` tag to create a CORBA object:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>Must be CORBA. COM is the default.</td>
</tr>
<tr>
<td>context</td>
<td>Specifies the CORBA binding method, that is, how the object is obtained, as follows:</td>
</tr>
<tr>
<td></td>
<td>• IOR Uses a file containing the object’s unique Interoperable Object Reference.</td>
</tr>
<tr>
<td></td>
<td>• NameService Uses a naming service.</td>
</tr>
<tr>
<td>class</td>
<td>Specifies the information required for the binding method to access the object.</td>
</tr>
<tr>
<td></td>
<td>- If you set the context attribute to IOR, The class attribute must be to the full pathname of a file containing the string version of the IOR. ColdFusion must be able to read this IOR file at all times, so make it local to the server or put it on the network in an accessible location.</td>
</tr>
<tr>
<td></td>
<td>- If you set the context attribute to NameService, The class attribute must be a name delimited by forward slashes (/), such as MyCompany/Department/Dev. You can use period-delimited “kind” identifiers as part of the class attribute; for example, adobe.current/Eng.current/CF.</td>
</tr>
<tr>
<td>name</td>
<td>Specifies the name (handle) that your application uses to call the object’s interface.</td>
</tr>
<tr>
<td>locale</td>
<td>(Optional) Identifies the connector configuration. You can omit this option if ColdFusion Administrator has only one connector configuration, or if it has multiple connector configurations and you want to use the one that is currently selected in the Administrator. If you specify this attribute, it must be an ORB name you specified in the CORBA Connector ORB Name field when you configured a CORBA connector in ColdFusion Administrator; for example, Visibroker.</td>
</tr>
</tbody>
</table>

For example, use the following CFML to invoke a CORBA object specified by the tester.ior file if you configured your ORB name as Visibroker:

```cfml
<cfobject action = "create" type = "CORBA" context = "IOR" class = "d:\temp\tester.ior" name = "handle" locale = "Visibroker">
```

When you use the `CreateObject` function to invoke this CORBA object, specify the name as the function return variable, and specify the type, class, context, and locale as arguments. For example, the following line creates the same object as the preceding `cfobject` tag:

```cfml
handle = CreateObject("CORBA", "d:\temp\tester.ior", "IOR", "Visibroker")
```

Using a naming service

Currently, ColdFusion can only resolve objects registered in a CORBA 2.3-compliant naming service.

If you use a naming service, make sure that its naming context is identical to the naming context specified in the property file of the Connector configuration in use, as specified in the ColdFusion Administrator CORBA Connectors page. The property file must contain the line `"Svcnameroot=name"` where `name` is the naming context to be used. The server implementing the object must bind to this context, and register the appropriate name.

Using CORBA objects in ColdFusion

After you create the object, you can invoke attributes and operations on the object using the syntax described in “Creating and using objects” on page 973. The following sections describe the rules for using CORBA objects in ColdFusion pages. They include information on using methods in ColdFusion, which IDL types you can access from ColdFusion, and the ColdFusion data types that correspond to the supported IDL data types.
Using CORBA interface methods in ColdFusion

When you use the `cfobject` tag or the `CreateObject` function to create a CORBA object, ColdFusion creates a handle to a CORBA interface, which is identified by the `cfobject` name attribute or the `CreateObject` function return variable. For example, the following CFML creates a handle named `myHandle`:

```cfml
<cfobject action = "create" type = "CORBA" context = "IOR"
  class = "d:\temp\tester.ior" name = "myHandle" locale="visibroker">
  <cfset myHandle = CreateObject("CORBA", "d:\temp\tester.ior", "IOR", "visibroker")
</cfobject>
```

You use the handle name to invoke all of the interface methods, as in the following CFML:

```cfml
<cfset ret=myHandle.method(foo)>
```

The following sections describe how to call CORBA methods correctly in ColdFusion.

Method name case considerations

Method names in IDL are case-sensitive. However, ColdFusion is case-insensitive. Therefore, do not use methods that differ only in case in IDL.

For example, the following IDL method declarations correspond to two different methods:

```idl
testCall(in string a); // method #1
TestCall(in string a); // method #2
```

However, ColdFusion cannot differentiate between the two methods. If you call either method, you cannot be sure which of the two will be invoked.

Passing parameters by value (in parameters)

CORBA in parameters are always passed by value. When calling a CORBA method with a variable in ColdFusion, specify the variable name without quotation marks, as shown in the following example:

```idl
void method(in string a);
```

```cfml
<cfset foo="my string">
<cfset ret=myHandle.method(foo)>
```

Passing variables by reference (out and inout parameters)

CORBA out and inout parameters are always passed by reference. As a result, if the CORBA object modifies the value of the variable that you pass when you invoke the method, your ColdFusion page gets the modified value.

To pass a parameter by reference in ColdFusion, specify the variable name in double-quotation marks in the CORBA method. The following example shows an IDL line that defines a method with a string variable, `b`, that is passed in and out of the method by reference. It also shows CFML that calls this method.

```idl
void method(in string a, inout string b);
```

```cfml
<cfset foo = "My Initial String">
<cfset ret=myHandle.method(bar, "foo")>
<cfoutput>#foo#</cfoutput>
```

In this case, the ColdFusion variable `foo` corresponds to the inout parameter `b`. When the CFML executes, the following happens:

1. ColdFusion calls the method, passing it the variable by reference.
The CORBA method replaces the value passed in, "My Initial String", with some other value. Because the variable was passed by reference, this modifies the value of the ColdFusion variable.

The `cfoutput` tag prints the new value of the foo variable.

**Using methods with return values**

Use CORBA methods that return values as you would any ColdFusion function; for example:

```
<cfset foo=3.1415>
<cfset ret=handle.method("foo")>
<cfoutput>#ret#</cfoutput>
```

**Using IDL types with ColdFusion variables**

The following sections describe how ColdFusion supports CORBA data types. They include a table of supported IDL types and information about how ColdFusion converts between CORBA types and ColdFusion data.

**IDL support**

The following table shows which CORBA IDL types ColdFusion supports, and whether they can be used as parameters or return variables. (NA means not applicable.)

<table>
<thead>
<tr>
<th>CORBA IDL type</th>
<th>General support</th>
<th>As parameters</th>
<th>As return value</th>
</tr>
</thead>
<tbody>
<tr>
<td>constants</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>attributes</td>
<td>Yes (for properties)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>enum</td>
<td>Yes (as an integer)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>union</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>sequence</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>array</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>interface</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>typedef</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>struct</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>module</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>exception</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>any</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>boolean</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>char</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>wchar</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>string</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>wstring</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>octet</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>short</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Data type conversion

The following table lists IDL data types and the corresponding ColdFusion data types:

<table>
<thead>
<tr>
<th>IDL type</th>
<th>ColdFusion type</th>
</tr>
</thead>
<tbody>
<tr>
<td>boolean</td>
<td>Boolean</td>
</tr>
<tr>
<td>char</td>
<td>One-character string</td>
</tr>
<tr>
<td>wchar</td>
<td>One-character string</td>
</tr>
<tr>
<td>string</td>
<td>String</td>
</tr>
<tr>
<td>wstring</td>
<td>String</td>
</tr>
<tr>
<td>octet</td>
<td>One-character string</td>
</tr>
<tr>
<td>short</td>
<td>Integer</td>
</tr>
<tr>
<td>long</td>
<td>Integer</td>
</tr>
<tr>
<td>float</td>
<td>Real number</td>
</tr>
<tr>
<td>double</td>
<td>Real number</td>
</tr>
<tr>
<td>unsigned short</td>
<td>Integer</td>
</tr>
<tr>
<td>unsigned long</td>
<td>Integer</td>
</tr>
<tr>
<td>void</td>
<td>Not applicable (returned as an empty string)</td>
</tr>
<tr>
<td>struct</td>
<td>Structure</td>
</tr>
<tr>
<td>enum</td>
<td>Integer, where 0 corresponds to the first enumerator in the enum type</td>
</tr>
<tr>
<td>array</td>
<td>Array (must match the array size specified in the IDL)</td>
</tr>
<tr>
<td>sequence</td>
<td>Array</td>
</tr>
<tr>
<td>interface</td>
<td>An object reference</td>
</tr>
<tr>
<td>module</td>
<td>Not supported (cannot dereference by module name)</td>
</tr>
<tr>
<td>exception</td>
<td>ColdFusion throws an exception of type coldfusion.runtime.corba.CorbaUserException</td>
</tr>
<tr>
<td>attribute</td>
<td>Object reference using dot notation</td>
</tr>
</tbody>
</table>
**Boolean data considerations**

ColdFusion treats any of the following as Boolean values:

<table>
<thead>
<tr>
<th>True</th>
<th>&quot;yes&quot;, &quot;true&quot;, or 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>False</td>
<td>&quot;no&quot;, &quot;false&quot;, or 0</td>
</tr>
</tbody>
</table>

You can use any of these values with CORBA methods that take Boolean parameters, as the following code shows:

**IDL**

```idl
module Tester
{
    interface TManager
    {
        void testBoolean(in boolean a);
        void testOutBoolean(out boolean a);
        void testInoutBoolean(inout boolean a);
        boolean returnBoolean();
    }
}
```

**CFML**

```cfml
<CFSET handle = CreateObject("CORBA", "d:\temp\tester.ior", "IOR", "") >
<cfset ret = handle.testboolean("yes")>
<cfset mybool = True>
<cfset ret = handle.testoutboolean("mybool")>
<cfoutput>#mybool#</cfoutput>
<cfset mybool = 0>
<cfset ret = handle.testinoutboolean("mybool")>
<cfoutput>#mybool#</cfoutput>
<cfset ret = handle.returnboolean()> 
<cfoutput>#ret#</cfoutput>
```

**Struct data type considerations**

For IDL struct types, use ColdFusion structures. You can prevent errors by using the same case for structure key names in ColdFusion as you do for the corresponding IDL struct field names.

**Enum type considerations**

ColdFusion treats the enum IDL type as an integer with the index starting at 0. As a result, the first enumerator corresponds to 0, the second to 1, and so on. In the following example, the IDL enumerator corresponds to 0, b to 1 and c to 2:

**IDL**

```idl
module Tester
{
    enum EnumType {a, b, c};
    interface TManager
    {
        void testEnum(in EnumType a);
        void testOutEnum(out EnumType a);
        void testInoutEnum(inout EnumType a);
        EnumType returnEnum();
    }
}
```

**CFML**

```cfml
<CFSET handle = CreateObject("CORBA", "d:\temp\tester.ior", "IOR", "") >
<cfset ret = handle.testEnum(1)>
```

In this example, the CORBA object gets called with the second (not first) entry in the enumerator.
Double-byte character considerations
If you are using an ORB that supports CORBA later than version 2.0, you do not have to do anything to support double-byte characters. Strings and characters in ColdFusion will appropriately convert to wstring and wchar when they are used. However, the CORBA 2.0 IDL specification does not support the wchar and wstring types, and uses the 8-bit Latin-1 character set to represent string data. In this case, you cannot pass parameters containing those characters, however, you can call parameters with char and string types using ColdFusion string data.

Handling exceptions
Use the cftry and cfcatch tags to catch CORBA object method exceptions thrown by the remote server, as follows:

1. Specify type="coldfusion.runtime.corba.CorbaUserException" in the cfcatch tag to catch CORBA exceptions.
2. Use the cfcatch.getContents method to get the contents of the exception object.

The cfcatch.getContents method returns a ColdFusion structure containing the data specified by the IDL for the exception.

The following code example shows the IDL for a CORBA object that raises an exception defined by the Primitive-Exception type definition, and the CFML that catches the exception and displays the contents of the object.

<table>
<thead>
<tr>
<th>IDL</th>
<th>CFML</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface myInterface</td>
<td>&lt;cftry&gt;</td>
</tr>
<tr>
<td>{</td>
<td>&lt;cfset ret0 = handle.testPrimitiveException()&gt;</td>
</tr>
<tr>
<td>exception PrimitiveException</td>
<td>&lt;cfcatch type=coldfusion.runtime.corba.CorbaUserException&gt;</td>
</tr>
<tr>
<td>{</td>
<td>&lt;cfset exceptStruct= cfcatch.getContents()&gt;</td>
</tr>
<tr>
<td>long l;</td>
<td>&lt;cfdump var=&quot;#exceptStruct&quot;&gt;</td>
</tr>
<tr>
<td>string s;</td>
<td>&lt;/cfcatch&gt;</td>
</tr>
<tr>
<td>float f;</td>
<td>&lt;/cftry&gt;</td>
</tr>
<tr>
<td>};</td>
<td></td>
</tr>
<tr>
<td>void testPrimitiveException() raises (PrimitiveException);</td>
<td></td>
</tr>
</tbody>
</table>

CORBA example
The following code shows an example of using a LoanAnalyzer CORBA object. This simplified object determines whether an applicant is approved for a loan based on the information that is supplied.

The LoanAnalyzer CORBA interface has one method, which takes the following two in arguments:

- An Account struct that identifies the applicant's account. It includes a Person struct that represents the account holder, and the applicant's age and income.
- A CreditCards sequence, which corresponds to the set of credit cards the user currently has. The credit card type is represented by a member of the CardType enumerator. (This example assumes the applicant has no more than one of any type of card.)

The object returns a Boolean value indicating whether the application is accepted or rejected.

The CFML does the following:
1 Initializes the values of the ColdFusion variables that are used in the object method. In a more complete example, the information would come from a form, query, or both.

The code for the Person and Account structs is straightforward. The cards variable, which represents the applicant's credit cards, is more complex. The interface IDL uses a sequence of enumerators to represent the cards. ColdFusion represents an IDL sequence as an array, and an enumerator as 0-indexed number indicating the position of the selected item among the items in the enumerator type definition.

In this case, the applicant has a Master Card, a Visa card, and a Diners card. Because Master Card (MC) is the first entry in the enumerator type definition, it is represented in ColdFusion by the number 0. Visa is the third entry, so it is represented by 2. Diners is the fifth entry, so it is represented by 4. These numbers must be put in an array to represent the sequence, resulting in a three-element, one-dimensional array containing 0, 2, and 4.

2 Instantiates the CORBA object.

3 Calls the approve method of the CORBA object and gets the result in the return variable, ret.

4 Displays the value of the ret variable, Yes or No.
IDL

struct Person
{
    long pid;
    string name;
    string middle;
    string last_name;
}

struct Account
{
    Person person;
    short age;
    double income;
}

double loanAmount
enum cardType {AMEX, VISA, MC, DISCOVER, DINERS};
typedef sequence<cardType> CreditCards;
interface LoanAnalyzer
{
    boolean approve( in Account, in CreditCards);
}

CFML

<!--- Declare a "person" struct ---->
<cfset p = StructNew()>
<cfif IsStruct(p)>
    <cfset p.pid = 1003232>
    <cfset p.name = "Eduardo">
    <cfset p.middle = "R">
    <cfset p.last_name = "Doe">
</cfif>

<!--- Declare an "Account" struct --->
<cfset a = StructNew()>
<cfif IsStruct(a)>
    <cfset a.person = p>
    <cfset a.age = 34>
    <cfset a.income = 150120.50>
</cfif>

<!--- Declare a "CreditCards" sequence --->
<cfset cards = ArrayNew(1)>
    <cfset cards[1] = 0>  <!--- corresponds to Amex --->
    <cfset cards[2] = 2>  <!--- corresponds to MC --->
    <cfset cards[3] = 4>  <!--- corresponds to Diners --->

<!--- Creating a CORBA handle using the Naming Service---->
<cfset handle = CreateObject("CORBA", "FirstBostonBank/MA/Loans", "NameService")>

<cfset ret=handle.approve(a, cards)>
<cfoutput>Account approval: #ret#</cfoutput>
Part 8: Using External Resources

This part contains the following topics:

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- Interacting with Microsoft Exchange Servers ......................................... 1011
- Interacting with Remote Servers .......................................................... 1036
- Managing Files on the Server ............................................................... 1047
- Using Event Gateways .......................................................................... 1060
- Using the Instant Messaging Event Gateways ........................................ 1083
- Using the SMS Event Gateway ............................................................... 1099
- Using the FMS event gateway .............................................................. 1115
- Using the Data Services Messaging Event Gateway ............................... 1119
- Using the Data Management Event Gateway ........................................ 1124
- Creating Custom Event Gateways ......................................................... 1128
- Using the ColdFusion Extensions for Eclipse ........................................ 1142
Chapter 52: Sending and Receiving E-Mail

You can add interactive e-mail features to your ColdFusion applications by using the `cfmail` and `cfpop` tags. This complete two-way interface to mail servers makes the ColdFusion e-mail capability a vital link to your users.

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Using ColdFusion with mail servers ................................................................. 996
Sending e-mail messages .............................................................................. 997
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Using the cfmailparam tag .......................................................................... 1002
Receiving e-mail messages ........................................................................... 1004
Handling POP mail ...................................................................................... 1005

Using ColdFusion with mail servers

Adding e-mail to your ColdFusion applications lets you respond automatically to user requests. You can use e-mail in your ColdFusion applications in many different ways, including the following:

• Trigger e-mail messages based on users’ requests or orders.
• Allow users to request and receive additional information or documents through e-mail.
• Confirm customer information based on order entries or updates.
• Send invoices or reminders, using information pulled from database queries.

ColdFusion offers several ways to integrate e-mail into your applications. To send e-mail, you generally use the Simple Mail Transfer Protocol (SMTP). To receive e-mail, you use the Post Office Protocol (POP) to retrieve e-mail from the mail server. To use e-mail messaging in your ColdFusion applications, you must have access to an SMTP server and/or a valid POP account.

In your ColdFusion application pages, you use the `cfmail` and `cfpop` tags to send and receive e-mail, respectively. The following sections describe how to use the ColdFusion e-mail features and show examples of these tags.

How ColdFusion sends mail

The ColdFusion implementation of SMTP mail uses a spooled architecture. If you select to spool mail on the Mail page in the ColdFusion Administrator, when an application page processes a `cfmail` tag, the messages that are generated are not sent immediately. Instead, they are spooled to disk and processed in the background. This architecture has two advantages:

• End users of your application are not required to wait for SMTP processing to complete before a page returns to them. This design is especially useful when a user action causes more than a handful of messages to be sent.
• Messages sent using `cfmail` are delivered reliably, even in the presence of unanticipated events like power outages or server crashes.
You can set how frequently ColdFusion checks for spooled mail messages on the Mail page in the ColdFusion Administrator. If ColdFusion is extremely busy or has a large existing queue of messages, however, delivery can occur after the spool interval.

Some ColdFusion editions have advanced spooling options that let you fine tune how ColdFusion sends mail. For more information, see Configuring and Administering ColdFusion.

**Error logging and undelivered messages**

ColdFusion logs all errors that occur during SMTP message processing to the file mail.log in the ColdFusion log directory. The log entries contain the date and time of the error as well as diagnostic information about why the error occurred.

If a message is not delivered because of an error, ColdFusion writes it to this directory:

- In Windows: \CFusion\Mail\Undelivr
- On UNIX: /opt/coldfusion/mail/undelivr

The error log entry that corresponds to the undelivered message contains the name of the file written to the Undelivr (or undelivr) directory.

**Note:** To have ColdFusion try to resend a message that it could not deliver, move the message file from the Undelivr directory to the Spool directory.

For more information about the mail logging settings in the ColdFusion Administrator, see Configuring and Administering ColdFusion.

**Sending e-mail messages**

Before you configure ColdFusion to send e-mail messages, you must have access to an SMTP e-mail server. Also, before you run application pages that refer to the e-mail server, you can configure the ColdFusion Administrator to use the SMTP server. If you need to override the ColdFusion Administrator SMTP server setting for any messages, you can specify a new mail server in the `server` attribute of the `cfmail` tag.

**Configure ColdFusion for e-mail**

1. In the ColdFusion Administrator, select Server Settings > Mail.
2. In the Mail Server box, enter the name or IP address of your SMTP mail server.
3. (Optional) Change the Server Port and Connection Timeout default settings.
4. Select the Verify Mail Server Connection check box to make sure ColdFusion can access your mail server.
5. If your mail server does not use port 25, the default, SMTP port, change the Server Port default settings.
6. Depending on your ColdFusion edition, the Mail page in the Administrator has additional options that you can use to configure and optimize ColdFusion mail behavior. Select these as appropriate.
7. Click Submit Changes.

ColdFusion saves the settings. The page displays a message indicating success or failure for connecting to the server.
ColdFusion Enterprise edition includes additional mail spooling and delivery features. For more information on these features, and for information on the Administrator's mail settings, see Configuring and Administering ColdFusion.

**Sending SMTP e-mail with the cfmail tag**

The cfmail tag provides support for sending SMTP e-mail from within ColdFusion applications. The cfmail tag is similar to the cfoutput tag, except that cfmail outputs the generated text as an SMTP mail message rather than to a page. The cfmail tag supports all the attributes and commands that you use with cfoutput, including query. The following table describes basic cfmail tag attributes that you might use to send a simple email message. For a complete list of attributes, see the cfmail description in the CFML Reference.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject</td>
<td>The subject of the message.</td>
</tr>
<tr>
<td>from</td>
<td>The e-mail address of the sender.</td>
</tr>
<tr>
<td>to</td>
<td>The e-mail address of the recipient. Use a comma-delimited list to specify multiple recipients.</td>
</tr>
<tr>
<td>cc</td>
<td>(Optional) The e-mail address of a carbon copy recipient. The recipient's address is visible to other recipients. Use a comma-delimited list to specify multiple cc recipients.</td>
</tr>
<tr>
<td>bcc</td>
<td>(Optional) The e-mail address of a blind carbon copy recipient. The recipient's address is not visible to other recipients. Use a comma-delimited list to specify multiple bcc recipients.</td>
</tr>
</tbody>
</table>

**Send a simple e-mail message**

1. Create a ColdFusion page with the following content:

   ```
   <html>
   <head>
     <title>Sending a simple e-mail</title>
   </head>
   <body>
     <h1>Sample e-mail</h1>
     <cfmail
       from="Sender@Company.com"
       to="#URL.email#"
       subject="Sample e-mail from ColdFusion">
       This is a sample e-mail message to show basic e-mail capability.
       
     </cfmail>
     The e-mail was sent.
     
   </body>
   </html>
   ```

2. Save the file as send_mail.cfm in the myapps directory under your web_root directory.

3. Open your browser and enter the following URL:

   http://localhost:8500/myapps/send_mail.cfm?email=myname@mymycompany.com

   (Replace myname@mymycompany.com with your e-mail address.)

   The page sends the e-mail message to you, through your SMTP server.

**Note:** If you do not receive an e-mail message, check whether you have configured ColdFusion to work with your SMTP server; for more information, see "Sending e-mail messages" on page 997.
The cfmail tag has many options that let you customize your mail or control how it is sent. For a description of all attributes, including options to wrap mail text at a specified column, specify the mail character encoding, and specify the mail server, user name, and password, see the cfmail description in the CFML Reference.

**Sending HTML format e-mail**

If you know all the mail recipients use mail applications that are capable of reading and interpreting HTML code in a mail message, you can use the cfmail tag to send an HTML message. The cfmail tag type="HTML" attribute informs the receiving e-mail client that the message contains embedded HTML tags that must be processed. For an example that sends HTML mail, see “Including images in a message” on page 1003.

**Sending multipart mail messages**

The cfmailpart tag lets you create multipart mail messages, with each part having a different MIME type or character set. For example, if you do not know that all recipients can interpret HTML mail messages, you can send your message as a multipart mail with a text part and an HTML part. To do so use two cfmailpart tags, one with the HTML version of the message and one with the plain text message, as shown in the following example. To test this example, replace the To attribute value with a valid email address, save and run the page, and check the incoming email at the address you entered.

```cfc
<cfmail from = "peter@domain.com" To = "paul@domain.com"
Subject = "Which version do you see?">
<cfmailpart
    type="text"
    wraptext="74">
    You are reading this message as plain text, because your mail reader does not handle HTML text.
</cfmailpart>
<cfmailpart
    type="html">
    <h3>HTML Mail Message</h3>
    <p>You are reading this message as <strong>HTML</strong>.</p>
    <p>Your mail reader handles HTML text.</p>
</cfmailpart>
</cfmail>
```

**Note:** In the HTML version of the message, you must escape any number signs, such as those used to specify colors, by using two # characters; for example, bgcolor="##C5D9E5".

**Sample uses of the cfmail tag**

An application page containing the cfmail tag dynamically generates e-mail messages based on the tag's settings. The following sections show some of the tasks that you can accomplish with cfmail:

- Sending a mail message in which the data the user enters in an HTML form determine the recipient and contents
- Using a query to send a mail message to a database-driven list of recipients
- Using a query to send a customized mail message, such as a billing statement, to a list of recipients that is dynamically populated from a database
Sending form-based e-mail
In the following example, the contents of a customer inquiry form submittal are forwarded to the marketing department. You could also use the same application page to insert the customer inquiry into the database. You include the following code on your form so that it executes when users enter their information and submit the form:

```coldfusion
<cfmail
    from="#Form.EMailAddress#"
    to="marketing@MyCompany.com,sales@MyCompany.com"
    subject="Customer Inquiry">
    A customer inquiry was posted to our website:
    Name: #Form.FirstName# #Form.LastName#
    Subject: #Form.Subject#
    #Form.InquiryText#
</cfmail>
```

Sending query-based e-mail
In the following example, a query (ProductRequests) retrieves a list of the customers who inquired about a product during the previous seven days. ColdFusion sends the list, with an appropriate header and footer, to the marketing department:

```coldfusion
<cfmail
    query="ProductRequests"
    from="webmaster@MyCompany.com"
    to="marketing@MyCompany.com"
    subject="Widget status report">
    Here is a list of people who have inquired about MyCompany Widgets during the previous seven days:
    <cfoutput>
    #ProductRequests.FirstName# #ProductRequests.LastName# (#ProductRequests.Company#) - #ProductRequests.EMailAddress##013;
    </cfoutput>
    Regards,
The WebMaster
webmaster@MyCompany.com
</cfmail>
```

Reviewing the code
The following table describes the code:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<cfoutput>
  #ProductRequests.FirstName# #ProductRequests.LastName# (#ProductRequests.Company#) - #ProductRequests.EMailAddress##013;
</cfoutput>`                                                     | Presents a dynamic list embedded within a normal message, repeating for each row in the ProductRequests query. Because the cfmail tag specifies a query, the cfoutput tag does not use a query attribute. The `##013;` forces a carriage return between output records. |
Sending e-mail to multiple recipients

In addition to simply using a comma-delimited list in the to attribute of the cfmail tag, you can send e-mail to multiple recipients by using the query attribute of the cfmail tag. The following examples show how you can send the same message to multiple recipients and how you can customize each message for the recipient.

Sending a simple message to multiple recipients

In the following example, a query (BetaTesters) retrieves a list of people who are beta testing ColdFusion. This query then notifies each beta tester that a new release is available. The contents of the cfmail tag body are not dynamic. What is dynamic is the list of e-mail addresses to which the message is sent. Using the variable #TesterEMail#, which refers to the TesterEmail column in the Betas table, in the to attribute, enables the dynamic list:

```
<cfquery name="BetaTesters" datasource="myDSN">
  SELECT * FROM BETAS
</cfquery>

<cfmail query="BetaTesters" 
  from="beta@MyCompany.com"
  to="#BetaTesters.TesterEMail#"
  subject="Widget Beta Four Available">
To all Widget beta testers:

Widget Beta Four is now available for downloading from the MyCompany site. The URL for the download is:

http://beta.mycompany.com

Regards,
Widget Technical Support
beta@MyCompany.com
</cfmail>
```

Customizing e-mail for multiple recipients

In the following example, a query (GetCustomers) retrieves the contact information for a list of customers. The query then sends an e-mail to each customer to verify that the contact information is still valid:

```
<cfquery name="GetCustomers" datasource="myDSN">
  SELECT * FROM Customers
</cfquery>

<cfmail query="GetCustomers" 
  from="service@MyCompany.com"
  to="#GetCustomers.EMail#"
  subject="Contact Info Verification">
Dear #GetCustomers.FirstName# -

We'd like to verify that our customer database has the most up-to-date contact information for your firm. Our current information is as follows:

Company Name: #GetCustomers.Company#
Contact: #GetCustomers.FirstName# #GetCustomers.LastName#
Address:
```

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfquery name=&quot;GetCustomers&quot; atasource=&quot;myDSN&quot;&gt; SELECT * FROM Customers &lt;/cfquery&gt;</code></td>
<td>Retrieves all data from the Customers table into a query named GetCustomers.</td>
</tr>
<tr>
<td><code>&lt;cfmail from=&quot;service@MyCompany.com&quot; to=&quot;#GetCustomers.Email&quot; subject=&quot;Contact Info Verification&quot;&gt;</code></td>
<td>Uses the <code>to</code> attribute of <code>cfmail</code>, the <code>#GetCustomers.Email</code> query column causes one message to be sent to the address listed in each row of the query. Therefore, the mail body does not use a <code>cfoutput</code> tag.</td>
</tr>
<tr>
<td>Dear #GetCustomers.FirstName#, ... Company Name: #GetCustomers.Company# Contact: #GetCustomers.FirstName# #GetCustomers.LastName# Address: #GetCustomers.Address1# #GetCustomers.Address2# #GetCustomers.City#, #GetCustomers.State# #GetCustomers.Zip# Phone: #GetCustomers.Phone# Fax: #GetCustomers.Fax# Home Page: #GetCustomers.HomePageURL#</td>
<td>Uses other query columns (#GetCustomers.FirstName#, #GetCustomers.LastName#, and so on) within the <code>cfmail</code> section to customize the contents of the message for each recipient.</td>
</tr>
</tbody>
</table>

Using the `cfmailparam` tag

You use the `cfmailparam` tag to include files in your message or add a custom header to an e-mail message. You can send files as attachments or display them inline in the message. You nest the `cfmailparam` tag within the `cfmail` tag.

Attaching files to a message

You can use one `cfmailparam` tag for each attachment, as the following example shows:

```cfttml
<cfmail from="daniel@MyCompany.com">
```
Jake,

Here are the files you requested.

Regards,
Dan

<cfmailparam file="c:\widget_launch\photo_01.jpg">
<cfmailparam file="c:\widget_launch\press_release.doc">
</cfmail>

You must use a fully qualified system path for the file attribute of cfmailparam. The file must be located on a drive on the ColdFusion server machine (or a location on the local network), not the browser machine.

Including images in a message
You can use the cfmailparam to include images from other files in an HTML message, as follows:

1. Put a cfmailparam tag for each image following the cfmail start tag.
2. In each cfmailparam tag, do the following
   • Set the file attribute to the location of the image.
   • Specify disposition="inline"
   • Set the contentID attribute to a unique identifier; for example, myImage1.
3. In the location in your HTML where you want the message included, use an img tag such as the following:

   <img src="cid:myImage1">

The following example shows a simple mail message with an inline image. In this case, the image is located between paragraphs, but you could include it directly inline with the text. To test this example, replace the cfmail to parameter with a valid email address and change the file parameter to the path to a valid image.

<cfmail type="HTML"
to = "Peter@myCo.com"
from = "Paul@AnotherCo.com"
subject = "Sample inline image">
<cfmailparam file="C:\Inetpub\wwwroot\web.gif"
disposition="inline"
contentID="image1">
<p>There should be an image here</p>
<img src="cid:image1">
<p>This text follows the picture</p>
</cfmail>

Adding a custom header to a message
When the recipient of an e-mail message replies to the message, the reply is sent, by default, to the address specified in the From field of the original message. You can use the cfmailparam tag to provide a Reply-To e-mail address that tells the mail client to override the value in the From field. Using cfmailparam, the reply to the following example is addressed to widget_master@YourCompany.com:

<cfmail from="jacob@YourCompany.com"
to="daniel@MyCompany.com"
subject="Requested Files">
<cfmailparam name="Reply-To" value="widget_master@YourCompany.com">

Dan,
Thanks very much for the sending the widget press release and graphic.
I'm now the company's Widget Master and am accepting e-mail at
widget_master@YourCompany.com.

See you at Widget World 2002!

Jake
</cfmail>

Note: You can combine the two uses of cfmailparam within the same ColdFusion page. Write a separate cfmailparam
tag for each header and for each attached file.

Receiving e-mail messages

You create ColdFusion pages to access a Post Office Protocol (POP) server to retrieve e-mail message information.
ColdFusion can then display the messages (or just header information), write information to a database, or perform
other actions.

The cfpop tag lets you add Internet mail client features and e-mail consolidation to applications. Although a conven-
tional mail client provides an adequate interface for personal mail, there are many cases in which an alternative
interface to some mailboxes is advantageous. You use cfpop to develop targeted mail clients to suit the specific needs
of a wide range of applications. The cfpop tag does not work with the other major e-mail protocol, Internet Mail
Access Protocol (IMAP).

Here are three instances in which implementing POP mail makes sense:

- If your site has generic mailboxes that are read by more than one person (sales@yourcompany.com), it can be
  more efficient to construct a ColdFusion mail front end to supplement individual user mail clients.

- In many applications, you can automate mail processing when the mail is formatted to serve a particular
  purpose; for example, when subscribing to a list server.

- If you want to save e-mail messages to a database.

Using cfpop with your POP server is like running a query on your mailbox contents. You set its action attribute to
retrieve either headers (using the GetHeaderOnly value) or entire messages (using the GetAll value) and assign it
a name value. You use the name to refer to the record set that cfpop returns, for example, when using the cfoutput
tag. To access a POP server, you also must define the server, username, and password attributes.

Note: If the cfpop tag encounters an error, such as an improperly formatted email message, when retrieving messages,
it tries to ignore the error; it returns empty fields in the result structure and retrieves any available messages.

For more information on the cfpop tag’s syntax and variables, see the CFML Reference.

Using the cfpop tag

Use the following steps to add POP mail to your application.

Implement the cfpop tag in your application

1. Choose the mailboxes to access within your ColdFusion application.
2. Determine which mail message components you must process: message header, message body, attachments, and so on.

3. Decide whether you must store the retrieved messages in a database.

4. Decide whether you must delete messages from the POP server after you retrieve them.

5. Incorporate the \texttt{cfpop} tag in your application and create a user interface for accessing a mailbox.

6. Build an application page to handle the output. Retrieved messages can include characters that do not display properly in the browser.

You use the \texttt{cfoutput} tag with the \texttt{HTMLCodeFormat} and \texttt{HTMLEditFormat} functions to control output to the browser. These functions convert characters with special meanings in HTML, such as the less than (<), greater than (>), and ampersand (&) symbols, into HTML-escaped characters, such as &lt;, &gt;, and &amp;. The \texttt{HTMLCodeFormat} tag also surrounds the text in a \texttt{pre} tag block.

### The \texttt{cfpop} Query Variables

Like any ColdFusion query, each \texttt{cfpop} query returns variables that provide information about the record:

- **RecordCount**: The total number of records returned by the query.
- **ColumnList**: A list of the headings of the columns that are returned by the query.
- **CurrentRow**: The current row of the query being processed by \texttt{cfoutput} or \texttt{cfloop} in a query-driven loop.

The query includes one variable that is not returned by the \texttt{cfquery} tag: the UID variable contains the unique identifier of the e-mail message file.

You can reference these properties in a \texttt{cfoutput} tag by prefixing the query variable with the query name in the \texttt{name} attribute of \texttt{cfpop}:

\begin{verbatim}
<cfoutput>
This operation returned #Sample.RecordCount# messages.
</cfoutput>
\end{verbatim}

### Handling POP Mail

This section describes how to specify the message or messages that you want to get (or get information about) and provides an example of each of the following uses of POP mail:

- Retrieving message headers
- Retrieving messages
- Retrieving messages and attachments
- Deleting messages

### Specifying the Message or Messages

For all \texttt{cfpop} actions, you can tell the tag to perform the action on all messages, or to do it on selected messages. To operate on all messages, for example to get all message headers, do not specify a messageNumber or UID attribute. To operate on specific messages, for example, to delete three selected messages, specify a messageNumber or UID attribute with a comma-delimited list of messages to act on.
Retrieving message headers

To retrieve message headers without getting the messages, specify `action="GetHeaderOnly"` in the `cfpop` tag. Whether you use `cfpop` to retrieve the header or the entire message, ColdFusion returns a query object that contains one row for each message in the specified mailbox. You specify the query object name in the `cfpop` tag `name` attribute. The query has the following fields:

- `date`
- `from`
- `header` (A string with all the mail header fields, including those that have separate fields in the query object)
- `messageNumber` (The sequential number of the message in the POP server; identical to the row number of the entry in the query object)
- `messageID` (The mail header Message-ID field)
- `replyTo`
- `subject`
- `cc`
- `to`
- `UID` (The mail header X-UID field)

The `cfpop` tag with the `getHeaderOnly` attribute retrieves any file attachments if you specify an `attachmentPath` attribute; otherwise, it does not get the attachments, and the `attachmentFiles` column contains empty strings.

Retrieve only the message header

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>POP Mail Message Header Example</title>
   </head>

   <body>
   <h2>This example retrieves message header information:</h2>

   <cfpop server="mail.company.com"
      username="#myusername#"
      password="#mypassword#"
      action="GetHeaderOnly"
      name="Sample">
   <cfoutput query="Sample">
      MessageNumber: #HTMLEditFormat(Sample.messageNumber)# <br>
      To: #HTMLEditFormat(Sample.to)# <br>
      From: #HTMLEditFormat(Sample.from)# <br>
      Subject: #HTMLEditFormat(Sample.subject)# <br>
      Date: #HTMLEditFormat(Sample.date)#<br>
      Cc: #HTMLEditFormat(Sample.cc)# <br>
      ReplyTo: #HTMLEditFormat(Sample.replyTo)# <br>
   </cfoutput>
   </body>
   </html>
   ```

2. Edit the following lines so that they refer to valid values for your POP mail server, user name, and password:
3  Save the file as header_only.cfm in the myapps directory under your web_root and view it in your web browser:

This code retrieves the message headers and stores them in a cfpop record set called Sample. For more information about working with record set data, see "Using Query of Queries" on page 413.

The HTMLCodeFormat function replaces characters that have meaning in HTML, such as the less than (<) and greater than (>) signs that can surround detailed e-mail address information, with escaped characters such as &lt; and &gt;.

In addition, you can process the date returned by cfpop with the ParseDateTime function, which accepts an argument for converting POP date/time objects into a CFML date-time object.

You can reference any of these columns in a cfoutput tag, as the following example shows:

```cfoutput>
   #ParseDateTime(queryname.date, "POP")#
   #HTMLCodeFormat(queryname.from)#
   #HTMLCodeFormat(queryname.messageNumber)#
</cfoutput>
```

### Retrieving messages

When you use the cfpop tag with action="GetAll", ColdFusion returns the same columns as with getheaderonly, plus the following additional columns:

- attachments (A tab-delimited list of attachment filenames)
- attachmentfiles (A tab-delimited list of paths to the attachment files retrieved to the local server, if any. You get the files only if you specify an attachmentpath attribute.)
- body
- htmlbody
- textbody

If the message is multipart, the htmlbody and textbody fields contain the contents of the HTML and plain text parts, and the body field has the first part in the message. If the message has only one part, the body contains the message, and either the htmlbody or textbody field, depending on the message type, also has a copy of the message.

### Retrieve entire messages

1  Create a ColdFusion page with the following content:

```html
<html>
<head><title>POP Mail Message Body Example</title></head>
<body>
<h2>This example adds retrieval of the message body:</h2>
<cfpop server="mail.company.com"
    username=#myusername#
    password=#mypassword#
    action="GetAll"
    name="Sample">
<cfoutput query="Sample">
    MessageNumber: #HTMLEditFormat(Sample.messageNumber)# <br>
    To: #Sample.to# <br>
```
Edit the following lines so that they refer to valid values for your POP mail server, user name, and password:

```cfpop
server="mail.company.com"
username=#myusername#
password=#mypassword#
```

3. Save the file as header_body.cfm in the myapps directory under your web_root and view it in your web browser:

This example does not use a CFML function to encode the body contents. As a result, the browser displays the formatted message as you would normally see it in a mail program that supports HTML messages.

## Retrieving messages and attachments

When you use the `cfpop` tag with an `attachmentpath` attribute to specify the directory in which to store attachments, ColdFusion retrieves any attachment files from the POP server and saves them in the specified directory. The `cfpop` tag fills the `attachmentfiles` field with a tab-separated list of the locations of the attachment files. Use the `cffile` tag to delete these temporary files when they are no longer needed. ColdFusion creates the directory if it does not exist. (ColdFusion must have the appropriate rights on the system to create the directory.)

If a message has no attachments, the `attachments` and `attachmentfiles` columns contain empty strings.

**Note:** CFML does not provide a way to change the name of a mail attachment returned by `cfpop` before it tries to save the file. If the attachment name is invalid for the file system on which ColdFusion is running, the attachment cannot be saved.

## Retrieve all parts of a message, including attachments

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>POP Mail Message Attachment Example</title>
</head>

<body>
<h2>This example retrieves message header, body, and all attachments:</h2>

<cfpop server="mail.company.com"
username=#myusername#
password=#mypassword#
action="GetAll"
attachmentpath="c:\temp\attachments"
```
2 Edit the following lines so that they refer to valid values for your POP mail server, user name, and password:

```cfpop server="mail.company.com"
  username=#myusername#
  password=#mypassword#```

3 Save the file as header_body_att.cfm in the myapps directory under your `web_root` and view it in your web browser:

*Note: To avoid duplicate filenames when saving attachments, set the `generateUniqueFilenames` attribute of `cfpop` to Yes.*

### Deleting messages

Using the `cfpop` tag to delete a message permanently removes it from the server. By default, retrieved messages remain on the POP mail server. To delete the messages, set the `action` attribute of the `cfpop` tag to Delete. Use the `messagenumber` attribute to specify the messages to delete; omit the attribute to delete all the user's messages from the server.

*Note: Message numbers are reassigned at the end of every POP mail server communication that contains a delete action. For example, if you retrieve four messages from a POP mail server, the server returns the message numbers 1,2,3,4. If you delete messages 1 and 2 with a single `cfpop` tag, messages 3 and 4 are assigned message numbers 1 and 2, respectively.*

#### Delete messages

1 Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>POP Mail Message Delete Example</title>
</head>

<body>
<h2>This example deletes messages:</h2>
```
<cfpop server="mail.company.com"
    username=#username#
    password=#password#
    action="Delete"
    messagenumber="1,2,3"> 

</body>
</html>

2  Edit the following lines so that they refer to valid values for your POP mail server, user name, and password:

<cfpop server="mail.company.com"
    username=#username#
    password=#password# 

3  Save the file as message_delete.cfm in the myapps directory under your web_root and view the file in your web browser.

4  Run the header_only.cfm page that you created to confirm that the messages have been deleted.

Important: When you view this page in your web browser, ColdFusion immediately deletes the messages from the POP server.
Chapter 53: Interacting with Microsoft Exchange Servers

You can use Adobe ColdFusion to interact with Microsoft Exchange servers to send, get, and manage mail; and to create, get, and manage calendar events, connections, and tasks.

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Deleting Exchange items and attachments ....................................................................... 1027
Working with meetings and appointments .......................................................................... 1028

Using ColdFusion with Microsoft Exchange servers

ColdFusion can interact with the Microsoft Exchange server to perform the following actions:

<table>
<thead>
<tr>
<th>Item</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail messages</td>
<td>get, get attachments, get meeting information, move to a different folder, delete, delete attachments, set properties</td>
</tr>
<tr>
<td>Calendar events</td>
<td>create, get, get attachments, delete, delete attachments, modify, respond</td>
</tr>
<tr>
<td>Contacts</td>
<td>create, get, get attachments, delete, delete attachments, modify</td>
</tr>
<tr>
<td>Tasks</td>
<td>create, get, get attachments, delete, delete attachments, modify</td>
</tr>
</tbody>
</table>

To perform these actions, you use the following ColdFusion tags:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfxchangeconnection</td>
<td>Opens and closes persistent connections between an application and the Exchange server. Gets information about subfolders of the Inbox.</td>
</tr>
<tr>
<td>cfxexchangecalendar</td>
<td>Creates, gets, and manages calendar events.</td>
</tr>
<tr>
<td>cfxexchangecontact</td>
<td>Creates, gets, and manages contacts.</td>
</tr>
<tr>
<td>cfxchangemail</td>
<td>Gets and manages mail messages. Does not send mail.</td>
</tr>
<tr>
<td>cfmail</td>
<td>Sends mail to the exchange server.</td>
</tr>
<tr>
<td>cfxexchangetask</td>
<td>Creates, gets, and manages tasks.</td>
</tr>
<tr>
<td>cfxexchangefilter</td>
<td>Specifies the criteria to get specific items. Used only as a child of the cfxexchangecalendar, cfxexchangecontact, cfxchangemail, and cfxexchangetask tags that specify the get action.</td>
</tr>
</tbody>
</table>

The following list describes a few of the activities you can do using ColdFusion with the Exchange server:
• Build a customized Exchange web client interface.
• View information about upcoming tasks.
• Create mailing lists based on contact entries.
• Automatically add tasks to users’ task lists based on new bugs or customer contacts.
• Schedule meetings and appointments.
• Show and manage meeting attendee availability.

Managing connections to the Exchange server

To communicate with an Exchange server, you must establish a connection with the server. The connection can use the HTTP protocol or the HTTPS protocol. By default, ColdFusion connects to the mailbox that belongs to the login user name, but you can also connect to any mailbox whose owner has delegated access rights to the login user name. You can also access the server by using a proxy host.

Note: To establish any connection, the Exchange server must grant the login user Outlook web access. For information on how to enable this access, see Enabling Outlook web access.

Connections to the server can be persistent or transient:
• A persistent connection lasts until you explicitly close it. Persistent connections let you use a single connection for multiple tasks, which saves the processing overhead of opening and closing a separate connection for each interaction with the Exchange server.
• A transient connection lasts for the duration of the tag that interacts with the Exchange server. Transient connections are a useful technique on ColdFusion pages where you only have to access the Exchange server for a single tag; for example, where you only get a set of contacts.

Enabling access to the Exchange server

To enable access to the Exchange server, you must ensure the following:
• The Exchange server, Exchange access, and WebDav access are configured in IIS.
• The Exchange server enables Outlook web access to all login users.
• If you are using HTTPS to log into the exchange server, you have a valid client certificate in the JRE certificate store.

Ensure that IIS is configured for access to the Exchange server

1. Open the IIS manager from the Administrative Tools control panel on the machine where the Exchange server is installed.
2. Expand the Web Sites node in the tree on the left pane. If you see Exchange there, the web application is configured for Exchange. If you do not see it, follow the Microsoft instructions for configuring Exchange in the Web site.
3. Click the Web Service Extension node in the tree on the left pane. The right pane will show Web Service Extensions and their status. Make sure that Microsoft Exchange Server and WebDav entries are both allowed. If either entry is prohibited, select it and click the Allow button.
Enabling Outlook web access
To establish any connection, the Exchange server must grant the login user Outlook web access.

Check and grant web access
1. In the Exchange administrator, open Administrative Tools > Active Directory Users and Computers > your domain name > users.
2. Right-click the user whose ID you use to establish connections.
3. Select the Exchange Features tab.
4. In the Protocols section, enable the Outlook Web Access entry if it is disabled.

Enabling HTTPS access to the Exchange server
To enable HTTPS access from ColdFusion to the Exchange server you must
- Enable SSL on the Exchange server side
- Ensure that the JRE certificate store has a valid client certificate

Enabling SSL on the Exchange server side
Use the following steps to enable SSL on the Exchange server side
1. On the system where the Exchange server is installed, open the IIS manager from the Administrative Tools control panel.
2. In the tree on the left pane, expand the Web Sites node,
3. Right-click Exchange and ExchWeb in the expanded list and open the Web Site Properties dialog, then click the Directory Security tab.
4. In the Secure Communications section, click Edit to open the Secure Communications dialog. Select the Require secure channel (SSL) check box, click OK, and click Apply.

As an alternative to steps 3 and 4, you could do the following: Right-click Default Web Site. In Secure Communications->Edit, check the Require secure channel (SSL) check box, click OK, and Click Apply. Select the nodes (for example Exchange) for which SSL should be enabled.

Enabling HTTPS access on the ColdFusion server
To use HTTPS to access the exchange server, you must have a valid client certificate in the JRE certificate store. You will need to install a certificate if the certificate on the Exchange server is not issued by a well known authority; The Java certificate store already contains certificates from some authorities.

You can ask your system administrator to give you a certificate that you can install on the ColdFusion server, or you can do the following:
1. Open Outlook Web Access in Internet Explorer and go to File->Properties.
2. Click the certificates button.
3. Click the Details tab and the ‘Copy To File’ button on the tab. Then follow the wizard options to save the certificate.

To install the certificate, run the following command using keytool.exe, which is in the jre\bin folder:
keytool.exe -importcert -file <path_to_certificate_file> -keystore ..\lib\security\cacerts

Note: The keytool.exe program requires you to enter a password. The default password is changeit.
Using persistent connections

To open a persistent connection, you use the `cfexchangeconnection` tag and specify the `open` action, the server IP address or URL, the user name, and the name of the connection (which you use in subsequent tags to specify the connection). You typically also specify a password, and can specify several other attributes, including a proxy host or a delegate mailbox ID. For details, see `cfexchangeconnection` in the CFML Reference.

Persistent connections use HTTP or HTTPS protocol with the `keepAlive` property set to `true`. As a result, the connections do not automatically close at the end of an HTTP request or ColdFusion page. You should close the connection when you are done using it; if you do not, ColdFusion retains the connection until an inactivity time-out period elapses, after which, ColdFusion recovers the connection resources.

**Note:** You can store a connection in a persistent scope, such as the Application scope, and reuse it on multiple pages. However, there is no advantage to doing so, because the connections are lightweight and there is no substantial performance gain if you use a persistent scope.

The following example opens a connection, gets all mail sent from spamsource.com and deletes the messages from the Exchange server:

```cfml
<cfexchangeConnection
  action = "open"
  username = 
  password = 
  server = 
  connection = ">
  <cfexchangeemail action = "get" name = "spamMail" connection = "conn1">
    <cfexchangefilter name = "fromID" value = "spamsource.com">
  </cfexchangeemail>
</cfexchangeConnection>

<cfloop query="spamMail">
  <cfexchangeemail action = "delete" connection = "conn1"
    uid = "#spamMail.uid#">
</cfloop>

<cfexchangeConnection
  action = "close"
  connection = "conn1">
```

Using transient connections

Transient connections last only as long as the tag that uses them takes to complete processing. To create a transient connection, you specify the connection directly in your action tag (such as `cfexchangetask`) by using the same attributes as you do in the `cfexchangeconnection` tag (with the exception of the connection name).

The following example uses a transient connection to create a single task:

```cfml
<!---- Create a structure with the task fields. ---->
<cfscript>
  stask = StructNew();
  stask.Priority = "high";
  stask.Status = "Not Started";
  stask.DueDate = "3:00 PM 09/14/2007";
  stask.Subject = "My New Task";
  stask.PercentCompleted = 0;
  Message = "Do this NOW!";
</cfscript>

<!---- Create the task by using a transient connection. ---->
```
<cfexchangetask action = "create"
    username = "#user1#"
    password = "#password1#"
    server = "#exchangeServerIP#"
    task = "#stask#"
    result = "theUID">

<!---- Display the UID to confirm that the action completed. --->
<cfdump var = "#theUID#">

### Accessing delegated accounts

In Exchange, one user can grant, or delegate, another user access rights to their account. Users can delegate reviewer (read-only), author (read-write), or editor (read-write-delete) rights to any combination of the calendar, contacts, Inbox, or task list.

**Note:** You cannot use ColdFusion to delegate access rights.

To access the delegator’s account as a delegated user, specify the following information:

- Specify the delegated user’s user name and password in the `username` and `password` attributes.
- Specify the mailbox name of the account that you are accessing in the `mailboxName` attribute.

You can do this in a `cfexchangeconnection` tag that opens a persistent connection, or in a ColdFusion Exchange tag that uses a transient connection.

For example, if access rights to docuser3's account are delegated to docuser4, you can use the `cfexchangeconnection` tag as in the following example to open a connection to docuser3’s account by using docuser4’s credentials:

```cfexchangeconnection action="open"
    connection="theConnection"
    server="myexchangeserver.mycompany.com"
    username="docuser4"
    password="secret"
    mailboxName="docuser3">
```

You can use this connection for any activities that docuser3 has delegated to docuser4. If docuser3, for example, has only delegated reviewer rights to the calendar, you can use this connection only with the `cfexchangecalendar` tag with `get` and `getAttachments` attributes.

### Creating Exchange items

You can create Exchange events, contacts, and tasks by using the `cfexchangecalendar`, `cfexchangecontact`, or `cfexchangetask` tag, respectively, and specifying an `action` attribute value of `create`. You create mail messages by using the `cfmail` tag to send the message. For information on sending mail, see “Sending and Receiving E-Mail” on page 996.

When you create a calendar event, contact, or task, you specify the action, the connection information (persistent connection name or transient connection attributes) and an attribute that specifies a structure with the information you are adding. You can also specify a `result` variable that contains the value of the Exchange UID for the entry that you create. You can use this UID to identify the entry in tags that modify or delete the entry.

The name of the attribute that you use to specify the entry information varies with the tag you are using, as follows:
You must enclose in number signs (#) the variable that contains the details of the event, contact, or task data, as in the following example:

```xml
<cfexchangecalendar action="create" connection="myConn" event="#theEvent#"
    result="resultUID">
```

The contents of the entry information structure depend on the tag. For details of the structure contents, see `cfexchangecalendar`, `cfexchangecontact`, and `cfexchangetask` in the CFML Reference.

**Note:** To create an Exchange calendar appointment, create a calendar event and do not specify any required or optional attendees.

The following example lets a user enter information in a form and creates a contact on the Exchange server with the information:

```xml
<!---- Create a structure to hold the contact information. --->
<cfset sContact="#StructNew()#">

<!---- A self-submitting form for the contact information --->
<cfform format="flash" width="550" height="460">
<cfformitem type="html"><b>Name</b></cfformitem>
<cfformgroup type="horizontal" label="">
<cfinput type="text" label="First" name="firstName" width="200">
<cfinput type="text" label="Last" name="lastName" width="200">
</cfformgroup>
<cfformgroup type="VBox">
<cfformitem type="html"><b>Address</b></cfformitem>
<cfinput type="text" label="Company" name="Company" width="435">
<cfinput type="text" label="Street" name="street" width="435">
<cfinput type="text" label="City" name="city" width="200">
<cfselect name="state" label="State" width="100">
<option value="CA">CA</option>
<option value="MA">MA</option>
<option value="WA">WA</option>
</cfselect>
<cfinput type="text" label="Country" name="Country" width="200" Value="U.S.A." />
<cfformitem type="html"><b>Phone</b></cfformitem>
<cfinput type="text" validate="telephone" label="Business"
    name="businessPhone" width="200">
<cfinput type="text" validate="telephone" label="Mobile"
    name="cellPhone" width="200">
<cfinput type="text" validate="telephone" label="Fax" name="fax"
    width="200">
<cfformitem type="html"><b>Email</b></cfformitem>
<cfinput type="text" validate="email" name="email" width="200">
</cfformgroup>

<cfinput type="Submit" name="submit" value="Submit" >
</cfform>

<!---- If the form was submitted, fill the contact structure from it. --->
<cfif isDefined("Form.Submit")>
<cfscript>
sContact.FirstName=Form.firstName;
sContact.Company=Form.company;
sContact.LastName=Form.lastName;
sContact.BusinessAddress.Street=Form.street;
sContact.BusinessAddress.City=Form.city;
sContact.BusinessAddress.State=Form.state;
sContact.BusinessAddress.Country=Form.country;
sContact.BusinessPhoneNumber=Form.businessPhone;
sContact.MobilePhoneNumber=Form.cellPhone;
sContact.BusinessFax=Form.fax;
sContact.Email1=Form.email;
</cfscript>

<!---- Create the contact in Exchange --->
<cfexchangecontact action="create"
    username="#user1#"
    password="#password1#"
    server="#exchangeServerIP#"
    contact="#sContact#"
    result="theUID">

<!---- Display a confirmation that the contact was added. --->
<cfif isDefined("theUID")>
    <cfoutput>Contact Added. UID is#theUID#</cfoutput>
</cfif>
</cfif>

For another example of creating items, which creates a task, see “Using transient connections” on page 1014.

## Getting Exchange items and attachments

You can get calendar events, contacts, mail messages, and tasks from the Exchange server. You can also get attachments to these items.

Getting an exchange item and its attachments can require multiple operations.

- To get mail that is not directly in the Inbox, you must specify the path from the root of the mailbox to the mail folder, and you can get items from only a single mail folder at a time. You can use the `cfexchangeconnection` tag to get the names, paths, and sizes of all folders in a mailbox, and can use the results to iterate over the folders.
- To get an attachment to an item, you must first get the item, and then use the item UID to get its attachments.
- If an Exchange item contains a message with inline images, the images are available as attachments. You can get the attachments, use the attachment CID to locate the image in the message, and display the image inline.

### Getting and using folder names

To get the names of folders in the mailbox, or the subfolders of a particular folder, use the `cfexchangeconnection` tag with the `getSubfolders` action. This action returns a query with a row for each subfolder. The query has three columns:

- folder name
- full path from the mailbox to the folder, including the Inbox
- folder size, in bytes
You can specify the folder whose subfolders you are getting and whether to recursively get all levels of subfolders.

You can use a folder path from the getSubfolders action in the cfexchangemail tag folder attribute to specify the folder that contains the mail message that requires action. If you do not specify a folder, the cfexchangemail tag searches only the top level of the Inbox for the message to be acted on.

To perform operations on mail from multiple folders, including getting mail items or attachments, you can loop over the entries in the query returned by the getSubfolders action, as the following example shows. This example generates a report of all declined meeting messages in the Inbox and all its subfolders.

<!--- Create a connection. --->
<cfexchangeConnection
  action="open"
  username="#user2#"
  password="#password2#"
  server="#exchangeServerIP#"
  connection="conn1">

<!--- Get the names and paths to all subfolders. --->
<cfexchangeconnection action="getSubfolders" connection="conn1"
  name="folderInfo" folder="Inbox" recurse="yes">

<!--- Get the information from the Inbox top level. The getSubfolders results do not include an Inbox row. --->
<cfexchangemail action="get" connection="conn1"
  name="theResponses">
  <cfexchangefilter name="MessageType" value="Meeting_Response">
  <cfexchangefilter name="folder" value="#folderinfo.folderpath#">
  <cfexchangefilter name="MessageType" value="Meeting_Response">
  </cfexchangefilter>
  </cfexchangefilter>
  </cfexchangemail>

<!--- Use a query of queries to select only the declined meetings. --->
<!--- You cannot use cfexchangefilter to filter for the meeting response type. --->
<cfquery dbtype="query" name="theResponses">
  SELECT * FROM theResponses
  WHERE MEETINGRESPONSE = 'Decline'
</cfquery>

<!--- Loop through the subfolders and get the meeting responses from each folder. --->
<cfloop query="folderInfo">
  <cfexchangemail action="get" connection="conn1"
    name="#folderinfo.foldername#">
    <cfexchangefilter name="folder" value="#folderinfo.folderpath#">
    <cfexchangefilter name="MessageType" value="Meeting_Response">
    </cfexchangefilter>
    </cfexchangemail>
</cfloop>

<!--- Use the evaluate function to get the name of the folder. --->
<cfset meetingData=evaluate(folderinfo.foldername)>

<!--- Use a query of queries with a UNION clause to add this folder's results to the theResponses query. --->
<cfquery dbtype="query" name="theResponses">
  SELECT * FROM meetingData
  WHERE MEETINGRESPONSE = 'Decline'
  UNION
  SELECT * FROM theResponses
</cfquery>

</cfloop>

<!--- Close the connection. --->
<cfexchangeConnection
  action="close"
Getting items

You get one or more events, contacts, mail messages, or tasks from the Exchange server by using a cfxexchangeCalendar, cfxexchangeContact, cfxexchangeMail, or cfxexchangeTask tag, respectively, and specifying an action attribute value of get. ColdFusion returns the items in a query object that you specify in the tag’s name attribute. You determine the items to get by specifying selection conditions in cfxexchangeFilter child tags. The code to get items from the Exchange server has the following pattern:

```cfml
<cfexchange***
    action="get"
    name="results query object name"
    connection information>
    <cfxexchangeFilter
        name="filter type"
        value="filter value">
    <cfxexchangeFilter
        name="data/time filter type"
        from="start date/time"
        to="end date/time">
        ...
    </cfxexchangeFilter>
</cfexchange>
```

The following rules determine how you get items:

- You can have zero or more cfxexchangeFilter tags.
  - If you do not specify a maxrows field in the structure specified by the name attribute, ColdFusion gets a maximum of 100 items. To get more items, specify a maxrows field value greater than 100.
  - If you specify multiple cfxexchangeFilter tags with different name attributes, ColdFusion gets all items that match all of the specified conditions.
  - If you specify multiple cfxexchangeFilter tags with identical name attributes ColdFusion gets the items that match only the last tag with the duplicate name attribute.
- The name attributes correspond to field names in the Exchange item records. The valid values for the name attributes depend on the type of item you are getting. For detailed lists of the valid values, see the corresponding tag references in the CFML Reference.
  - If the name attribute specifies a field that takes text or numerical information, you use the value attribute to specify the condition.
  - If the name attribute specifies a field that takes a date, time, or date and time, you use the from and to attributes to specify the range. You can omit one of these attributes to specify an open-ended range, such as all dates up to and including December 1, 2007.
  - Date ranges are inclusive. The selected items include those with the specified to or from dates.
• You cannot use the empty string as a value attribute to search for an empty value. To find entries where a particular field has an empty value, get all entries and use a query of queries to filter the results to include only entries where the field is empty.
• In fields that take text strings such as Message and or Subject, ColdFusion returns items that contain the exact phrase that you specify in the value attribute.
• When you use the cfexchangemail tag, ColdFusion gets only items a single folder. If you include a filter for a folder, ColdFusion gets items that are directly in the Inbox only and does not search any subfolders. For an example of getting information from multiple folders, see “Getting and using folder names” on page 1017.

When ColdFusion gets the results, it creates the query object specified in the name attribute, if it does not exist, and populates each row with a single item such as a mail message. The query columns depend on the type of item. For example, a mail message has FromID and ToID fields, and a contact has FirstName and LastName fields. For detailed information on the returned structures, see the corresponding tag in the CFML Reference.

The query results for all types of items have two columns:
• A UID column with the unique ID of the item. You use this value to specify the item when you delete, modify, or (for calendar entries) respond to it. You also use the UID value to get the item's attachments.
• A HasAttachments column with a Boolean value specifying whether the item has any attachments. If this field is true, you can use the getAttachments action to get the attachments.

The following example gets the mail messages that were sent during the last week to the docuser1 user from any e-mail address that includes adobe.com. To keep this code short, the example uses the cfdump tag to show the results.

```cfscript
<cfset rightNow = Now()>
<cfset lastWeek = DateAdd("d","-7", rightNow)>
<cfset weeksMail = cfexchangemail action="get" name="weeksMail"
    username="#user1#" password="#password1#"
    server="#exchangeServerIP#">
    <cfexchangefilter name="FromID" value="adobe.com">
        <cfexchangefilter name="TimeSent" from="#lastWeek#" to="#rightNow#">
    </cfexchangemail>
</cfset>
<cfset weeksMail = cfdump var="#weeksMail#">

Getting item attachments

To get the attachments to an Exchange contact, event, message, or task, use a ColdFusion Exchange tag with a getAttachments action. You must also specify the following information in the tag:
• The UID of the message that contains the attachment or attachments.
• The name of the query that will contains information about the returned attachments. When the tag completes processing, the query object contains one record for each retrieved attachment. The query has six columns that contain the filename, complete path to the saved attachment file, MIME type, file size, CID value (or an empty string) and an indicator that shows whether the attachment is a message.
• The path where the attachment is saved. (If you omit the path, ColdFusion does not get the attachments, but does get the information about the attachments.)
• Optionally, whether to create unique filenames by appending numbers to the names when two or more attachments have the same names. (The default is to not create unique filenames.)
The following ColdFusion Exchange tag gets all attachments to the message identified by the theUID variable, saves them in the C:/temp/cf_files/attachments directory, and stores information about the attachments in the attachInfo structure:

```coldfusion
<cfexchangemail action="getattachments"
   connection="#myconn1#"
   uid="#theUID#"
   name="#attachInfo#"
   attachmentPath="C:/temp/cf_files/attachments"
   generateUniqueFilenames="true">
```

To get a message's attachments, you must have the UID of the message and know that the message has attachments. Use a ColdFusion Exchange tag, such as `cfexchangemail`, with the `get` action to determine this information. When the tag completes processing, the query specified by the `name` attribute includes the following columns:

- The HasAttachments field is `true` if a message has one or more attachments
- The UID field contains the Exchange UID of the item. The exact UID format depends on the type of item; event, contact, message, or task.

You can use these fields in your decision logic that determines whether to get attachments for a message and determines the message UID.

The following example gets the attachments to all mail messages from docuser2 in the last week. It puts each message's attachments in a directory whose name is the hexadecimal part of the message UID. For each message with attachments, the application reports subject and date of the message, followed by a table listing the message's attachments. The table includes the attachment name, MIME type, and size.

Notice that if a message has multiple attachments with the same name, the attachment information query always lists the attachments with their original, duplicate names, even if you specify `generateUniqueFilenames="true"`. The `generateUniqueFilenames` attribute only affects the names of the files on disk. The attachment information structure's `attachmentFilePath` column does have the unique filenames, however.

```coldfusion
<cfset rightNow = Now()>
<cfset lastWeek = DateAdd("d","-7", rightNow)>

<cfexchangemail action="get" folder="Inbox/MailTest" name="weeksMail" connection="conn1">
   <cfexchangefilter name="FromID" value="docuser2">
   <cfexchangefilter name="TimeSent" from="#lastWeek#" to="#rightNow#">
```

```coldfusion
<cfloop query="weeksMail">
   <cif weeksMail.HasAttachment>
      <!--- The UID is surrounded in <> characters and has an @ character. Extract the hexadecimal number part for use as a directory name. --->
      <cfset atpos=Find('@', weeksMail.UID)>
      <cfset shortUID=Mid(weeksMail.UID, 2, atpos-2)>
      <cfexchangemail action="getAttachments" connection="conn1" folder="Inbox/MailTest" name="#shortUID#">
```
uid="#weeksMail.uid#"
name="attachData"
attachmentPath="C:/temp/cf_files/attachments/#shortUID#"
generateUniqueFilenames="true">

<cfoutput>
Directory #shortUID# contains these attachments to the following message:<br />
Subject: #weeksMail.Subject#<br />
Sent: #dateFormat(weeksmail.TimeSent)#<br />
<cftable query="attachData" colheaders="true">
  <cfcol header="Filename" text="#attachmentFilename#">
  <cfcol header="Size" text="#size#">
  <cfcol header="MIME type" text="#mimeType#">
</cftable>
</cfoutput>
</cfif>
</cfloop>

<cfexchangeconnection
action="close"
connection="conn1">

Displaying images inline
If an HTML message includes inline images, the Exchange server saves the images as attachments. You must take the following steps to display the images in the retrieved message:

1 Use cfexchangemail tag get action to get the mail message.

2 Use cfexchangemail tag getattachments action to get the message attachments. Specify the UID of the mail message you got in the previous step. Also specify an attachmentPath attribute value that is under your web root, so that you can access the saved files by using a URL.

3 Search through the HTMLMessage field text that you got in step 1 and find the image items. Get the CID (content ID) value for each image.

4 Search the attachments query that you got in step 1. For each row with a CID column value that you got in step 3, get the corresponding attachmentFilePath column value.

5 Replace every img tag src attribute value with the attachmentFilePath field value that corresponds to the cid value.

6 Display the resulting HTML.
The following example shows how to display a message with an inline image by retrieving the image from the attachments.

<!---- Open the connection to the Exchange server. ---->
<cfexchangeconnection
action="open"
username = "#user1#"
password = "#password1#"
server = "#exchangeServerIP#"
connection = "testconn">

<!---- Get the mail message. ---->
<cfexchangemail action="get" connection ="testconn" name="getMail">
  <cfexchangeFilter name="Subject" value="sample inline image">
  
  </cfexchangemail>
<cfdump var="#getMail#">

<!--- The following code assumes we found only one matching message. --->
<cfoutput query="getMail">
    <cfset theUID = #getMail.UID#>
    <cfset htmlmessage = getMail.htmlmessage>
</cfoutput>

<!--- Get the message's attachments. --->
<CFExchangeMail action="getAttachments" UID="#theUID#" connection="testconn"
    name="attachments"
    attachmentPath="C:\ColdFusion8\wwwroot\My_Stuff\cfexchange\Book\attachments"
generateuniquefilenames="no">

<!--- Extract the image names from the mail message --->
<!--- Initialize the index into the message used in finding --->
<cfset findstart = 1>
<!--- Use an index loop to find all image source entries in the message --->
<!--- This example supports up to 25 inline images --->
<cfloop index="i" from="1" to="25">
    <!--- find a cid: entry --->
    <cfset stringStart[i] = Find('"cid:\', htmlmessage, findstart)>
    <!--- Exit the loop if no match was found --->
    <cfif (stringStart[i] EQ 0)>
        <cfbreak>
    </cfif>
    <!--- Increment the string index used in finding images. --->
    <cfset findstart = stringStart[i] +5 >
    <!--- Get text to the right of "cid:" --->
    Using a string length of 30 should get more than the image name. --->
    <cfset rightpart[i]=Mid(htmlmessage, findstart, 30)>
    <!--- use the ListFirst function to remove all the text starting
    at the quotation mark. --->
    <cfset imagename[i]=ListFirst(rightpart[i], '')>
    <!--- Loop over the attachments query and find the CID. --->
    <cfloop query="attachments">
        <!--- Replace the image name with the contents of the attachment --->
        <cfif attachments.CID EQ imagename[i]>
            <cfset htmlmessage = Replace(htmlmessage,"cid:" imagename[i] ",
    "attachments/" attachments.ATTACHMENTFILENAME"")>
        </cfif>
    </cfloop>
</cfloop>

<h3>The full mail message</h3>
<cfoutput>#htmlmessage#</cfoutput>

<cfexchangeconnection
    action="close"
    connection = "testconn"
Modifying Exchange items

You can modify any elements of calendar, contact, and task items that you can set in ColdFusion. For mail message, you can change the Importance, Sensitivity, and IsRead flags, and you can move the mail messages between folders.

Note: If an item has attachments and you specify attachments when you modify the item, the new attachments are added to the previous attachments; they do not replace them. You must use the deleteAttachments action to remove any obsolete or changed attachments.

Modifying calendar, contact, and task items

You can modify calendar, contact, and task items by using the cfexchangecalendar, cfexchangecontact, or cfexchangetask tag with an action attribute value of modify. You specify a contact, event, or task attribute with a structure that contains the item properties that you want to change, and their new values. You do not have to specify the values for properties that you are not changing. To change the end time of a calendar task, for example, you specify only an EndTime field in the event attribute structure.

The following example lets you create, and then modify a calendar event. When you first submit the form, ColdFusion creates the calendar event and redisplays the form with the data you entered. You should accept the event before you modify the form and resubmit it. When you submit the form a second time, ColdFusion sends the modification information. For information about accepting events, see “Working with meetings and appointments” on page 1028.

The following example resends all the event data (to limit the example length), but you could change the example so that it only sends modified data. This example also omits recurrence information to keep the code relatively simple:

<!--- Initialize the form.eventID to 0, to indicate a new event. --->
<!---- The EventID field is a hidden field managed by this application. --->
<cfparam name="form.eventID" default="0">

<!---- If the form was submitted, populate an event structure from it. --->
<cfif isDefined("Form.Submit")>
  <cfscript>
    sEvent=StructNew();
    sEvent.AllDayEvent="false";
    sEvent.Subject=Form.subject;
    if (IsDefined("Form.allDay")) {
      sEvent.AllDayEvent="true";
      sEvent.StartTime=createDateTime(Year(Form.date), Month(Form.date), Day(Form.date), 8, 0, 0);
    } else {
      sEvent.StartTime=createDateTime(Year(Form.date), Month(Form.date), Day(Form.date), Hour(Form.startTime), Minute(Form.startTime), 0);
      sEvent.EndTime=createDateTime(Year(Form.date), Month(Form.date), Day(Form.date), Hour(Form.endTime), Minute(Form.endTime), 0);
    }
    sEvent.Location=Form.location;
    sEvent.RequiredAttendees=Form.requiredAttendees;
    sEvent.OptionalAttendees=Form.optionalAttendees;
    //sEvent.Resources=Form.resources;
    if (Form.reminder NEQ "") {
      sEvent.Reminder=Form.reminder;
    } else {
      sEvent.Reminder=0;
  </cfscript>
sEvent.Importance=Form.importance;
sEvent.Sensitivity=Form.sensitivity;
sEvent.message=Form.Message;
</cfscript>

<!--- If this is the first time the form is being submitted, create a new event. --->
<cfif form.eventID EQ 0>
<!--- Create the event in Exchange --->
<cfexchangecalendar action="create"
    username="#user1#"
    password="#password1#"
    server="#exchangeServerIP#"
    event="#sEvent#"
    result="theUID">
<!--- Display the new event UID and set form.eventID to it. --->
<cfif isDefined("theUID")>
    <cfoutput>Event Added. UID is #theUID#</cfoutput>
    <cfset Form.eventID = theUID >
</cfif>
</cfif>

<!--- The form is being resubmitted with new data; update the event. --->
<cfexchangecalendar action="modify"
    username="#user1#"
    password="#password1#"
    server="#exchangeServerIP#"
    event="#sEvent#"
    uid="#Form.eventID#">
<cfoutput>Event ID #Form.eventID# Updated.</cfoutput>
</cfif>
</cfif>

<!--- A self-submitting form for the event information --->
<cfform format="xml" preservedata="true" style="width:500" height="600">
    <cfinput type="text" label="Subject" name="subject" style="width:435">
    <br />
    <cfinput type="checkbox" label="All Day Event" name="allDay">
    <cfinput type="datefield" label="Date" name="date" validate="date"
        style="width:100">
    <cfinput type="text" label="Start Time" name="startTime" validate="time"
        style="width:100">
    <cfinput type="text" label="End Time" name="endTime" validate="time"
        style="width:100">
    <cfinput type="text" label="Location" name="location" style="width:435">
    <br />
    <cfinput type="text" label="Required Attendees" name="requiredAttendees"
        style="width:435">
    <br />
    <cfinput type="text" label="Optional Attendees" name="optionalAttendees"
        style="width:435">
    <br />
    <cfinput type="text" label="Resources" name="resources" style="width:435">
    <br />
    <cfinput type="text" label="Reminder (minutes)" validate="integer"
        name="reminder" style="width:200">
    <cfselect name="importance" label="Importance" style="width:100">
        <option value="normal">Normal</option>
        <option value="high">High</option>
        <option value="low">Low</option>
    </cfselect>
Setting mail attributes

To set a mail message's Importance, Sensitivity, or IsRead flag, use the cfexchangemail tag with an action attribute value of set. Specify only the flags that you are changing in the message attribute.

The following example snippet implements a catch-up operation by changing the IsRead flag to true on all mail messages that are directly in the Inbox and are more than 2 weeks old. The example does not change the flags on any messages in folders in the Inbox; to do this you must use a separate cfexchangemail tag for each folder. For information on accessing and using multiple folders, see "Getting and using folder names" on page 1017.

<!---- Create a structure with a true IsRead field --->
<cfset changeValues.IsRead="true"/>

<!---- Open the connection. --->
<cfexchangeConnection
    action="open"
    username="#user1#"
    password="#password1#"
    server="#exchangeServerIP#"
    connection="conn1">

<!---- Get the mail in the Inbox that is at least two weeks old. --->
<cfexchangemail action="get" name="oldMail" connection="conn1">
    <cfexchangefilter name="timeSent" from="01/01/2000"
        to="#DateAdd("d","-14", Now())#">
</cfexchangemail>

<!---- Loop through the resulting oldMail query and set the IsRead indicator to true. --->
<cfloop query="oldMail">
    <cfexchangemail action="set" connection="conn1"
        message="#changeValues#"
        uid="#oldMail.uid#">
</cfloop>

<!---- Close the connection. --->
<cfexchangeConnection
    action="close"
    connection="conn1">

Moving mail between folders

To move a one or more mail messages from one folder to another, use the cfexchangemail tag move action, as shown in the following code snippet, which moves all messages with the subject “Rams and Ewes” from the Unread folder in the Inbox to the Sheep folder in the inbox.
Deleting Exchange items and attachments

To delete an exchange item, use the ColdFusion Exchange tag with the `action` attribute of `delete` and specify the item UID. Deleting the exchange item deletes all attachments.

To delete only the attachments to an exchange item, use the ColdFusion Exchange tag with the `action` attribute of `deleteAttachments` and specify the item UID.

This example deletes all meeting requests in the Inbox for meetings that have passed, but does not delete any requests in folders in the Inbox. To delete requests in the Inbox, you must use a separate `cfexchangemail` tag for each folder.

For information on accessing and using multiple folders, see “Getting and using folder names” on page 1017.

```coldfusion
<cfexchangeconnection
    action="open"
    username="#user#"
    password="#password#"
    server="#exchangeServerIP#"
    connection="conn1">

<!--- Get all meeting notifications from the Inbox. --->
<cfexchangemail action="get" name="requests" connection="conn1">
    <cfexchangefilter name="MessageType" value="Meeting"/>
</cfexchangemail>

<!--- Get the meeting request data and put it in an array. --->
<cfset i=1>
<cfset meetingData=ArrayNew(1)>
<cfloop query="requests">
    <cfexchangemail action="getmeetinginfo" connection="conn1"
        name="meeting" meetinguid="#MeetingUID#" mailUID="#UID#">
        <cfset meetingData[i]=meeting>
        <cfset i=i+1>
    </cfloop>

<!--- Loop through the request data array and delete any outdated meeting messages from the Inbox. --->
<cfloop index="i" from="1" to="#ArrayLen(meetingData)#">
    <cfif meetingData[i].StartTime LTE now()>
        <cfexchangemail action="delete" connection="conn1"
            UID="#meetingData[i].UID#">
    </cfif>
</cfloop>

<cfexchangeconnection
    action="close"
    connection="conn1">

For another example that deletes all mail from a known spam address, see “Using persistent connections” on page 1014.
Working with meetings and appointments

The following techniques apply specifically to calendar events and the notices about meetings that you get in your mail Inbox:

- How to get detailed information about meeting requests, cancellation notices, and responses to invitations
- How to specify event recurrence

Working with meeting notices and requests

Your mailbox gets a meeting notice when someone takes any of the following actions:

- Sends you a meeting request
- Cancels a meeting in your calendar
- Responds to a meeting request that you sent and tells Exchange to notify you

The information provided by the `cfexchangemail` tag with the `get` action does not provide detailed information about meeting. It only includes the following meeting-related information:

- The event UID
- The type of message type: a meeting request, response, or cancellation
- If the message is a response to a meeting request, an indication whether the meeting was accepted, declined, or tentatively accepted

Also, a meeting request does not appear in your calendar (so you cannot get detailed information about it using the `cfexchangecalendar` tag) until you accept it.

To get detailed information about a meeting message, you must use the `cfexchangemail` tag with the `getMeetingInfo` action. After getting the information, you can take the necessary action, such as using an `cfexchangecalendar` tag with the `response` action to accept or decline a meeting request.

Get meeting message details and respond to meeting requests

1. Get the mail messages that contain the meeting notifications by using a `cfexchangemail` tag with an `action` attribute value of `get` and a `cfexchangefilter` child tag with the following attributes:

   - A name attribute with a value `MessageType`
   - A value attribute with a value of `Meeting, Meeting_Request, Meeting_Response, or Meeting_Cancel`. A value of `Meeting` gets all meeting notifications.

   You can use additional `cfexchangefilter` tags to further limit the messages you get.

   When the `cfexchangemail` tag completes processing, the `MeetingUID` column of the structure specified by the `cfexchangemail` tag name attribute contains the UIDs of the meetings.

2. For each meeting, get the information about the meeting by using a `cfexchangemail` tag with the following attributes:

   - An action attribute value of `getMeetingInfo`.
   - A `meetingUID` attribute value with the value from the `MeetingUID` column of the structure specified by the `cfexchangemail` tag name attribute.
   - (Optional) A `uid` attribute with the UID of the message that contained the meeting notification. Use this attribute to identify a specific message if the Inbox contains multiple messages about a single meeting.
3 Use the information returned in step 2 in application-specific logic to determine the required messages and actions. For example, you could display all meeting requests in a form that lets a user submit a response to each message.

4 To respond to a meeting request, use the `cfexchangecalendar` tag with an `action` value of `respond` and set the following the attributes:

- Set the `uid` attribute to the Meeting UID you received in step 2. Do not use the Message UID.
- Specify a `responseType` value of `accept`, `decline`, or `tentative`.
- (Optional) Specify a `notify` value of `true` (the default value) or `false` to control whether the event owner receives a meeting response message.
- If the owner receives a notification, you can also specify a `message` attribute with a text message that is included in the response.

The following example shows how you can use this process. It displays all meeting invitations in the Inbox and lets the user respond to each request and send a message with the response:

```coldfusion
<cfexchangeconnection
    action="open"
    username="#user2#"
    password="#password2#"
    server="#exchangeServerIP#"
    connection="conn1">
</cfexchangeconnection>

<cfif isDefined("Form.Submit")>
<!--- When the form has been submitted, send the responses. --->
<cfloop index="k" from="1" to="#Form.responses#">
    <cfset resp = Form["response" & k] >
    <cfset msg = Form["respMessage" & k] >
    <cfset msguid = Form["UID" & k] >
    <cfexchangecalendar action="respond" connection="conn1"
        uid="#msguid#" responseType="#resp#" message="#msg#">
    <cfoutput><h4>Response #k# sent!</h4></cfoutput>
</cfloop>
</cfif>

<cfelse>
<!--- Get all messages with meeting Requests. --->
<cfexchangemail action="get" name="requests" connection="conn1">
    <cfexchangefilter name="MessageType" value="Meeting_Request">
</cfexchangemail>

<!--- Get the meeting request data. --->
<cfloop query="requests">
    <cfexchangemail action="getmeetinginfo" connection="conn1"
        name="meeting" meetinguid="#MeetingUID#">
    <cfset meetingData[requests.currentrow]=meeting>
</cfloop>

<!--- Display the invitation data in a form. --->
<cfform name="bar">
<cfloop index="j" from="1" to="#ArrayLen(meetingData)#">
    <h3>Meeting Request #j#</h3>
    Subject: #meetingData[j].Subject# <br />
    Sensitivity: #meetingData[j].Sensitivity# <br />
    Organizer: #meetingData[j].Organizer# <br />
    All Day?: #meetingData[j].AllDayEvent# <br />
</cfloop>
</cfform>
```
For an example that gets information about all declined meeting messages in the Inbox and all its subfolders, see the example in “Getting and using folder names” on page 1017.

Specifying Calendar recurrence

To create an event that recurs multiple times, you specify the following fields in the event attribute structure:

- Set the IsRecurring field to true.
- Specify a RecurrenceType field value of DAILY, WEELY, MONTHLY, or YEARLY.
- (Optional) Specify one of the following mutually exclusive fields: RecurrenceCount, RecurrenceEndDate, or RecurrenceNoEndDate.

**Note:** If you omit all three of these fields, the event is created with no end date, and if you specify a count or end date, the RecurrenceNoEndDate value is automatically false; therefore, you must specify a RecurrenceNoEndDate field only if you are changing an existing event with a recurrence count or end date to one with no end date.

1. Specify the recurrence details in additional fields that depend on the recurrence type.

To change an event recurrence, including to change whether the event recurs, you specify only the fields whose values change. To stop an event from recurring, set the IsRecurring field to false. To convert an event from nonrecurring to recurring, set the IsRecurring field to true and set all the necessary recurrence fields.

The following sections describe how to specify each type of recurrence. For detailed descriptions of the fields that you use, see cfexchangecalendar in the CFML Reference.
Note: If you specify a recurrence rule that conflicts with the start date that you specify, the first occurrence of the event is on first day following the start date that conforms to the rule, not on the start date. For example, if you schedule an event for the second Tuesday of the month, and specify a start date of June 2, 2007, the first occurrence of the event is on June 12, 2007.

Specifying daily recurrence
To set a recurrence that is based on days, you do one of the following:

- Define a RecurrenceFrequency field to specify the frequency of the event, in days. To schedule a meeting for every third day, for example, specify RecurrenceFrequency="3".
- Specify RecurEveryWeekDay="true" to specify a meeting that is held 5 days a week.

You cannot use daily recurrence to schedule a single event that occurs a multiple number of times, but only on week days. To schedule such an event, specify a weekly recurrence with multiple recurrence days.

The following CFScript code sample sets daily recurrence for every 3 days and sets the event to occur 20 times:

```
IsRecurring="true";
RecurrenceType="DAILY";
RecurrenceCount="20";
RecurrenceFrequency="3";
```

Specifying weekly recurrence
You can create an event that always occurs on the same day or days of the week, and occurs every week or every several weeks by specifying RecurrenceType="WEEKLY". You use the following fields to control the frequency:

- Define a RecurrenceFrequency field to specify the frequency of the event, in weeks. If you omit this field, the event occurs every week. To schedule a meeting for every fourth week, for example, specify RecurrenceFrequency="4".

- Specify a RecurrenceDays field with a comma-delimited list of one of more of the following strings: MON, TUE, WED, THUR, FRI, SAT, SUN. If you omit this attribute, the event recurs on the day of the week determined by the startTime field value.

The following CFScript code sample sets an event that occurs on Tuesday and Thursday of every other week until December 3, 2007.

```
IsRecurring="true";
RecurrenceType="WEEKLY";
RecurrenceEndDate="12/13/2007";
RecurrenceFrequency="2";
RecurrenceDays="TUE,THU";
```

Specifying monthly recurrence
You can create an event that always occurs on a monthly basis, or occurs every several months by specifying RecurrenceType="MONTHLY". You can schedule two types of events:

- Events that occur on the same date of each scheduled month, for example, on the tenth day of every 3 months.

- Events that occur on the same week of the month and the same day of the week, for example, on the second thursday of every month, or on the last Friday of every 6 months.

To specify a date-based monthly event, you only specify the recurrence type, and, if the recurrence is not every month, the frequency. ColdFusion schedules the event to occur on the day of the week determined by the startTime field value. To schedule a meeting that occurs on the start date every 4 months, specify the following recurrence fields:

```
IsRecurring="true";
```
To specify an event that occurs on the same day of the week, specify the following fields in addition to RecurrenceType:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RecurrenceType</td>
<td>The frequency of the event, in months. If you omit this field, the event occurs every month.</td>
</tr>
<tr>
<td>RecurrenceFrequency</td>
<td>The week of the month on which the event occurs. Valid values are first, second, third, fourth, and last.</td>
</tr>
<tr>
<td>RecurrenceDay</td>
<td>The day of the week on which the event occurs. Valid values are SUN, MON, TUE, WED, THU, FRI, and SAT.</td>
</tr>
</tbody>
</table>

The following CFScript code sample sets an event that occurs on the third Thursday of every three months:

```csharp
IsRecurring="true";
RecurrenceType="MONTHLY";
RecurrenceFrequency="4";
RecurrenceWeek="third";
RecurrenceDay="THU";
```

**Specifying yearly recurrence**

You can create an event that always occurs on a yearly basis by specifying `RecurrenceType="YEARLY"`. You can schedule two types of events:

- Events that occur on the same date of each year, for example, on every August 10.
- Events that occur on a specific day week and month, for example, on the second Thursday of August.

To specify a date-based yearly event, you only specify the recurrence type. ColdFusion schedules the event to occur each year on the date determined by the `startTime` field value. To schedule a meeting that occurs on the start date every year, specify the following recurrence fields:

```csharp
IsRecurring="true";
RecurrenceType="YEARLY";
```

To specify an event that occurs on the same day of the week and month each year, specify the following fields in addition to RecurrenceType:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RecurrenceMonth</td>
<td>The month of the year which the event occurs. Valid values are JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, and DEC.</td>
</tr>
<tr>
<td>RecurrenceWeek</td>
<td>The week of the month during which the event occurs. Valid values are first, second, third, fourth, and last.</td>
</tr>
<tr>
<td>RecurrenceDay</td>
<td>The day of the week on which the event occurs. Valid values are SUN, MON, TUE, WED, THU, FRI, and SAT.</td>
</tr>
</tbody>
</table>

The following CFScript code sample sets an event that occurs on the third Thursday of August three months:

```csharp
IsRecurring="true";
RecurrenceType="YEARLY";
RecurrenceMonth="AUG";
RecurrenceWeek="third";
RecurrenceDay="THU";
```
Example: Setting calendar recurrence

The following example lets you create events with all types of recurrence. To limit the code length, it does not prevent you from attempting to create events with invalid field combinations. When you submit the form, if an event is created, the form redispays, preceded by a dump that shows the field values that were used to create the event, and the event UID. You cannot resubmit the form to modify the event, but you can change some values in the form and create an event.

<!--- Create a structure to hold the event information. --->
<cfparam name="form.eventID" default="0">

<!--- If the form was submitted, populate the event structure from it. --->
<cfif isDefined("Form.Submit")>
<cfscript>
    sEvent.AllDayEvent="false";
    sEvent=StructNew();
    sEvent.Subject=Form.subject;
    if (IsDefined("Form.allDay")) {
        sEvent.AllDayEvent="true";
        sEvent.StartTime=createDateTime(Year(Form.date), Month(Form.date),
        Day(Form.date), 8, 0, 0);
    } else {
        sEvent.StartTime=createDateTime(Year(Form.date), Month(Form.date),
        Day(Form.date), Hour(Form.startTime), Minute(Form.startTime), 0);
        sEvent.EndTime=createDateTime(Year(Form.date), Month(Form.date),
        Day(Form.date), Hour(Form.endTime), Minute(Form.endTime), 0);
    }
    sEvent.Location=Form.location;
    sEvent.RequiredAttendees=Form.requiredAttendees;
    sEvent.OptionalAttendees=Form.optionalAttendees;
    //sEvent.Resources=Form.resources;
    if (Form.reminder NEQ "") {
        sEvent.Reminder=Form.reminder;
    } else {
        sEvent.Reminder=0;
    }
    sEvent.Importance=Form.importance;
    sEvent.Sensitivity=Form.sensitivity;
    //Recurrence Fields
    if (IsDefined("Form.isRecurring")) {
        sEvent.IsRecurring="true";
    }
    if (IsDefined("Form.recurrenceNoEndDate")) {
        sEvent.RecurrenceNoEndDate="true";
    }
    if (Form.recurrenceCount NEQ "") {
        sEvent.RecurrenceCount=Form.recurrenceCount;
    }
    if (Form.recurrenceEndDate NEQ "") {
        sEvent.RecurrenceEndDate=createDateTime(Year(Form.recurrenceEndDate),
        Month(Form.recurrenceEndDate), Day(Form.recurrenceEndDate), 0, 0, 0);
    }
    sEvent.RecurrenceType=Form.recurrenceType;
    if (Form.recurrenceFrequency NEQ "") {
        sEvent.recurrenceFrequency=Form.recurrenceFrequency;
    }
    if (IsDefined("Form.recurEveryWeekDay")) {
        sEvent.RecurEveryWeekDay="true";
    }
    if (Form.recurrenceDays NEQ "") {
        sEvent.RecurrenceDays=Form.recurrenceDays;
    }
    if (Form.recurrenceDay NEQ "") {
        sEvent.RecurrenceDay=Form.recurrenceDay;
    }
    if (Form.recurrenceWeek NEQ "") {

sEvent.RecurrenceWeek=Form.recurrenceWeek;
if (Form.recurrenceMonth NEQ "") {
    sEvent.RecurrenceMonth=Form.recurrenceMonth;
}
sEvent.message=Form.Message;
</cfscript>

<cfdump var="sEvent#">

<!---- Create the event in Exchange. ---->
<cfexchangecalendar action="create"
    username="#user1#"
    password="#password1#"
    server="#exchangeServerIP#"
    event="#sEvent#"
    result="theUID">
<![if !defined("theUID")]>
    <cfoutput>Event Added. UID is#theUID#</cfoutput>
    <cfset Form.eventID = theUID >
<![endif]>
</cfif>

<cfform format="xml" preservedata="true" style="width:500" height="700">
    <cfinput type="text" label="Subject" name="subject" style="width:435" />
    <cfinput type="checkbox" label="All Day Event" name="allDay" />
    <cfinput type="datefield" label="Date" name="date" validate="date"
        style="width:100" />
    <cfinput type="text" label="Start Time" name="startTime" validate="time"
        style="width:100" />
    <cfinput type="text" label="End Time" name="endTime" validate="time"
        style="width:100" />
    <cfinput type="text" label="Location" name="location"
        style="width:435" />
    <cfinput type="text" label="Required Attendees" name="requiredAttendees"
        style="width:435" />
    <cfinput type="text" label="Optional Attendees" name="optionalAttendees"
        style="width:435" />
    <cfinput type="text" label="Resources" name="resources"
        style="width:435" />
    <cfinput type="text" label="Reminder (minutes)" validate="integer"
        name="reminder" style="width:200" />
    <cfselect name="importance" label="Importance" style="width:100">
        <option value="normal">Normal</option>
        <option value="high">High</option>
        <option value="low">Low</option>
    </cfselect>
    <cfselect name="sensitivity" label="Sensitivity" style="width:100">
        <option value="normal">Normal</option>
        <option value="company-confidential">Confidential</option>
        <option value="personal">Personal</option>
        <option value="private">Private</option>
    </cfselect>
    <hr />
    <!--- Recurrence Information --->
    <cfinput type="checkbox" label="IsRecurring" name="isRecurring" />
    <cfinput type="checkbox" label="RecurrenceNoEndDate" name="noEndDate" />
    <cfinput type="text" label="RecurrenceCount" validate="integer"
        required="false" name="recurrenceCount" />
    <cfinput type="text" label="RecurrenceEndDate" validate="date"
<cfselect name="RecurrenceType" label="Recurrence Type" style="width:100">
   <option value="DAILY">Daily</option>
   <option value="WEEKLY">Weekly</option>
   <option value="MONTHLY">Monthly</option>
   <option value="YEARLY">Yearly</option>
</cfselect>
<cfinput type="text" label="RecurrenceFrequency" validate="integer" name="recurrenceFrequency">
<cfinput type="checkbox" label="RecurEveryWeekDay" name="recurEveryWeekDay">
<cfinput type="text" label="RecurrenceDays" name="recurrenceDays">
<cfinput type="text" label="RecurrenceDay" name="recurrenceDay">
<cfselect name="RecurrenceWeek" label="RecurrenceWeek" style="width:100">
   <option value=""></option>
   <option value="first">First</option>
   <option value="second">Second</option>
   <option value="third">Third</option>
   <option value="fourth">Fourth</option>
   <option value="last">Last</option>
</cfselect>
<hr />
<cfinput type="textarea" label="Message" name="message" style="width:300; height:100">
<cfinput type="Submit" name="submit" value="Submit" />
Chapter 54: Interacting with Remote Servers

ColdFusion wraps the complexity of Hypertext Transfer Protocol (HTTP) and File Transfer Protocol (FTP) communications in a simplified tag syntax that lets you extend your site's offerings across the web.

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About interacting with remote servers

Transfer protocols are mechanisms for moving files and information from a source to one or more destinations. Two of the more popular protocols are the Hypertext Transfer Protocol (HTTP) and the File Transfer Protocol (FTP). ColdFusion has the cfhttp and cfftp tags that let you use these protocols to interact with remote servers.

The cfhttp tag lets you receive a web page or web-based file, just as a web browser uses HTTP to transport web pages. When you type a URL into a web browser, you make an HTTP request to a web server. With the cfhttp tag, you can display a web page, send variables to a ColdFusion or CGI application, retrieve specialized content from a web page, and create a ColdFusion query from a text file. You can use the Get or Post methods to interact with remote servers.

The cfftp tag takes advantage of FTP’s main purpose—transporting files. Unlike HTTP, FTP was not designed to interact with other servers for processing and interacting with data. After you establish an FTP connection with the cfhttp tag, you can use it to upload, download, and manage files and directories.

Using cfhttp to interact with the web

The cfhttp tag, which lets you retrieve information from a remote server, is one of the more powerful tags in the CFML tag set. You can use one of two methods—Get or Post—to interact with a remote server using the cfhttp tag:

- Using the Get method, you can only send information to the remote server in the URL. This method is often used for a one-way transaction in which cfhttp retrieves an object.
- Using the Post method, you can pass variables to a ColdFusion page or CGI program, which processes them and returns data to the calling page. The calling page then appears or further processes the data that was received. For example, when you use cfhttp to Post to another ColdFusion page, that page does not appear. It processes the request and returns the results to the original ColdFusion page, which then uses the information as appropriate.
Using the cfhttp Get method

You use Get to retrieve files, including text and binary files, from a specified server. The retrieved information is stored in a special variable, cfhttp.fileContent. The following examples show several common Get operations.

Retrieve a file and store it in a variable
1. Create a ColdFusion page with the following content:

```html
<html>
<head>
    <title>Use Get Method</title>
</head>
<body>
<cfhttp
    method="Get"
    url="http://www.adobe.com"
    resolveurl="Yes">
<cfoutput>
#cfhttp.FileContent# <br>
</cfoutput>
</cfhttp>
</body>
</html>
```

2. (Optional) Replace the value of the url attribute with another URL.

3. Save the file as get_webpage.cfm in the myapps directory under your web_root and view it in the web browser.

   The browser loads the web page specified in the url attribute.

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<cfhttp method="Get"
    url="http://www.adobe.com"
    resolveurl="Yes">` | Get the page specified in the URL and make the links absolute instead of relative so that they appear properly. |
| `<cfoutput>
    #cfhttp.FileContent# <br>
</cfoutput>` | Display the page, which is stored in the variable cfhttp.fileContent, in the browser. |

Get a web page and save it in a file
1. Create a ColdFusion page with the following content:

```html
<html>
<head>
    <title>Use Get Method</title>
</head>
<body>
<cfhttp
    method = "Get"
    url="http://www.adobe.com/software"
    path="c:\temp"
    file="adobe_software.htm">
</body>
</html>
```

2. (Optional) Replace the value of the url attribute with another URL and change the filename.
3  (Optional) Change the path from C:\temp to a path on your hard drive.

4  Save the page as save_webpage.cfm in the myapps directory under your web_root directory.

5  Go to the specified path and view the file that you specified in a text editor (using the values specified in step 1, this is C:\temp\macr_software.htm).

   The saved file does not appear properly in your browser because the Get operation saves only the specified web page HTML. It does not save the frame, image, or other files that the page might include.

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfhttp method=&quot;Get&quot; url=&quot;http://www.adobe.com/adobe/accessibility/images/spotlight.jpg&quot; path=&quot;c:\temp&quot; file=&quot;macr_software.htm&quot;&gt;</code></td>
<td>Get the page specified in the URL and save it in the file specified by the path and file attributes. When you use the path and file attributes, ColdFusion ignores any resovleurl attribute. As a result, frames and other included files cannot appear when you view the saved page.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>#cfhttp.MimeType#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

Get a binary file and save it

1  Create a ColdFusion page with the following content:

   `<cfhttp method="Get" url="http://www.adobe.com/software" path="c:\temp" file="macr_software.htm">`

   `<cfoutput>`
   `#cfhttp.MimeType#`
   `</cfoutput>`

2  (Optional) Replace the value of the url attribute with the URL of a binary file that you want to download.

3  (Optional) Change the path from C:\temp to a path on your hard drive.

4  Save the file as save_binary.cfm in the myapps directory under your web_root and open it in the web browser to view the MIME type.

5  (Optional) Verify that the binary file now exists at the location you specified in the path attribute.

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>#cfhttp.MimeType#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>#cfhttp.MimeType#</code></td>
<td></td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td></td>
</tr>
<tr>
<td><code>#cfhttp.MimeType#</code></td>
<td>Display the MIME type of the file.</td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>
Creating a query object from a text file

You can create a query object from a delimited text file by using the cfhttp tag and specifying method="Get" and the name attribute. This is a powerful method for processing and handling text files. After you create the query object, you can easily reference columns in the query and perform other ColdFusion operations on the data.

ColdFusion processes text files in the following manner:

- You can specify a field delimiter with the delimiter attribute. The default is a comma.
- If data in a field might include the delimiter character, you must surround the entire field with the text qualifier character, which you can specify with the textqualifier attribute. The default text qualifier is the double-quotation mark (".
- The textqualifier=" specifies that there is no text qualifier. If you use textqualifier="" (four " marks in a row), it explicitly specifies the double-quotation mark as the text qualifier.
- If there is a text qualifier, you must surround all field values with the text qualifier character.
- To include the text qualifier character in a field, use a double character. For example, if the text qualifier is ", use " to include a quotation mark in the field.
- The first row of text is always interpreted as column headings, so that row is skipped. You can override the file's column heading names by specifying a different set of names in the columns attribute. You must specify a name for each column. You then use these new names in your CFML code. However, ColdFusion never treats the first row of the file as data.
- When duplicate column heading names are encountered, ColdFusion adds an underscore character to the duplicate column name to make it unique. For example, if two CustomerID columns are found, the second is renamed "CustomerID_".

Create a query from a text file

1. Create a text file with the following content:

   OrderID,OrderNum,OrderDate,ShipDate,ShipName,ShipAddress
   001,001,01/01/01,01/11/01,Mr. Shipper,123 Main Street
   002,002,01/01/01,01/28/01,Shipper Skipper,128 Maine Street

2. Save the file as text.txt in the myapps directory under your web_root.

3. Create a ColdFusion page with the following content:

   ```cfml
   <cfhttp method="Get"
   url="http://127.0.0.1/myapps/text.txt"
   name="juneorders"
   textqualifier="">
   <cfoutput query="juneorders">
   OrderID: #OrderID#
   Order Number: #OrderNum#
   Order Date: #OrderDate#
   </cfoutput>
   <!--- Now substitute different column names --->
   <!--- by using the columns attribute --->
   <hr>
   <!--- Now using replacement column names<br>

   <cfhttp method="Get"
   url="http://127.0.0.1/myapps/text.txt"
   name="juneorders"
columns="ID,Number,ODate,SDate,Name,Address"
	textqualifier="">
</cfoutput>

4 Save the file as query_textfile.cfm in the myapps directory under your web_root and view it in the web browser.

Using the cfhttp Post method

Use the Post method to send cookie, form field, CGI, URL, and file variables to a specified ColdFusion page or CGI program for processing. For Post operations, you must use the cfhttpparam tag for each variable you want to post. The Post method passes data to a specified ColdFusion page or an executable that interprets the variables being sent and returns data.

For example, when you build an HTML form using the Post method, you specify the name of the page to which form data is passed. You use the Post method in cfhttp in a similar way. However, with the cfhttp tag, the page that receives the Post does not, itself, display anything.

Pass variables to a ColdFusion page
1 Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>HTTP Post Test</title>
</head>
<body>
<h1>HTTP Post Test</h1>
<cfhttp method="Post"
	url="http://127.0.0.1:8500/myapps/post_test_server.cfm">
<cfhttpparam type="Cookie"
	value="cookiemonster"
	name="mycookie6">
<cfhttpparam type="CGI"
	value="cgivar 
	name="mycgi">
<cfhttpparam type="URL"
	value="theurl"
	name="myurl">
<cfhttpparam type="Formfield"
	value="twriter@adobe.com"
	name="emailaddress">
<cfhttpparam type="File"
	name="myfile"
	file="c:\pix\trees.gif">
</cfhttp>
<cfoutput>
File Content:<br>
	#cfhttp.filecontent#<br>
Mime Type:#cfhttp.MimeType#<br>
</cfoutput>
</body>
</html>
```
2 Replace the path to the GIF file to a path on your server (just before the closing cfhttp tag).

3 Save the file as post_test.cfm in the myapps directory under your web_root.

**Note:** You must write a page to view the variables. This is the next procedure.

**Reviewing the code**

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cfhttp method=&quot;Post&quot; url=&quot;http://127.0.0.1:8500/myapps/post_test_server.cfm&quot;&gt;</code></td>
<td>Post an HTTP request to the specified page.</td>
</tr>
<tr>
<td><code>&lt;cfhttpparam type=&quot;Cookie&quot; value=&quot;cookiemonster&quot; name=&quot;mycookie6&quot;&gt;</code></td>
<td>Send a cookie in the request.</td>
</tr>
<tr>
<td><code>&lt;cfhttpparam type=&quot;CGI&quot; value=&quot;cgivar &quot; name=&quot;mycgi&quot;&gt;</code></td>
<td>Send a CGI variable in the request.</td>
</tr>
<tr>
<td><code>&lt;cfhttpparam type=&quot;URL&quot; value=&quot;theurl&quot; name=&quot;myurl&quot;&gt;</code></td>
<td>Send a URL in the request.</td>
</tr>
<tr>
<td><code>&lt;cfhttpparam type=&quot;Formfield&quot; value=&quot;twriter@adobe.com&quot; name=&quot;emailaddress&quot;&gt;</code></td>
<td>Send a Form field in the request.</td>
</tr>
<tr>
<td><code>&lt;cfhttpparam type=&quot;File&quot; name=&quot;myfile&quot; file=&quot;c:\pix\trees.gif&quot;&gt;</code></td>
<td>Send a file in the request. The <code>&lt;/&gt;</code> tag ends the http request.</td>
</tr>
<tr>
<td><code>&lt;cfoutput File Content:&lt;br&gt; #cfhttp.filecontent#&lt;br&gt;</code></td>
<td>Display the contents of the file that the page that is posted to creates by processing the request. In this example, this is the output from the cfoutput tag in server.cfm.</td>
</tr>
<tr>
<td><code>&lt;/cfoutput&gt; Mime Type: #cfhttp.MimeType#&lt;br&gt;</code></td>
<td>Display the MIME type of the created file.</td>
</tr>
</tbody>
</table>

**View the variables**

1 Create a ColdFusion page with the following content:

```html
<html>
<head><title>HTTP Post Test</title> </head>
<body>
<h1>HTTP Post Test</h1>
<cffile destination="C:\temp\" nameconflict="Overwrite"
  filefield="Form.myfile"
  action="Upload"
  attributes="Normal">
<cfoutput>
The URL variable is: #URL.myurl# <br>
The Cookie variable is: #Cookie.mycookie6# <br>
The CGI variable is: #CGI.mycgi#. <br>
The Formfield variable is: #Form.emailaddress#. <br>
The file was uploaded to #File.ServerDirectory#\#File.ServerFile#. 
</cfoutput></cfoutput> 
</body>
</html>
```
Replace C:\temp\ with an appropriate directory path on your hard drive.

Save the file as post_test_server.cfm in the myapps directory under your web_root.

View post_test.cfm in your browser and look for the file in C:\temp\ (or your replacement path).

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cffile destination=&quot;C:\temp\&quot; nameconflict=&quot;Overwrite&quot; filefield=&quot;Form.myfile&quot; action=&quot;Upload&quot; attributes=&quot;Normal&quot;&gt;</code></td>
<td>Write the transferred document to a file on the server. You send the file using the type=&quot;File&quot; attribute, but the receiving page gets it as a Form variable, not a File variable. This <code>cffile</code> tag creates File variables, as follows.</td>
</tr>
<tr>
<td><code>&lt;cfoutput&gt;</code></td>
<td>Output information. The results are not displayed by this page. They are passed back to the posting page in its <code>cfhttp.filecontent</code> variable.</td>
</tr>
<tr>
<td>The URL variable is: <code>#URL.myurl#</code></td>
<td>Output the value of the URL variable sent in the HTTP request.</td>
</tr>
<tr>
<td>The Cookie variable is: <code>#Cookie.mycookie#</code></td>
<td>Output the value of the Cookie variable sent in the HTTP request.</td>
</tr>
<tr>
<td>The CGI variable is: <code>#CGI.mycgi#</code></td>
<td>Output the value of the CGI variable sent in the HTTP request.</td>
</tr>
<tr>
<td>The Form variable is: <code>#Form.emailaddress#</code></td>
<td>Output the Form variable sent in the HTTP request. You send the variable using the type=&quot;formField&quot; attribute but the receiving page gets it as a Form variable.</td>
</tr>
<tr>
<td>The file was uploaded to <code>#File.ServerDirectory#\#File.ServerFile#</code>.</td>
<td>Output the results of the <code>cffile</code> tag on this page. This time, the variables really are File variables.</td>
</tr>
</tbody>
</table>

Return results of a CGI program

The following code runs a CGI program search.exe on a website and displays the results, including both the MIME type and length of the response. The search.exe program must expect a “search” parameter.

```html
<cfhttp method="Post"
    url="http://www.my_favorite_site.com/search.exe"
    resolveurl="Yes">
    <cfhttpparam type="Formfield"
        name="search"
        value="ColdFusion">
</cfhttp>
<cfoutput>
    Response Mime Type: `#cfhttp.mime#`<br>
    Response Length: `#len(cfhttp.filecontent)#`<br>
    Response Content: <br>
    #htmlcodeformat(cfhttp.filecontent)#<br>
</cfoutput>
```

Performing file operations with `cfftp`

The `cfftp` tag lets you perform tasks on remote servers using File Transfer Protocol (FTP). You can use `cfftp` to cache connections for batch file transfers when uploading or downloading files.

**Note:** To use `cfftp`, you must select the Enable ColdFusion Security option on the Sandbox Security page in the Security area in the ColdFusion Administrator. (In the Standard Edition, select Security > Basic Security.)
For server/browser operations, use the \texttt{cffile}, \texttt{cfcontent}, and \texttt{cfdirectory} tags.

Using \texttt{cfftp} involves two major types of operations: connecting, and transferring files. The FTP protocol also provides commands for listing directories and performing other operations. For a complete list of attributes that support FTP operations and additional details on using the \texttt{cfftp} tag, see the \textit{CFML Reference}.

\textbf{Open an FTP connection and retrieve a file listing}

1. Create a ColdFusion page with the following content:

```html
<html>
<head>
<title>FTP Test</title>
</head>

<body>
<h1>FTP Test</h1>
<!--- Open ftp connection --->
<cfftp connection="Myftp"
    server="MyServer"
    username="MyUserName"
    password="MyPassword"
    action="Open"
    stoponerror="Yes">
    <!--- Get the current directory name. --->
    <cfftp connection=Myftp
        action="GetCurrentDir"
        stoponerror="Yes">
    <!--- output directory name --->
    <cfoutput>
        The current directory is:#cfftp.returnvalue#<p>
    </cfoutput>
    <!--- Get a listing of the directory. --->
    <cfftp connection=Myftp
        action="listdir"
        directory="#cfftp.returnvalue#"
        name="dirlist"
        stoponerror="Yes">
    <!--- Close the connection.--->
    <cfftp action="close" connection="Myftp">
    <p>Did the connection close successfully?
    <cfoutput>#cfftp.succeeded#</cfoutput></p>
    <!--- output dirlist results --->
    <hr>
    <p>FTP Directory Listing:</p>
    <cftable query="dirlist" colheaders="yes" htmltable>
        <cfcol header="<B>Name</b>" TEXT="#name#">
        <cfcol header="<B>Path</b>" TEXT="#path#">
        <cfcol header="<B>URL</b>" TEXT="#url#">
        <cfcol header="<B>Length</b>" TEXT="#length#">
        <cfcol header="<B>LastModified</b>" TEXT="#DateFormat(lastmodified)#">
        <cfcol header="<B>IsDirectory</b>" TEXT="#isdirectory#">
    </cftable>
</p>
</body>
</html>
```
2. Change MyServer to the name of a server for which you have FTP permission.

3. Change MyUserName and MyPassword to a valid user name and password.

To establish an anonymous connection, enter “anonymous” as the user name and an e-mail address (by convention) for the password.

4. Save the file as ftp_connect.cfm in the myapps directory under your web_root and view it in the web browser.

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;cfftp connection=&quot;Myftp&quot; server=&quot;MyServer&quot; username=&quot;MyUserName&quot; password=&quot;MyPassword&quot; action=&quot;Open&quot; stoponerror=&quot;Yes&quot;&gt;</td>
<td>Open an FTP connection to the MyServer server and log on as MyUserName. If an error occurs, stop processing and display an error. You can use this connection in other cfftp tags by specifying the Myftp connection.</td>
</tr>
<tr>
<td>&lt;cfftp connection=Myftp action=&quot;GetCurrentDir&quot; stoponerror=&quot;Yes&quot;&gt;</td>
<td>Use the Myftp connection to get the name of the current directory; stop processing if an error occurs. Display the current directory.</td>
</tr>
<tr>
<td>&lt;cfftp connection=Myftp action=&quot;ListDir&quot; directory=&quot;#cfftp.returnvalue#&quot; name=&quot;dirlist&quot; stoponerror=&quot;Yes&quot;&gt;</td>
<td>Use the Myftp connection to get a directory listing. Use the value returned by the last cfftp call (the current directory of the connection) to specify the directory to list. Save the results in a variable named dirlist (a query object). Stop processing if there is an error.</td>
</tr>
<tr>
<td>&lt;cfftp action=&quot;close&quot; connection=&quot;Myftp&quot;&gt; &lt;p&gt;Did the connection close successfully? &lt;cfoutput&gt;#cfftp.succeeded#&lt;/cfoutput&gt; &lt;/p&gt;</td>
<td>Close the connection, and do not stop processing if the operation fails (because you can still use the results). Instead, display the value of the cfftp.succeeded variable, which is Yes if the connection is closed, and No if the operation failed.</td>
</tr>
<tr>
<td>&lt;cftable query=&quot;dirlist&quot; colheaders=&quot;yes&quot; htmltable&gt; &lt;cfcol header=&quot;&lt;b&gt;Name&lt;/b&gt;&quot; TEXT=&quot;#name#&quot;&gt; &lt;cfcol header=&quot;&lt;b&gt;Path&lt;/b&gt;&quot; TEXT=&quot;#path#&quot;&gt; &lt;cfcol header=&quot;&lt;b&gt;URL&lt;/b&gt;&quot; TEXT=&quot;#url#&quot;&gt; &lt;cfcol header=&quot;&lt;b&gt;Length&lt;/b&gt;&quot; TEXT=&quot;#length#&quot;&gt; &lt;cfcol header=&quot;&lt;b&gt;LastModified&lt;/b&gt;&quot; TEXT=&quot;#DateFormat(lastmodified)#&quot;&gt; &lt;cfcol header=&quot;&lt;b&gt;IsDirectory&lt;/b&gt;&quot; TEXT=&quot;#isdirectory#&quot;&gt; &lt;/cftable&gt;</td>
<td>Display a table with the results of the ListDir FTP command.</td>
</tr>
</tbody>
</table>

After you establish a connection with cfftp, you can reuse the connection to perform additional FTP operations until either you or the server closes the connection. When you access an already-active FTP connection, you do not need to re-specify the user name, password, or server. In this case, make sure that when you use frames, only one frame uses the connection object.

**Note:** For a single simple FTP operation, such as GetFile or PutFile, you do not need to establish a connection. Specify all the necessary login information, including the server and any login and password, in the single cfftp request.
Caching connections across multiple pages

The FTP connection established by the `cfftp` tag is maintained only in the current page unless you explicitly assign the connection to a variable with Application or Session scope.

Assigning a `cfftp` connection to an application variable could cause problems, since multiple users could access the same connection object at the same time. Creating a session variable for a `cfftp` connection makes more sense, because the connection is available to only one client and does not last past the end of the session.

Example: caching a connection

```cflock scope="Session" timeout=10>
<cfftp action="Open"
    username="anonymous"
    password="me@home.com"
    server="ftp.eclipse.com"
    connection="Session.myconnection">
</cflock>
```

In this example, the connection cache remains available to other pages within the current session. You must enable session variables in your application for this approach to work, and you must lock code that uses session variables. For more information on locking, see "Using Persistent Data and Locking" on page 272.

Note: Changing a connection's characteristics, such the `retrycount` or `timeout` values, might require you to re-establish the connection.

Connection actions and attributes

The following table shows the available `cfftp` actions and the attributes they require when you use a named (that is, cached) connection. If you do not specify an existing connection name, you must specify the `username`, `password`, and `server` attributes.

<table>
<thead>
<tr>
<th>Action</th>
<th>Attributes</th>
<th>Action</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>none</td>
<td>Rename</td>
<td>existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>new</td>
</tr>
<tr>
<td>Close</td>
<td>none</td>
<td>Remove</td>
<td>server</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>item</td>
</tr>
<tr>
<td>ChangeDir</td>
<td>directory</td>
<td>GetCurrentDir</td>
<td>none</td>
</tr>
<tr>
<td>CreateDir</td>
<td>directory</td>
<td>GetCurrentURL</td>
<td>none</td>
</tr>
<tr>
<td>ListDir</td>
<td>name</td>
<td>ExistsDir</td>
<td>directory</td>
</tr>
<tr>
<td></td>
<td>directory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RemoveDir</td>
<td>directory</td>
<td>ExistsFile</td>
<td>remotefile</td>
</tr>
<tr>
<td>GetFile</td>
<td>localfile</td>
<td>Exists</td>
<td>item</td>
</tr>
<tr>
<td></td>
<td>remotefile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PutFile</td>
<td>localfile</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>remotefile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 55: Managing Files on the Server

The `cffile`, `cfdirectory`, and `cfcontent` tags handle browser and server file management tasks, such as uploading files from a client to the web server, viewing directory information, and changing the content type that is sent to the web browser. To perform server-to-server operations, use the `cfftp` tag, described in “Performing file operations with `cfftp`” on page 1042.

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- Using `cffile` ................................................................. 1047
- Using `cfdirectory` .......................................................... 1054
- Using `cfcontent` ........................................................... 1056

**About file management**

ColdFusion lets you access and manage the files and directories on your ColdFusion server. The `cffile` tag has several attributes for moving, copying, deleting, and renaming files. You use the `cfdirectory` tag to list, create, delete, and rename directories. The `cfcontent` tag lets you define the MIME (Multipurpose Internet Mail Extensions) content type that returns to the web browser.

**Using `cffile`**

You can use the `cffile` tag to work with files on the server in several ways:

- Upload files from a client to the web server using an HTML form
- Move, rename, copy, or delete files on the server
- Read, write, or append to text files on the server

You use the `action` attribute to specify any of the following file actions: `upload`, `move`, `rename`, `copy`, `delete`, `read`, `readBinary`, `write`, and `append`. The required attributes depend on the `action` specified. For example, if `action="write"`, ColdFusion expects the attributes associated with writing a text file.

**Note:** Consider the security and logical structure of directories on the server before allowing users access to them. You can disable the `cffile` tag in the ColdFusion Administrator. Also, to access files that are not located on the local ColdFusion system, ColdFusion services must run using an account with permission to access the remote files and directories.

**Uploading files**

File uploading requires that you create two files:

- An HTML form to specify file upload information
- An action page containing the file upload code

The following procedures describe how to create these files.
Create an HTML file to specify file upload information

1. Create a ColdFusion page with the following content:

```html
<html>
<head><title>Specify File to Upload</title></head>
<body>
<h2>Specify File to Upload</h2>
<!---- the action attribute is the name of the action page --->
<form action="uploadfileaction.cfm"
enctype="multipart/form-data"
method="post">
<p>Enter the complete path and filename of the file to upload:
<input type="file"
name="FiletoUpload"
size="45">

</p>
<input type="submit"
value="Upload">
</form>
</body>
</html>
```

2. Save the file as uploadfileform.cfm in the myapps directory under your web_root and view it in the browser.

Note: The form will not work until you write an action page for it (see the next procedure).

Reviewing the code

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| `<form action="uploadfileaction.cfm"
enctype="multipart/form-data"
method="post">` | Create a form that contains file selection fields for upload by the user. The action attribute value specifies the ColdFusion template that will process the submitted form. The enctype attribute value tells the server that the form submission contains an uploaded file. The method attribute is set to post to submit a ColdFusion form. |
| `<input type="file"
name="FiletoUpload"
size="45">` | Allow the user to specify the file to upload. The file type instructs the browser to prepare to read and transmit a file from the user’s system to your server. It automatically includes a Browse button to let the user look for the file instead of manually entering the entire path and filename. |

The user can enter a file path or browse the system and select a file to send.

1. Create a ColdFusion page with the following content:

```cfml
<cfml>
<head> <title>Upload File</title></head>
<body>
<h2>Upload File</h2>
<cffile action="upload"
destination="c:temp\"
nameConflict="overwrite"
fileField="Form.FiletoUpload">
<cfoutput>
You uploaded #cffile.ClientFileName#.###cffile.ClientFileExt# successfully to #cffile.ServerDirectory#.
</cfoutput>
</body>
</cfml>
```
2. Change the following line to point to an appropriate location on your server:

   destination="c:\temp\"

   **Note:** This directory must exist on the server.

3. Save the file as uploadfileaction.cfm in the myapps directory under your `web_root`.

4. View uploadfileform.cfm in the browser, enter a file to upload, and submit the form.

   The file you specified uploads.

**Reviewing the code**

The following table describes the code and its function:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;cffile action=&quot;upload&quot;</code></td>
<td>Output the name and location of the uploaded file on the client machine.</td>
</tr>
<tr>
<td>destination=&quot;c:\temp&quot;</td>
<td>Specify the destination of the file.</td>
</tr>
<tr>
<td>nameConflict=&quot;overwrite&quot;</td>
<td>If the file already exists, overwrite it.</td>
</tr>
<tr>
<td>fileField=&quot;Form.FiletoUpload&quot;</td>
<td>Specify the name of the file to upload. Do not enclose the variable in number signs.</td>
</tr>
<tr>
<td>You uploaded #cffile.ClientFileName#.cffile.ClientFileExt# successfully to #cffile.ServerDirectory#.</td>
<td>Inform the user of the file that was uploaded and its destination. For information on scope variables, see “Evaluating the results of a file upload” on page 1051.</td>
</tr>
</tbody>
</table>

**Note:** This example performs no error checking and does not incorporate any security measures. Before deploying an application that performs file uploads, ensure that you incorporate both error handling and security. For more information, see “Securing Applications” on page 311 and “Handling Errors” on page 246.

**Resolving conflicting filenames**

When you save a file to the server, there is a risk that a file with the same name might already exist. To resolve this problem, assign one of these values to the `nameConflict` attribute of the `cffile` tag:

- **Error**: (default) ColdFusion stops processing the page and returns an error. The file is not saved.
- **Skip**: Allows custom behavior based on file properties. Neither saves the file nor returns an error.
- **Overwrite**: Overwrites a file that has the same name as the uploaded file.
- **MakeUnique**: Generates a unique filename for the uploaded file. The name is stored in the file object variables `serverFile` and `serverFileName`. You can use this variable to record the name used when the file was saved. The unique name might not resemble the attempted name. For more information on file upload status variables, see “Evaluating the results of a file upload” on page 1051.

**Controlling the type of file uploaded**

For some applications, you might want to restrict the type of file that is uploaded. For example, you might not want to accept graphic files in a document library.

You use the `accept` attribute to restrict the type of file that you allow in an upload. When an `accept` qualifier is present, the uploaded file's MIME content type must match the criteria specified or an error occurs. The `accept` attribute takes a comma-separated list of MIME data names, optionally with wildcards.
A file’s MIME type is determined by the browser. Common types, such as image/gif and text/plain, are registered in the browser.

**Note:** Current versions of Microsoft Internet Explorer and Netscape support MIME type associations. Other browsers and earlier versions might ignore these associations.

ColdFusion saves any uploaded file if you omit the `accept` attribute or specify "*/". You can restrict the file types, as demonstrated in the following examples.

The following `cffile` tag saves an image file only if it is in the GIF format:

```cfml
<cffile action="Upload"
    fileField="Form.FiletoUpload"
    destination="c:\uploads\"
    nameConflict="Overwrite"
    accept="image/gif">
```

The following `cffile` tag saves an image file only if it is in GIF or JPEG format:

```cfml
<cffile action="Upload"
    fileField="Form.FiletoUpload"
    destination="c:\uploads\"
    nameConflict="Overwrite"
    accept="image/gif, image/jpeg">
```

**Note:** If you receive an error similar to “The MIME type of the uploaded file (image/jpeg) was not accepted by the server”, enter `accept="image/jpeg"` to accept JPEG files.

This `cffile` tag saves any image file, regardless of the format:

```cfml
<cffile action="Upload"
    fileField="Form.FiletoUpload"
    destination="c:\uploads\"
    nameConflict="Overwrite"
    accept="image/**">
```

**Setting file and directory attributes**

In Windows, you specify file attributes using the `attributes` attribute of the `cffile` tag. In UNIX, you specify file or directory permissions using the `mode` attribute of the `cffile` or `cfdirectory` tag.

**Windows**

In Windows, you can set the following file attributes:

- Hidden
- Normal
- ReadOnly

To specify several attributes in CFML, use a comma-separated list for the `attributes` attribute; for example, `attributes="ReadOnly,Hidden"`. If you do not use the `attributes` attribute, the file's existing attributes are maintained. If you specify any other attributes in addition to Normal, the additional attribute overrides the Normal setting.

**UNIX**

In UNIX, you can individually set permissions on files and directories for each of three types of users—owner, group, and other. You use a number for each user type. This number is the sum of the numbers for the individual permissions allowed. Values for the `mode` attribute correspond to octal values for the UNIX `chmod` command:

- 4 = read
• 2 = write
• 1 = execute

You enter permissions values in the mode attribute for each type of user: owner, group, and other in that order. For example, use the following code to assign read permissions for everyone:

```
mode=444
```

To give a file or directory owner read/write/execute permissions and read only permissions for everyone else:

```
mode=744
```

### Evaluating the results of a file upload

After a file upload is completed, you can retrieve status information using file upload status variables. This status information includes data about the file, such as its name and the directory where it was saved.

You can access file upload status variables using dot notation, using either file.varname or cffile.varname. Although you can use either the File or cffile prefix for file upload status variables, cffile is preferred; for example, cffile.ClientDirectory. The File prefix is retained for backward compatibility.

**Note:** File status variables are read-only. They are set to the results of the most recent cffile operation. If two cffile tags execute, the results of the first are overwritten by the subsequent cffile operation.

The following table describes the file upload status variables that are available after an upload:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attemptedServerFile</td>
<td>Initial name that ColdFusion uses when attempting to save a file; for example, myfile.txt. (see &quot;Resolving conflicting filenames&quot; on page 1049).</td>
</tr>
<tr>
<td>clientDirectory</td>
<td>Directory on the client's system from which the file was uploaded.</td>
</tr>
<tr>
<td>clientFile</td>
<td>Full name of the source file on the client's system with the file extension; for example, myfile.txt.</td>
</tr>
<tr>
<td>clientFileExt</td>
<td>Extension of the source file on the client's system without a period; for example, txt (not .txt).</td>
</tr>
<tr>
<td>clientFileName</td>
<td>Name of the source file on the client's system without an extension; for example, myfile.</td>
</tr>
<tr>
<td>contentType</td>
<td>MIME content type of the saved file; for example, image for image/gif.</td>
</tr>
<tr>
<td>contentSubType</td>
<td>MIME content subtype of the saved file; for example, gif for image/gif.</td>
</tr>
<tr>
<td>dateLastAccessed</td>
<td>Date that the uploaded file was last accessed.</td>
</tr>
<tr>
<td>fileExisted</td>
<td>Indicates (Yes or No) whether the file already existed with the same path.</td>
</tr>
<tr>
<td>fileSize</td>
<td>Size of the uploaded file.</td>
</tr>
<tr>
<td>fileWasAppended</td>
<td>Indicates (Yes or No) whether ColdFusion appended the uploaded file to an existing file.</td>
</tr>
<tr>
<td>fileWasOverwritten</td>
<td>Indicates (Yes or No) whether ColdFusion overwrote a file.</td>
</tr>
<tr>
<td>fileWasRenamed</td>
<td>Indicates (Yes or No) whether the uploaded file was renamed to avoid a name conflict.</td>
</tr>
<tr>
<td>fileWasSaved</td>
<td>Indicates (Yes or No) whether ColdFusion saved the uploaded file.</td>
</tr>
<tr>
<td>oldFileSize</td>
<td>Size of the file that was overwritten in the file upload operation. Empty if no file was overwritten.</td>
</tr>
<tr>
<td>serverDirectory</td>
<td>Directory where the file was saved on the server.</td>
</tr>
<tr>
<td>serverFile</td>
<td>Full name of the file saved on the server with the file extension; for example, myfile.txt.</td>
</tr>
<tr>
<td>serverFileExt</td>
<td>Extension of the file saved on the server without a period; for example, txt (not .txt).</td>
</tr>
</tbody>
</table>
Moving, renaming, copying, and deleting server files

With the cffile tag, you can create application pages to manage files on your web server. You can use the tag to move files from one directory to another, rename files, copy a file, or delete a file.

The examples in the following table show static values for many of the attributes. However, the value of all or part of any attribute in a cffile tag can be a dynamic parameter.

<table>
<thead>
<tr>
<th>Action</th>
<th>Example code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move a file</td>
<td><code>&lt;cffile action=&quot;move&quot; source=&quot;c:\files\upload\KeyMemo.doc&quot; destination=&quot;c:\files\memo\&quot;&gt;</code></td>
</tr>
<tr>
<td>Rename a file</td>
<td><code>&lt;cffile action=&quot;rename&quot; source=&quot;c:\files\memo\KeyMemo.doc&quot; destination=&quot;c:\files\memo\OldMemo.doc&quot;&gt;</code></td>
</tr>
<tr>
<td>Copy a file</td>
<td><code>&lt;cffile action=&quot;copy&quot; source=&quot;c:\files\upload\KeyMemo.doc&quot; destination=&quot;c:\files\backup\&quot;&gt;</code></td>
</tr>
<tr>
<td>Delete a file</td>
<td><code>&lt;cffile action=&quot;delete&quot; file=&quot;c:\files\upload\oldfile.txt&quot;&gt;</code></td>
</tr>
</tbody>
</table>

This example sets the ReadOnly flag bit for the uploaded file:

```xml
<cffile action="Copy"
    source="c:\files\upload\keymemo.doc"
    destination="c:\files\backup"
    attributes="ReadOnly">
```

**Note:** Ensure you include the trailing slash (\) when you specify the destination directory. Otherwise, ColdFusion treats the last element in the pathname as a filename. This only applies to copy actions.

Reading, writing, and appending to a text file

In addition to managing files on the server, you can use the cffile tag to read, create, and modify text files. As a result, you can do the following things:

- Create log files. (You can also use cflog to create and write to log files.)
- Generate static HTML documents.
- Use text files to store information that can be incorporated into web pages.

**Reading a text file**

You can use the cffile tag to read an existing text file. The file is read into a local variable that you can use anywhere in the application page. For example, you could read a text file and then insert its contents into a database, or you could read a text file and then use one of the string replacement functions to modify the contents.
Read a text file

1. Create a ColdFusion page with the following content:

   ```
   <html>
   <head>
       <title>Read a Text File</title>
   </head>

   <body>
       Ready to read the file:<br>
       <cffile action="read"
             file="C:\inetpub\wwwroot\mine\message.txt"
             variable="Message">

       <cfoutput>
           #Message#
       </cfoutput>
   </body>
   </html>
   ```

2. Replace C:\inetpub\wwwroot\mine\message.txt with the location and name of a text file on the server.

3. Save the file as readtext.cfm in the myapps directory under your web_root and view it in the browser.

Writing a text file on the server

You can use the `cffile` tag to write a text file based on dynamic content. For example, you could create static HTML files or log actions in a text file.

Create a form in to capture data for a text file

1. Create a ColdFusion page with the following content:

   ```
   <html>
   <head>
       <title>Put Information into a Text File</title>
   </head>

   <body>
       <h2>Put Information into a Text File</h2>

       <form action="writetextfileaction.cfm" method="Post">
         <p>Enter your name: <input type="text" name="Name" size="25"></p>
         <p>Enter the name of the file: <input type="text" name="FileName" size="25">.txt</p>
         <p>Enter your message: <textarea name="message" cols=45 rows=6></textarea></p>
         <input type="submit" name="submit" value="Submit">
       </form>
   </body>
   </html>
   ```

2. Save the file as writetextfileform.cfm in the myapps directory under your web_root.

   Note: The form will not work until you write an action page for it (see the next procedure).

Write a text file

1. Create a ColdFusion page with the following content:

   ```
   <html>
   <head>
       <title>Write a Text File</title>
   </head>

   <body>
   ```
2 Modify the path C:\inetpub\wwwroot\mine\ to point to a path on your server.

3 Save the file as writetextfileaction.cfm in the myapps directory under your web_root.

4 View the file writetextfileform.cfm in the browser, enter values, and submit the form.
   The text file is written to the location you specified. If the file already exists, it is replaced.

Appending a text file
You can use the cffile tag to append additional text to the end of a text file; for example, when you create log files.

Append a text file
1 Open the writetextfileaction.cfm file.

2 Change the value for the action attribute from write to append so that the file appears as follows:

   <html>
   <head>
     <title>Append a Text File</title>
   </head>
   <body>
     <cffile action="append"
           file="C:\inetpub\wwwroot\mine\message.txt"
           output="Appended By: #Form.Name#">
   </body>
   </html>

3 Save the file as writetextfileaction.cfm in the myapps directory under your web_root.

4 View the file in the browser, enter values, and submit the form.
   The appended information displays at the end of the text file.

Using cfdirectory

Use the cfdirectory tag to return file information from a specified directory and to create, delete, and rename directories. When listing directory contents or deleting a directory, you can optionally use the recurse attribute to access or delete all subdirectories.

As with the cffile tag, you can disable cfdirectory processing in the ColdFusion Administrator. For details on the syntax of this tag, see the CFML Reference.

Returning file information
When you use the action="list" attribute setting, the cfdirectory returns a query object as specified in the name attribute. The name attribute is required when you use the action="list" attribute setting. This query object contains result columns that you can reference in a cfoutput tag, using the value specified in the name attribute:

name: Directory entry name.
**directory**: Directory containing the entry.

**size**: Directory entry size.

**type**: File type: File or Dir.

**dateLastModified**: Date an entry was last modified.

**attributes**: (Windows only) File attributes, if applicable.

**mode**: (UNIX only) The octal value representing the permissions setting for the specified directory.

**Note**: ColdFusion supports the ReadOnly and Hidden values for the attributes attribute for cfdirectory sorting.

Depending on whether your server is on a UNIX system or a Windows system, either the Attributes column or the Mode column is empty. Also, you can specify a filename in the filter attribute to get information on a single file.

The following procedure describes how to create a ColdFusion page in which to view directory information.

**View directory information**

1. Create a ColdFusion page with the following content:

   ```html
   <html>
   <head>
   <title>List Directory Information</title>
   </head>

   <body>
   <h3>List Directory Information</h3>
   <cfdirectory
directory="c:\inetpub\wwwroot\mine"
name="mydirectory"
sort="size ASC, name DESC, datelastmodified">
   <table cellspacing=1 cellpadding=10>
   <tr>
   <th>Name</th>
   <th>Size</th>
   <th>Type</th>
   <th>Modified</th>
   <th>Attributes</th>
   <th>Mode</th>
   </tr>
   <cfoutput query="mydirectory">
   <tr>
   <td>#mydirectory.name#</td>
   <td>#mydirectory.size#</td>
   <td>#mydirectory.type#</td>
   <td>#mydirectory.dateLastModified#</td>
   <td>#mydirectory.attributes#</td>
   <td>#mydirectory.mode#</td>
   </tr>
   </cfoutput>
   </table>
   </body>
   </html>
   ```

2. Modify the path C:\inetpub\wwwroot\mine so that it points to a directory on your server.

3. Save the file as directoryinfo.cfm in the myapps directory under your web_root and view it in the browser.
Using cfcontent

The cfcontent tag downloads files from the server to the client. You can use this tag to set the MIME type of the content returned by a ColdFusion page and, optionally, define the filename of a file to be downloaded by the current page. By default, ColdFusion returns a MIME content type of text/html so that a web browser renders your template text as a web page.

As with the cffile and cfdirectory tags, you can disable processing in the ColdFusion Administrator.

About MIME types

A MIME type is a label that identifies the contents of a file. The browser uses the MIME type specification to determine how to interact with the file. For example, the browser could open a spreadsheet program when it encounters a file identified by its MIME content type as a spreadsheet file.

A MIME content type consists of "type/subtype" format. The following are common MIME content types:

- text/html
- image/gif
- application/pdf

Changing the MIME content type with cfcontent

You use the cfcontent tag to change the MIME content type that returns to the browser along with the content generated from your ColdFusion page.

The cfcontent tag has one required attribute, type, which defines the MIME content type returned by the current page.

Change the MIME content type with cfcontent

1. Create an HTML page with the following content:
   
   `<h1>cfcontent_message.htm</h1>`
2  Save the file as cfcontent_message.htm in the myapps directory under your web_root.
   This HTML file will be called by the ColdFusion file that you write in steps 3 through 7.

3  Create a ColdFusion page with the following content:

\[
\begin{html}
   \begin{head}
      \title{cfcontent Example}
   \end{head}

   \begin{body}
      \h3{cfcontent Example}

      <cfcontent
         type = "text/html"
         file = "C:\CFusion\wwwroot\myapps\cfcontent_message.htm"
         deleteFile = "No">
   \end{body}
\end{html}
\]

4  If necessary, edit the file = line to point to your myapps directory.

5  Save the file as cfcontent.cfm in the myapps directory under your web_root and view it in the browser.
   The text of the called file (cfcontent_message.htm) displays as normal HTML, as shown in the following image:

6  In cfcontent.cfm, change type = "text/html" to type = "text/plain".

7  Save the file and view it in the browser (refresh it if necessary).
   The text displays as unformatted text, in which HTML tags are treated as text:
The following example shows how the cfcontent tag can create an Excel spreadsheet that contains your data.

**Create an Excel spreadsheet with cfcontent**

1. Create a ColdFusion page with the following content:

   ```
   <!--- Use cfsetting to block output of HTML outside of cfoutput tags. --->
   <cfsetting enablecfoutputonly="Yes">

   <!---- Get employee info. ---->
   <cfquery name="GetEmps" datasource="cfdocexamples">
     SELECT * FROM Employee
   </cfquery>

   <!---- Set content type. ---->
   <cfcontent type="application/msexcel">

   <!---- Suggest default name for XLS file. ---->
   <!---- "Content-Disposition" in cfheader also ensures relatively correct Internet Explorer behavior. ---->
   <cfheader name="Content-Disposition" value="filename=Employees.xls">

   <!---- Format data using cfoutput and a table. Excel converts the table to a spreadsheet. The cfoutput tags around the table tags force output of the HTML when using cfsetting enablecfoutputonly="Yes" ---->
   <cfoutput>
     <table cols="4">
       <cfloop query="GetEmps">
         <tr>
           <td>#Emp_ID#</td>
           <td>#FirstName#</td>
           <td>#LastName#</td>
         </tr>
       </cfloop>
     </table>
   </cfoutput>
   ```

2. Save the file as employees_to_excel.cfm in the myapps directory under your web_root and view it in the browser.

   The data appears in an Excel spreadsheet, as in the following image:
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fruh</td>
<td>Ben</td>
<td></td>
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<tr>
<td>2</td>
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<td>Marjorie</td>
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<tr>
<td>3</td>
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<td>Elanna</td>
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<tr>
<td>4</td>
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<td>Lancy</td>
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</tr>
<tr>
<td>5</td>
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<td>Jeremy</td>
<td></td>
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<tr>
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<td>Lightner</td>
<td>Carolyn</td>
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<td>7</td>
<td>More</td>
<td>Sue</td>
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<td>8</td>
<td>Lund</td>
<td>John</td>
<td></td>
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<td>9</td>
<td>Reff</td>
<td>Victoria</td>
<td></td>
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<tr>
<td>10</td>
<td>Allen</td>
<td>John</td>
<td></td>
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<tr>
<td>11</td>
<td>Crooks</td>
<td>Robert</td>
<td></td>
<td></td>
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<tr>
<td>12</td>
<td>Montgomery</td>
<td>Shown</td>
<td></td>
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<tr>
<td>13</td>
<td>Robinson</td>
<td>Danaled</td>
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<tr>
<td>14</td>
<td>Allaire</td>
<td>JD</td>
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<tr>
<td>15</td>
<td>Dow</td>
<td>John</td>
<td></td>
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<tr>
<td>16</td>
<td>Jones</td>
<td>Bob</td>
<td></td>
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<tr>
<td>17</td>
<td>Smith</td>
<td>Jane</td>
<td></td>
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<tr>
<td>18</td>
<td>Juma</td>
<td>Stephanie</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Cynthia</td>
<td>Jones</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Chapter 56: Using Event Gateways

Adobe ColdFusion provides event gateways, which you can use when writing applications. You configure an event gateway for an application and deploy the application.

To use event gateways, you should have a thorough knowledge of ColdFusion development concepts and practices, including ColdFusion components (CFCs). To write applications for custom gateways that are not provided in ColdFusion, you must also know the details of the event gateway you are using, including its requirements.

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About event gateways

ColdFusion event gateways are ColdFusion elements that let ColdFusion react to or generate external events or messages in an asynchronous manner. Event gateways let a ColdFusion application handle information that does not come through an HTTP request. For example, you can use event gateways to handle instant messages, short messages from mobile devices, or messages sent to a TCP/IP port.

The event gateway mechanism has the following major features:

- ColdFusion event gateways do not require HTTP requests. ColdFusion developers can write ColdFusion gateway applications without using any CFM pages (just CFCs).
- ColdFusion CFCs can use event gateways to listen for and respond directly to external events.
- Event gateways operate asynchronously. A gateway typically gets a message and dispatches it for processing, without requiring or waiting for a response.
- ColdFusion developers can create event gateways to handle any kind of event that a Java application can receive.

ColdFusion includes several product-level event gateways, such as a gateway for the XMPP (Extensible Messaging and Presence Protocol) instant messaging protocol. Adobe also provides the source for several example gateways, such as a generalized socket gateway, that you can extend to handle your specific needs. You can also write your own gateways in Java to handle other event or messaging technologies supported by the Java runtime or by third-party providers, such as gateways for additional instant messaging protocols, gateways for specific ERP systems, or other protocols, such as NNTP.
Using event gateways

Because event gateways provide a generalized asynchronous messaging mechanism, you can use them with many kinds of event or messaging resources. For example, ColdFusion includes gateways (either product quality, or lighter weight example gateways) for communicating between ColdFusion applications and the following types of resources:

- Mobile phones and other devices that support short messaging services (SMS)
- XMPP or IBM Sametime Instant message clients
- Java Sockets (which let your ColdFusion application communicate with TCP/IP-based devices and programs, such as Telnet terminal clients).
- Java Messaging Service (JMS) resources, such as storefront sales order handling systems.

Event gateways are not limited to sending or receiving information using communications protocols. For example, ColdFusion includes an example event gateway that monitors changes to a directory and invokes a CFC method whenever the directory changes. ColdFusion also includes an event gateway that lets a CFML application “call” a CFC asynchronously and continue processing without getting a response from the CFC.

Just as you can create event gateways that serve many different event or messaging based technologies, you can write many kinds of applications that use them. Just a few examples of possible gateway uses include the following.

Server to client push examples

- An application that sends an instant message (IM) or SMS text message to a person who can approve a purchase order, get a response, and mark the purchase order as approved or denied.
- A bot that notifies users through their preferred messaging method (cell phone, instant messaging, or even e-mail) when watch list stock goes up, and offers to buy or sell the stock immediately.
- An application that authenticates web users by sending them an SMS message that includes code that they must enter into the browser in order to proceed.

Client to server examples

- A menu-based SMS application that lets users get information from any of several web service data providers. ColdFusion includes a SMS menuing example int the gateways/cfc directory.
- A instant messaging application that takes messages from users to technical support and assigns and directs the messages to the most available support staff member. The application could also log the user ID and session, and you could use ColdFusion to generate usage reports.
- A directory lookup robot IM “buddy” that responds to messages chat contain an employee's name with the employee's phone number or buddy ID.

Server to serve examples

- A JMS subsystem that publishes status updates that are consumed by business intelligence systems.
- A system that monitors and publishes download events from a website.

Event gateway terms and concepts

This document uses the following terms when referring to event gateways:

Event: A trigger that ColdFusion can receive from an external source. ColdFusion event gateways receive events.

Message: The information provided by an event. In ColdFusion, a message is the data structure that the event gateway receives when an event is triggered.
**Event gateway**: Java code that receives events and sends them to and from ColdFusion application code. This document uses the term *event gateway*, without the word type or instance, to refer to the general concept of a ColdFusion event gateway. Where the context makes the meaning obvious, the term can also refer to event gateway type or event gateway instance.

**Event gateway type**: A specific *event gateway* implementation, represented by a Java class. Each event gateway type handles messages belonging to a particular a communications method or protocol, such as short message service (SMS), an instant messaging protocol, or Sockets. You generally have one event gateway type per communication protocol. You configure each event gateway type on the Gateway Types page in the Event Gateways area in the ColdFusion Administrator.

**Event gateway instance**: A specific instance of an *event gateway type* class. You configure each event gateway instance on the ColdFusion Gateways page by specifying the event gateway type, an ID, the path to the *event gateway application* CFC that uses this instance, and a configuration file (if needed for the selected event gateway type). You can have multiple event gateway instances per event gateway type, for example, for different event gateway applications.

**Event gateway application**: One or more CFCs and any supporting CFM pages that handle events from an *event gateway instance* and send messages using the event gateway instance. The event gateway application is not part of an event gateway instance, but the code that is responsible for processing event messages to and from the instance.

**Event gateway listener**: Code in an *event gateway* that receives events from an event source and passes them to the ColdFusion *gateway service* for delivery to a CFML listener CFC.

**Listener CFC**: A CFC that contains one or more methods that respond to incoming messages from one or more event gateway instances. Part of an *event gateway application*.

**ColdFusion gateway service**: The part of ColdFusion that provides underlying support for *event gateways*, including a path between an *event gateway instance* and listener CFCs.

**How event gateway applications work**

The following diagram shows the architecture of ColdFusion event gateway applications:

**How event gateways interact**

Typically, a ColdFusion event gateway instance, a Java object, listens for events coming from an external provider. For example, a general socket event gateway listens for messages on an IP socket, and an SMS event gateway receives messages from an SMSC server.
Each event gateway instance communicates with one or more listener CFCs through the ColdFusion event gateway service. The listener CFCs receive CFEvent object instances that contain the messages, process them, and can send responses back to the event gateway, which can send the messages to the external resources.

Alternatively, a ColdFusion application can initiate a message by calling a ColdFusion function that sends the message to the event gateway. The event gateway then forwards the message to an external resource, such as an instant messaging server. A CFC in the application listens for any responses to the sent message.

Some event gateways can be one-way: they listen for a specific event and send it to a CFC, or they get messages from a ColdFusion function and dispatch it, but they do not do both. The example DirectoryWatcherGateway listens for events only, and the asynchronous CFML event gateway receives messages from CFML only. (You could even say that the directory watcher gateway doesn’t listen for events; it creates its own events internally by periodically checking the directory state.) For information on the asynchronous CFML event gateway, see “Using the CFML event gateway for asynchronous CFCs” on page 1075.

**Event gateway structure**
Java programmers develop ColdFusion event gateways by writing Java classes that implement the coldfusion.event-gateway.Gateway interface. ColdFusion event gateways normally consist of one or more threads that listen for events from an event provider, such as a Socket, an SMSC server, or some other source. The event gateway sends event messages to the ColdFusion event gateway service message queue, and provides a method that gets called when an event gateway application CFC or CFM page sends an outgoing message.

The event gateway class can also do the following:

- Provide the ColdFusion application with access to a helper class that provides event gateway-specific services, such as buddy-list management or connection management.
- Use a file that specifies configuration information, such as IP addresses and ports, passwords, and other ID information, internal time-out values, and so on.

**About developing event gateway applications**
ColdFusion application developers write applications that use event gateways. The person or company that provides the event gateway supplies gateway-specific information to the ColdFusion developer. This information must include the structure and contents of the messages that the ColdFusion application receives and sends to the event gateway, plus any information about configuration files or helper methods that the ColdFusion application might use.

The ColdFusion developer writes a CFC that listens for messages. Many event gateway types send messages to a listener CFC method named onIncomingMessage. A minimal event gateway application might implement only this single method. More complex event gateway types can require multiple CFC listener methods. For example, the ColdFusion XMPP IM event gateway sends user messages to the onIncomingMessage CFC method, but sends requests to add buddies to the onAddBuddyRequest CFC method.

Depending on the event gateway and application types, the event gateway application might include CFM pages or CFC methods to initiate outgoing messages. The application also might use an event gateway-specific Gateway-Helper object to do tasks such as getting buddy lists in IM applications or getting a messaging server’s status.

The ColdFusion application developer also configures an event gateway instance in the ColdFusion Administrator, and possibly in a configuration file. The ColdFusion Administrator configuration information specifies the listener CFC that handles the messages from the event gateway and other standard event gateway configuration details. The configuration file, if required, contains event gateway type-specific configuration information.
Event gateway facilities and tools

ColdFusion provides a number of features and tools for developing and deploying event-handling applications, these including the following:

- Standard event gateways.
- Development tools and example code.
- A gateway directory structure configured for use by custom event gateways and event gateway applications. This directory also contains the example code.
- An event gateway-specific log file
- Three pages in the ColdFusion Administrator for managing event gateways.

Standard event gateways

Adobe provides several event gateways as part of ColdFusion. These event gateways support the following messaging protocols:

- **SMS (Short Message Service):** A system designed for exchanging short, often text, messages with wireless devices, such as mobile phones or pagers. For detailed information on using the SMS event gateway, see “Using the SMS Event Gateway” on page 1099.

- **XMPP (Extensible Messaging and Presence Protocol):** An open, XML-based protocol for instant messaging. For detailed information on using the XMPP event gateway, see “Using the Instant Messaging Event Gateways” on page 1083.

- **IBM Lotus Instant Messaging:** (commonly referred to as Lotus Sametime) The IBM product for real-time collaboration. For detailed information on using the Lotus Sametime event gateway, see “Using the Instant Messaging Event Gateways” on page 1083.

ColdFusion also provides an event gateway, the CFML asynchronous event gateway, that lets a CFML application invoke a CFC method asynchronously. This event gateway does not follow the model of providing a mechanism for exchanging messages with resources outside of ColdFusion. Instead, it provides a one-way path for invoking CFCs when an application does not require (indeed, cannot receive) a return value from the CFC. For detailed information on using the CFML asynchronous event gateway, see “Using the CFML event gateway for asynchronous CFCs” on page 1075.

Development tools and example code

ColdFusion provides the following tools and example code for developing your own event gateways and event gateway applications:

- An SMS client (phone simulator) and a short message service center (SMSC) server simulator, for developing SMS applications without requiring an external SMS provider.
- Four sample event gateways with source code:
  - A template for an empty event gateway that contains a skeleton on which you can build your own event gateways
  - A TCP/IP socket event gateway that listens on a TCP/IP port
  - A directory watcher event gateway that monitors changes to the contents of a directory
  - A Java Messaging Service (JMS) gateway that acts as a JMS consumer or producer.
• Several sample applications, including the following:
  • A menu application that uses an inquiry-response drill-down menu to provide services such as weather reports and stock quotes.
  • A simple echo application that sends back the messages that it receives.
  • A temperature converter, an asynchronous logging application.
  • An application that returns employee phone number and other information.

The chapters in this manual use these example applications.

• Javadoc documentation for the Java interfaces and classes that you use to create gateways.

For more information on these examples, see “Using the example event gateways and gateway applications” on page 1077.

**The ColdFusion gateway directory**

The ColdFusion installation includes a `cf_root`/WEB-INF/cfusion/gateway directory on J2EE configurations, or `cf_root`/gateway directory on server configurations. This directory contains all the code for ColdFusion example event gateways and example event gateway applications, and example configuration files for use by standard ColdFusion event gateways. You do not have to put your event gateways, event gateway application CFCs, or event gateway configuration files in this directory, but ColdFusion is configured to find event gateways and CFCs that you put there.

The following table lists the event gateway directory subdirectories, their purpose, and their initial contents. For more information on using the example event gateways and applications, see “Using the example event gateways and gateway applications” on page 1077.

<table>
<thead>
<tr>
<th>Directory</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfc</td>
<td>Event gateway application CFCs. ColdFusion is installed with an Administrator Mapping between /gateway and this cfc directory.</td>
</tr>
<tr>
<td>cfc/examples</td>
<td>Code for the ColdFusion sample applications.</td>
</tr>
<tr>
<td>config</td>
<td>Configuration files for all ColdFusion event gateways, including standard ColdFusion event gateways, such as SMS, and example event gateways, such as the directory watcher event gateway.</td>
</tr>
<tr>
<td>doc/api</td>
<td>Javadoc for the Gateway, and GatewayHelper interfaces, and the CFEvent, GatewayServices, and GenericGateway classes that gateway developer use when writing gateways. This documentation is a subset of the information in “Gateway development interfaces and classes” on page 1325 in the CFML Reference.</td>
</tr>
<tr>
<td>lib</td>
<td>Executable code for example and user-developed event gateway classes. The ColdFusion class loader includes this directory on its classpath and includes any JAR files that are in that directory on the class path. The examples.jar file in this directory contains the class files for the DirectoryWatcherGateway, EmptyGateway, and SocketGateway classes.</td>
</tr>
</tbody>
</table>
| src/examples | Source code for the example event gateway classes that Adobe provides. Includes the EmptyGateway.java file and the following subdirectories:  
  • socket: Socket gateway source files  
  • watcher: directory watcher gateway source files  
  • JMS: JMS gateway source files |
The eventgateway.log file
Event gateways provided with ColdFusion log event gateway errors and events to the cf_root\WEB-INF\cfusion\logs\eventgateway.log file on J2EE configurations, or the cf_root\logs\eventgateway.log file on server configurations. ColdFusion includes methods that let any event gateway use this file. This log file can be very useful in debugging event gateways and event gateway applications.

ColdFusion Administrator event gateway pages
The ColdFusion Administrator includes a Gateways section with three pages for managing event gateways:

- Settings
- Gateway types
- Gateways

The Settings page lets you enable and disable support for event gateways, specify the number of threads that ColdFusion can devote to processing events, specify the maximum number of events that ColdFusion can hold in its event queue (which holds events that are waiting to be processed) and start the SMS test server.

The Gateway Types page lets you add, remove, and configure event gateway types by specifying a name, a Java class, and startup time-out behavior.

Note: The gateway type name in the ColdFusion Administrator does not have to be the same as the gateway type that is used in the gateway Java code and the CFEvent data structure; however, you should use the same name in both places for consistency.

The Gateways page lets you add, remove, configure, start, and stop individual event gateway instances. You configure an event gateway instance by specifying a unique ID, the gateway type, one or more listener CFC paths, a configuration file (not required for all gateway types), and a startup mode (manual, automatic, or disabled).

Structure of an event gateway application
To develop an event gateway application, you create and use some or all of the following elements:

- One or more listener CFCs that handle any incoming messages and send any necessary responses.
- In some applications, ColdFusion pages that generate outgoing messages directly.
- An event gateway instance configuration in the ColdFusion Administrator. This configuration might require a separate event gateway configuration file.
- In some applications, a GatewayHelper object to provide access to additional features of the protocol or technology; for example, to manage instant messaging buddy lists.

The role of the listener CFC
All incoming event messages must be handled by one or more listener CFCs. You specify the listener CFCs when you configure an event gateway in the ColdFusion Administrator. You must specify at least one CFC in the administrator. Some gateway types can use more than one CFC. By default, the ColdFusion event gateway service delivers events by calling the CFC's onIncomingMessage method.
The event gateway developer must inform the event gateway application developer of methods that the listener CFC must implement (may be only the onIncomingMessage method) and of the structure and contents of the event message data, contained in the CFEvent instance, that the listener CFC must handle. Outgoing messages have the same event message data structure as incoming messages.

Many gateways let the listener CFCs send a response by calling the cfreturn function, but ColdFusion does not require a return value. Listener CFCs can also use the SendGatewayMessage function, which provides more flexibility than the cfreturn tag.

The role of ColdFusion pages
ColdFusion CFM pages cannot receive event messages. However, they can send messages using an event gateway. Therefore, an event gateway application that initiates outgoing messages might use one or more SendGatewayMessage functions to send the messages. An application that sends an SMS message to notify users when a package ships, for example, could use the SendGatewayMessage function to send the notification.

The role of the ColdFusion Administrator
The Gateways page in the ColdFusion Administrator associates a specific event gateway instance with one or more listener CFCs that processes messages from the event gateway. It tells the ColdFusion event gateway service to send messages received by the event gateway to the listener CFC. It also lets you specify a configuration file for the event gateway instance and whether to start the event gateway instance (and therefore any responder application) when ColdFusion starts. For more information on using the Administrator, see the ColdFusion Administrator online Help.

The role of the GatewayHelper object
A ColdFusion event gateway provides an information conduit: at its most basic, it receives and dispatches event messages. In some cases, however, an event gateway must provide additional functionality. An instant messaging event gateway, for example, needs to provide such services as managing buddies and providing status information. To support such use, an event gateway can enable access to a GatewayHelper object. The event gateway developer writes a Java class that provides the necessary utility routines as Java methods, and ColdFusion application developers can get an instance of the class by calling the CFML GetGatewayHelper method. The application calls the GatewayHelper object’s methods using normal ColdFusion object access techniques. The ColdFusion instant messaging event gateways and the example socket event gateway provide GatewayHelper objects.

Configuring an event gateway instance
Before you develop or deploy an event gateway application, you must use the ColdFusion Administrator to configure an event gateway instance that will handle the event messages. You specify the following information:

- An event gateway ID to identify the specific event gateway instance. You use this value in the CFML GetGatewayHelper and SendGatewayMessage functions.
- The event gateway type, which you select from the available event gateway types, such as SMS or Socket.
- The absolute path to the listener CFC or CFCs that will handle incoming messages. If you have multiple listener CFCs, enter the paths separated by commas. You must specify absolute file paths, even if you put the CFCs in the ColdFusion gateway\cfc directory.
- A configuration file, if required for this event gateway type or instance.
Developing an event gateway application

All event gateway applications handle information. They exchange event messages, and possibly other types of information, with other resources. Event gateway applications require a listener CFC to handle events that are sent to the event gateway. Event gateway applications can also use the following code elements:

- **SendGatewayMessage** CFML functions to send messages from outside the listener CFC (or, optionally, from the CFC)
- **GatewayHelper objects**
- **The eventgateway log file**

Event gateway application models

Event gateway applications follow one or both of the following models:

- **Responder applications**: Where event messages from external sources initiate a response from a ColdFusion listener CFC
- **Initiator applications**: Where a ColdFusion application generates event messages to send out using the event gateway

Unlike other ColdFusion applications, responder applications are request-free. They do not have CFM pages, just CFCs, and they do not respond to HTTP requests. Instead, ColdFusion the event gateway service deliver the event messages directly to the listener CFC, and the CFC listener method returns any response directly to the event gateway service. Applications that allow mobile phone owners to get a news feed, check for text messages, or request other forms of information follow this model.

Initiator applications are similar to most ColdFusion applications. At some point, ColdFusion executes a CFM page in response to a request. (The request could be initiated by the ColdFusion Administrator Scheduled Tasks page.) ColdFusion sends a message to the event gateway when the application calls a CFML SendGatewayMessage function. An application that uses SMS to notify customers when orders have been shipped follows this model.

Sending information to the event gateway

A ColdFusion application can send an outgoing message to the event gateway in either of the following ways:

- In a cfreturn tag in the listener CFC's listener method
- By calling the ColdFusion SendGatewayMessage function

The first method is useful to automatically respond to incoming messages. Some complex applications that respond to incoming messages might use the SendGatewayMessage function either in place or in addition to the return value.
Some event gateway types also use a GatewayHelper object to send information to external resources. For example, the ColdFusion XMPP and Lotus Sametime instant messaging event gateways provide a GatewayHelper object that can manage buddy lists, and set configuration and status information on the instant messaging server. For more information on the GatewayHelper object, see “Using the GatewayHelper object” on page 1074. For more information on the instant messaging GatewayHelper object, see “Sample IM message handling application” on page 1088.

The example code in “Example event gateway CFC” on page 1072 shows the use of a listener return value, and indicates how event gateways can require different data in the return structure to send equivalent messages.

Developing event gateway listener CFCs

The listener CFC responds to event gateway messages. The listener CFC uses, at a minimum, the following basic software elements:

- One or more listener methods
- CFEvent structures that contain the messages

Listener CFCs can use ColdFusion persistent scopes to store data that needs to be preserved over multiple CFC invocations or shared with other CFML elements.

Listener methods

The ColdFusion event gateway service calls one or more listener methods in the CFC to process incoming messages. The number of listener methods that you must write and their names depends on the event gateway. For example, the ColdFusion SMS event gateway requires a single listener method, which is typically named onIncomingMessage. (You can change the SMS event gateway listener method name in the event gateway configuration file.) The ColdFusion XMPP IM event gateway expects the listener CFC to have five methods: onIncomingMessage, onAddBuddyRequest, onAddBuddyResponse, onBuddyStatus, and onIMServerMessage. By default, if the event gateway does not specify the method name, ColdFusion calls the listener CFC's onIncomingMessage method. For the sake of consistency, Adobe recommends that any event gateway with a single listener method use the onIncomingMessage method.

The listener method does the following:

1. Takes a single parameter, a CFEvent structure, described in the following section.
2. Processes the contents of the instance as required by the application.
3. Optionally, returns an outgoing message to the event gateway in a cfreturn tag. It can also send a message back to the event gateway by calling the ColdFusion SendGatewayMessage function.

The following code shows a listener CFC with an onIncomingMessage method that echoes a message back to the Socket event gateway that sent it. It contains the minimum code required to process an incoming message and respond to the sender using the socket gateway.

```coldfusion
<cfcomponent displayname="echo" hint="echo messages from the event gateway">
   <cffunction name="onIncomingMessage" output="no">
      <cfargument name="CFEvent" type="struct" required="yes" />
      <!--- Create a return structure that contains the message. --->
      <cfset retValue = structNew()>
      <cfset retValue.DestinationID = arguments.CFEvent.OriginatorID>
      <cfset retValue.MESSAGE = "Echo: " & arguments.CFEvent.Data.MESSAGE>
      <!--- Send the return message back. --->
      <cfreturn retValue>
   </cffunction>
</cfcomponent>
```
Other event gateways require different fields in the return structure. For example, to echo a message using the SMS event gateway, you use the following lines to specify the return value:

```cfscript
<cfset retValue.command = "submit">
<cfset retValue.sourceAddress = arguments.CFEVENT.gatewayid>
<cfset retValue.destAddress = arguments.CFEVENT.originatorid>
<cfset retValue.ShortMessage = "Echo: " & arguments.CFEvent.Data.MESSAGE
```

The **CFEvent structure**
The ColdFusion event gateway service passes a CFEvent structure with information about the message event to the listener method. The following table describes the structure's fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GatewayID</td>
<td>The event gateway that sent the event; the value is the ID of an event gateway instance configured on the ColdFusion Administrator Gateways page. If the application calls the SendGatewayMessage function to respond to the event gateway, it uses this ID as the function's first parameter.</td>
</tr>
<tr>
<td>Data</td>
<td>A structure containing the event data, including the message. The Data structure contents depend on the event gateway type.</td>
</tr>
<tr>
<td>OriginatorID</td>
<td>The originator of the message. The value depends on the protocol or event gateway type. Many event gateways require this value in response messages to identify the destination of the response. Identifies the sender of the message.</td>
</tr>
<tr>
<td>GatewayType</td>
<td>The type of event gateway, such as SMS. An application that can process messages from multiple event gateway types can use this field. This value is the gateway type name that is specified by the event Gateway class. It is not necessarily the same as the gateway type name in the ColdFusion Administrator.</td>
</tr>
<tr>
<td>CFPath</td>
<td>The location of the listener CFC. The listener CFC does not need to use this field.</td>
</tr>
<tr>
<td>CFCMethod</td>
<td>The listener method that ColdFusion invokes to process the event. The listener CFC does not need to use this field.</td>
</tr>
<tr>
<td>CFCTimeout</td>
<td>The time-out, in seconds, for the listener CFC to process the event request. The listener CFC does not need to use this field.</td>
</tr>
</tbody>
</table>

When a ColdFusion application responds to an event gateway message, or sends a message independently, it does not use a CFEvent structure. However, the ColdFusion event gateway service creates a Java CFEvent instance with the message data before calling the event gateway's outgoingMessage method.

**Using persistent scopes in listener CFCs**
ColdFusion listener CFCs can use the Application, Client, and Session persistent scopes.

Because incoming event gateway messages are not associated with HTTP requests, ColdFusion uses different session and client IDs for interactions initiated by these events than for CFM Page requests, as follows:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session ID</td>
<td>gatewayType_gatewayID_originatorID</td>
</tr>
<tr>
<td>cfid</td>
<td>originatorID</td>
</tr>
<tr>
<td>cftoken</td>
<td>gatewayType_gatewayID</td>
</tr>
</tbody>
</table>

The **gatewayID** value is the event gateway ID that you set in the ColdFusion Administrator, and **gatewayType and originatorID** are the values that the event gateway sets in the CFEvent instance for an incoming message.
Application scope
The Application scope lets the CFC share data with any ColdFusion page or CFC that uses the same application name. This way, a listener CFC can use the same Application scope as CFML pages that might be used to send messages. Also, you can put multiple listener CFCs in a single directory and have them share an Application.cfc or Application.cfm file and application name.

As with all ColdFusion code, use the Application.cfc This.name variable or the cfapplication tag to set the application name. The listener CFC can use an Application.cfc or Application.cfm file if the CFC is in a directory that is in or under one of the following places:

- the ColdFusion web root
- a directory that is in the ColdFusion Administrator Mappings list.

The ColdFusion installer creates a mapping in the ColdFusion Administrator for the gateway\cfc directory.

Client scope
The Client scope can store long-term information associated with a message sender’s ID. For example, it can store information about an IM buddy.

To use Client variables across multiple connections, your gateway type must use the same client ID for all interactions with a particular client. For many technologies and gateways, such as the IM and SMS gateways, this is not an issue.

Note: To use Client scope variables with gateways, you must store the Client scope variables in a data source or the registry. You cannot store the variables in cookies, because gateways do not use cookies.

Session scope
The Session scope can store information required across multiple interactions. For example, an interactive IM or SMS application that uses a drill-down menu to select a service can store the information about the menu selections in the Session scope.

Event gateway sessions terminate when they time out. Because the identifiers for event sessions and clients differ from those used for request-driven sessions and clients, you cannot use the same Session or Client scope on a standard CFM page that sends an outgoing message and in a listener CFC that might handle an incoming response to that message.

For an example of using the Session scope, see the example Menu application in the gateway\cfc\examples\menu directory.

Note: ColdFusion cannot create a session if an initiator application uses a SendGatewayMessage method to start an interaction with a client, such as an SMS user. In this case, the sending code must keep track (for example, in a database) of the messages it sends and their destinations. When a response event arrives, it can look up the originatorID to determine whether it was in response to an outgoing message.

Debugging event gateway CFCs
When an event gateway CFC responds to an event, it cannot display debugging information in the response page, as CFM pages do. As a result, many of the normal ColdFusion debugging techniques, including the cfdump tag, are not available. When you develop event gateway CFCs, you should consider the following debugging techniques:

- Put trace variables in the Application scope. These variables persist, and you can specify an application name for your CFC (see “Application scope” on page 1071). You can inspect the Application scope contents, including your trace variables, in any CFML page that has the same application name as your CFC.
(Continued)

- Use **cflog** tags to help you trace any errors by logging significant events to a file. Also, carefully inspect the eventgateway.log and exceptions.log files that ColdFusion maintains. For more information on using the eventgateway.log file, see “The eventgateway.log file” on page 1066.

- You can simulate responses from CFCs to the event gateway by using the **SendGatewayMessage** function in a CFM page. The function’s *message* parameter should contain the information that the CFC would put in its return variable.

- If you run ColdFusion from the command line, you can use the Java **System.out.println** method to write messages to the console window, as the following code shows:

  ```cfscript>
  sys = createObject("java", "java.lang.System");
  sys.out.println("Debugging message goes here");
  </cfscript>

  **Note:** You do not have to restart the event gateway instance when you make changes to a CFC. ColdFusion automatically uses the updated CFC when the next event occurs.

### Example event gateway CFC

The following code shows a temperature scale converter tool that can work with any of several event gateways: SMS, XMPP, Lotus Sametime, or the example Socket event gateway. Users enter a string that consists of the temperature scale (F, Fahrenheit, C, or Celsius), a comma, and a temperature on their device. The CFC converts Celsius to Fahrenheit or Fahrenheit to Celsius, and returns the result.

This example shows how a responder event gateway application can work, and illustrates how different event gateway types require different outgoing message formats:

```cfcomponent displayname="tempconverter" hint="Convert temperatures between Celsius and Fahrenheit">
  <cffunction name="onIncomingMessage" output="no">
    <cfargument name="CFEvent" type="struct" required="yes">
      <!--- Standard error message giving the correct input format. --->
      <cfset var errormsg = "Please enter scale, integer where scale is F or C, for example: F, 32">
      <!--- Get the message. --->
      <cfset data=cfevent.DATA>
      <cfset message="#data.message#">
      <!--- Where did it come from? --->
      <cfset orig="#CFEvent.originatorID#">
      <!--- Process the input, generate a message with the new temperature. --->
      <!--- Input format is: degrees, temperature. --->
      <cfif listlen(message) eq 2>
        <cfif (listgetat(message,1) IS "F") OR
            (listgetat(message,1) IS "Fahrenheit") OR
            (listgetat(message,1) IS "C") OR
            (listgetat(message,1) IS "Celsius")>
          <cfset scale=listgetat(message,1)>
          <cfif isNumeric(listgetat(message,2))>
            <cfset temperature=listgetat(message,2)>
            <cfswitch expression="#scale#">
              <cfcase value="F, Fahrenheit">
                <cfset retmsg = temperature & " degrees Fahrenheit is " & (temperature-32.0) * (5.0/9.0) & " degrees Celsius">
              </cfcase>
              <cfcase value="C, Celsius">
                <cfset retmsg = temperature & " degrees Celsius is " & ((temperature-32.0) * (5.0/9.0)) & " degrees Fahrenheit">
              </cfcase>
            </cfswitch>
          </cfif>
        </cfif>
      </cfif>
    </cfargument>
  </cffunction>
</cfcomponent>
```


<cfset retmsg = temperature & " degrees Celsius is ">
(temperature * 9.0/5.0) + 32 & " degrees Fahrenheit">
</cfcase>
</cfswitch>
<cfelse>
<cfset retmsg=errormsg>
</cfif>
<cfelse>
<cfset retmsg=errormsg>
</cfif>
<cfelse>
<cfset retmsg=errormsg>
</cfif>
<!--- Fill the return value as required for the event gateway type. --->
<cffunction name="SendGatewayMessage" type="function" returntype="string">
<cfargument name="gatewayID" type="string" required="true">
<cfargument name="messageStruct" type="structure" required="true">
<cfset retValue = structNew()>
<cfset retValue.MESSAGE = retmsg>
<cfset retValue.originatorID = orig>
<cfelseif (arguments.CFEVENT.GatewayType is "Sametime") OR
(arguments.CFEVENT.GatewayType is "XMPP")>
<cfset retValue = structNew()>
<cfset retValue.MESSAGE = retmsg>
<cfset retValue.BuddyID = arguments.CFEVENT.DATA.SENDER>
<cfset retValue.originatorID = orig>
<cfelseif arguments.CFEVENT.GatewayType is "SMS">
<cfset retValue = structNew()>
<cfset retValue.command = "submit">
<cfset retValue.sourceAddress = arguments.CFEVENT.gatewayid>
<cfset retValue.destAddress = arguments.CFEVENT.originatorid>
<cfset retValue.shortMessage = retmsg>
</cffunction>
</cfreturn retValue>
</cfcfunction>
</cfccomponent>

Sending a message using the SendGatewayMessage function

The SendGatewayMessage function has the following format:

SendGatewayMessage(gatewayID, messageStruct)

• The gatewayID parameter must be the gateway ID specified in the ColdFusion Administrator for the event gateway instance that will send the message.

• The messageStruct parameter is a structure whose contents depends on the requirements of the event gateway’s outgoingMessage method, and possibly the recipient application. For example, in addition to any message, the structure might include a destination identifier.

The CFEvent instance passed to the event gateway contains these two parameters in the GatewayID and Data fields; the remaining fields are empty.

The following example sends a message to a logging CFC, which logs information to a file. If the SendGatewayMessage function returns “OK”, the example code displays a message. The code uses an instance of the asynchronous CFML event gateway named Asynch Logger. The props variable used in the messageStruct parameter has two entries, the destination file and the message to log.
<cfscript>
  status = "No";
  props = structNew();
  props.Message = "Replace me with a variable with data to log";
  status = SendGatewayMessage("Asynch Logger", props);
  if (status IS "OK") WriteOutput("Event Message \\
"#props.Message#" has been sent.");
</cfscript>

**Note:** To see the code for the CFC that logs the information, see "Using the CFML event gateway for asynchronous CFCs" on page 1075.

**Using the GatewayHelper object**

The ColdFusion `GetGatewayHelper` function tells ColdFusion to create and initialize a Java GatewayHelper object that provides event gateway-specific helper methods and properties. To use this function, the event gateway must implement a GatewayHelper class. For example, an instant messaging event gateway might make buddy list management methods available in a GatewayHelper object.

The ColdFusion `GetGatewayHelper` function takes a single parameter, the ID of the event gateway instance that provides the helper, and returns a GatewayHelper Java object. The parameter value must be the gateway ID for the instance that is specified in the ColdFusion Administrator. If you do not want to hard-code an ID value in the application (for example, if your listener CFC can respond to multiple event gateway instances), get the gateway ID from the CFEvent structure of the first incoming message.

The CFML code accesses the GatewayHelper object's methods and properties using standard ColdFusion Java object access techniques (see "Integrating J2EE and Java Elements in CFML Applications" on page 927). For example, if an event gateway's GatewayHelper class includes an `addBuddy` method that takes a single String parameter, you could use the following code to get the ColdFusion XMPP or Sametime gateway GatewayHelper object and add a buddy to the buddies list:

<cfscript>
  myHelper = GetGatewayHelper(myGatewayID);
  status = myHelper.addBuddy("jsmith23", "Jim Smith", "support");
</cfscript>

**Using the event gateway error log file**

When a standard ColdFusion event gateway encounters an error that does not prevent the event gateway from continuing to process, it logs it to the eventgateway.log file in the ColdFusion logs directory. Other event gateways can also to log information in this file, or to other application-specific files in the logs directory.

The standard ColdFusion event gateways log errors in interaction with any messaging server, errors in messages sent by the ColdFusion application, and recoverable errors in event gateway operation. The event gateways also log informational status messages for significant normal events, including event gateway initialization and restarts.

ColdFusion event gateway messages in the eventgateway.log file normally have the following format:

```
gatewayType (gatewayID) message body
```

When you are developing an event gateway application, you can use the ColdFusion Log viewer to inspect the eventgateway.log file and filter the display by using the gateway type and possibly the gateway ID as keywords. By selecting different severity levels, you can get a good understanding of errors and possible inefficiencies in your application and event gateway operation.
Deploying event gateways and applications

To deploy an event gateway application in a ColdFusion server, you must install your listener CFC and configure an gateway instance that uses the CFC.

**Deploy an event gateway application**

1. Ensure that the ColdFusion Administrator is configured with the required event gateway type. If it is not, deploy the event gateway type (see "Deploying an event gateway" on page 1140).

2. If the event gateway type requires a configuration file, ensure that there is a valid file in the gateway\config directory. Some event gateways might be designed to let multiple event gateway instances share a configuration file. Others might require a separate file for each event gateway instance.

3. Install the event gateway application listener CFC and any other application components. ColdFusion provides a `cf_root\gateways\cfc` directory as a convenient location for these CFCs, and includes a mapping in the ColdFusion Administrator page for that directory. However, ColdFusion does not require you to install the listener CFC in this directory.

4. Configure an event gateway instance on the Gateways page of the Event Gateways section in the ColdFusion Administrator (see "Configuring an event gateway instance" on page 1067)

**Using the CFML event gateway for asynchronous CFCs**

The ColdFusion CFML event gateway lets CFML code send a message to CFC methods asynchronously. This event gateway lets you initiate processing by a CFC method without waiting for it to complete or return a value. Possible uses for asynchronous CFCs that you access using this event gateway include the following:

- Reindexing a Verity collection with new information without delaying an application, for example, when a user uploads a new file
- Logging information, particularly if there is significant amount of data to log
- Running batch processes that might take a substantial amount of time to complete

Because asynchronous CFCs run independently of a request, they do not provide feedback to the user. You must save any results or error information to a file, data source, or other external resource.

By default, ColdFusion delivers the message to a CFC method named `onIncomingMessage`. You can specify any method name, however, in the `SendGatewayMessage` method's `data` parameter.

**CFML event gateway data structure**

The structure that you use in the CFML `SendGatewayMessage` function can include two types of fields:

- The structure can include any number of fields with arbitrary contents for use in by the CFC.
- Several optional fields can configure how the gateway delivers the information to the CFC.

The CFML gateway looks for the following optional fields, and, if they exist, uses them to determine how it delivers the message. Do not use these field names for data that you send to your CFC method.
Using the CFML gateway
The following procedure describes how to use an asynchronous CFC that has a single, `onIncomingMessage` method.

Use an asynchronous CFC
1. Create a CFC with an `onIncomingMessage` method. Put the CFC in an appropriate directory for your application. For example, you can put it in the `cf_root\WEB-INF\cfusion\gateway\cfc` directory on J2EE configurations, in the `cf_root\gateway\cfc` directory on server configurations, or in a subdirectory of these directories. ColdFusion is installed with mappings to these cfc gateway directories.

   The `onIncomingMessage` method must take a CFEvent structure that contains input information in its Data field, and processes the contents of the Data field as needed.

2. Use the Gateways page in the ColdFusion Administrator to add an instance of the CFML event gateway type. Specify the following:
   - A unique Gateway ID.
   - The path to the CFC that you created in step 1.
   - The startup mode. Select Automatic startup mode to start the event gateway when ColdFusion starts up.
   - Do not specify a configuration file.

3. Start the event gateway instance.

4. Write CFML code that uses `SendGatewayMessage` functions to send messages in structures to the event gateway instance ID that you specified in step 2. The `SendGatewayMessage` function returns true if the gateway successfully queues the message in the ColdFusion Gateway Service; false, otherwise. It does not ensure that the CFC receives or processes the message.

5. Run your CFML application.

Example: logging messages
The following asynchronous CFML event gateway CFC uses the `cflog` tag to log a message to a file in the ColdFusion logs directory. The CFC takes a message with the following fields:

- file The name of the file in which to put the message. The default value is defaultEventLog.
- type The `cflog` type attribute to use. The default value is info.
- message The message text.

```cfcomponent>
```
<cffunction name="onIncomingMessage" output="no">
  <cfargument name="CFEvent" type="struct" required="yes">
  <cfscript>
  if (NOT IsDefined("CFEvent.Data.file")) {
    CFEvent.Data.file="defaultEventLog";
  }
  if (NOT IsDefined("CFEvent.Data.type")) {
    CFEvent.Data.type="info";
  }
  </cfscript>
  <cflog text="#CFEvent.Data.message#"
  file="#CFEvent.Data.file#"
  type="#CFEvent.Data.type#"
  thread="yes"
  date="yes"
  time="yes"
  application="yes">
</cffunction>
</cfcomponent>

The following minimal CFML page tests the event gateway:

Sending an event to the CFML event gateway that is registered in the ColdFusion Administrator as Asynch Logger.

<cfscript>
  status = false;
  props = structNew();
  props.Message = "Replace me with a variable with data to log";
  status = SendGatewayMessage("Asynch Logger", props);
  if (status IS True) WriteOutput('Event Message "#props.Message#" has been sent.');
</cfscript>

Using the example event gateways and gateway applications

ColdFusion provides several example event gateways and applications in the cf_root\WEB-INF\cfusion\gateway directory on J2EE configurations or the cf_root\gateway directory on server configurations. These gateways provide example code that you can examine or use in developing your gateways. They are intended as examples only, and are not complete, product-quality, implementations.

Example event gateways

The gateway\src\examples directory and its subdirectories include the sources for the example event gateways. Compiled versions are located in the gateway\lib\examples.jar file. The following sections briefly describe the event gateways and their functions. For more detailed information, see the code and comments in the files.

EmptyGateway

The EmptyGateway.java file contains an event gateway template that you can use as a skeleton for creating your own event gateway. For more information on this class, and on creating new event gateways, see "Creating Custom Event Gateways" on page 1128.
SocketGateway
The SocketGateway event gateway listens on a TCP/IP port. Therefore, you can use this gateway for applications that send and respond to messages using TCP/IP-based protocols such as Telnet, or for applications that send messages between sockets. For example, a simple gateway application that might respond to messages from a Telnet terminal client without supporting the full Telnet protocol.

Note: The ColdFusion Administrator uses Socket as the gateway type name for the SocketGateway class.

The SocketGateway.java file defines two classes: SocketGateway, the event gateway, and SocketHelper, a Gateway-Helper class. The Source file is located in the gateway\src\examples\socket directory.

SocketGateway: Listens on a TCP/IP port. This event gateway is multithreaded and can handle multiple clients simultaneously. It can send outgoing messages to existing clients, but cannot establish a link itself.

By default, the SocketGateway class listens on port 4445, but you can specify the port number in a configuration file. The file should contain a single line in the following format:

    port=portNumber

SocketHelper: A GatewayHelper class with the following methods:

- getSocketIDs() returns an array containing the socket IDs of all Java sockets that are open. The event gateway opens a socket for each remote client.
- killSocket(String socketid) Removes the specified socket. Returns a Boolean success indicator.

DirectoryWatcherGateway
The DirectoryWatcherGateway event gateway sends events to the listener CFC when a file is created, deleted, or modified in a directory. The watcher runs in a thread that sleeps for an interval specified in the configuration file, and when the interval has passed, checks for changes since the last time it was awake. If it finds added, deleted, or changed files, it sends a message to a listener CFC. You can configure separate CFCs for add, delete, and change events, or use a single CFC for all events. The source for this event gateway is located in the gateway/src/examples/watcher directory.

Note: The ColdFusion Administrator uses DirectoryWatcher as the gateway type name for the DirectoryWatcher-Gateway class.

Configuration file
This event gateway requires a configuration file, consisting of lines in the following format:

directory=C:/temp

Note: If you use backward slash characters (\) as directory separators in Windows the file paths, you must escape them by using double slashes, as in C:temp. You can use forward slashes (/) as the directory separator on all operating systems, including Windows.

The configuration file can have comment lines, preceded by a number sign (#). If you omit a property or comment it out, ColdFusion uses the default value. If you specify a property with no value, ColdFusion sets an empty property.

The configuration file can define the following values:

<table>
<thead>
<tr>
<th>Property</th>
<th>Req/Opt</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>directory</td>
<td>Required</td>
<td>Path to the directory to watch.</td>
</tr>
<tr>
<td>recurse</td>
<td>Optional</td>
<td>Whether to check subdirectories. The default value is no.</td>
</tr>
<tr>
<td>extensions</td>
<td>Optional</td>
<td>Comma-delimited list of extensions to watch. The event gateway logs only changed files with these extensions. An asterisk (*) indicates all files. The default value is all files.</td>
</tr>
</tbody>
</table>
An example configuration file is located in the gateway\config\directory-watcher.cfg file.

CFC methods
When the directory contents change, the event gateway calls one of the following CFC listener methods, unless you change the names in the configuration file:

- onAdd
- onChange
- onDelete

The CFEvent.Data field sent to the listener methods includes the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>Event type, one of ADD, CHANGE, DELETE.</td>
</tr>
<tr>
<td>FILENAME</td>
<td>Name of the file that was added, deleted, or changed.</td>
</tr>
<tr>
<td>LASTMODIFIED</td>
<td>The date and time that the file was created or modified. This field is not included if the file was deleted.</td>
</tr>
</tbody>
</table>

The event gateway supports multiple listener CFCs and sends the event messages to all listeners. The event gateway is one-way; it watches for events and dispatches event information to a CFC, but it does not accept return values from the CFC or input from SendGatewayMessage functions.

The directory watcher logs errors to the watcher.log file in the ColdFusion logs directory.

Example DirectoryWatcher application
The following code shows a simple directory watcher application. It enters a line in a log file each time a file is added, deleted, or changed in the directory specified in the configuration file. ColdFusion includes the date and time that a log entry is made. However, if the directory watcher monitors changes infrequently, for example once every minute or more, the time in the log entry might differ from the time a file was added or changed, so the information includes the time (but not date) for these actions.

```xml
<cfcomponent>
  <cffunction name="onAdd" output="no">
    <cfargument name="CFEvent" type="struct" required="yes"/>
    <cfset data=CFEvent.data>
    <cflog file="MydirWatcher" application="No"
      text="ACTION: #data.type#;FILE: #data.filename#;
      TIME: #timeFormat(data.lastmodified)#">
  </cffunction>

  <cffunction name="onDelete" output="no">
    <cfargument name="CFEvent" type="struct" required="yes"/>
    <cfset data=CFEvent.data>
    <cflog file="MydirWatcher" application="No"
      text="ACTION: #data.type#;FILE: #data.filename#">
  </cffunction>
</cfcomponent>
```
</cffunction>

<cffunction name="onChange" output="no">
<cfargument name="CFEvent" type="struct" required="yes">
<cfset data=CFEvent.data>
<cflog file="MydirWatcher" application="No"
   text=" ACTION: #data.type#;FILE: #data.filename#;
   TIME: #timeFormat(data.lastmodified)#">
</cffunction>
</cfcomponent>

JMSGateway
The JMSGateway class acts as a Java Messaging Service consumer or producer. The source for this event gateway is located in gateway/src/examples/JMS. The gateway requires a configuration file, which is in gateway/config/jmsgateway.cfg. For full documentation of the configuration options, see the configuration file. The ColdFusion Administrator lists the compiled gateway (which is included in the gateway/lib/examples.jar file) on the Gateway Types page.

Note: The ColdFusion Administrator uses JMS as the gateway type name for the JMSGateway class.

Using the JMS Gateway as a consumer
The JMSGateway class creates a subscriber to the topic specified in the configuration file. The gateway consumes the following types of messages:

- TextMessage
- BytesMessage containing raw UTF-8 text

The gateway passes the contents of the message to the configured CFC in the event structure, as follows:

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>data.id</td>
<td>Message correlation ID</td>
</tr>
<tr>
<td>data.msg</td>
<td>Text of the message</td>
</tr>
<tr>
<td>gatewayType</td>
<td>Gateway type: JMS</td>
</tr>
<tr>
<td>originatorID</td>
<td>Topic name from which the message was consumed</td>
</tr>
</tbody>
</table>

The listener CFC method must be named onIncomingMessage. If the CFC method does not send a message in response, it should return a structure containing a status field with a value of OK or EXCEPTION. (In this case, the gateway checks the return status field, but does not process these return values further.) To send a message, the CFC method must return a structure as documented in the following section.

Using the JMS Gateway as a producer
To send a JMS message, the return value of your CFC method or the second, messageStruct, parameter to the SendGatewayMessage function must be a structure with the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>status</td>
<td>Must be SEND.</td>
</tr>
<tr>
<td>topic</td>
<td>Name of the topic to publish the message to.</td>
</tr>
</tbody>
</table>
If you send the message in a `SendGatewayMessage` function, the function returns OK if the gateway sends the message, or EXCEPTION if it fails to send the message.

**ActiveMQ JMS event gateway**

Apache ActiveMQ is a message broker that implements JMS. The source for this event gateway is located in `gateway/src/examples/ActiveMQ`. For information about using the ActiveMQ JMS event gateway, see the `gateway/docs/ActiveMQDeveloperGuide.pdf` file.

**Menu example application**

ColdFusion is installed with a menu-based responder application. The menu application is written to work with any of the standard ColdFusion event gateways (SMS, XMPP, and Sametime) and with the Socket example event gateway, and ColdFusion is preconfigured with an instance of the application that uses SMS, as follows:

- The Gateways page in the ColdFusion Administrator includes a gateway instance for this application that uses the SMS gateway type.
- The `gateway/cfc/examples/menu` directory and its subdirectories include the CFML for the application.
- The `gateway/config/sms-test.cfg` file is configured to use this application with the SMS client (phone simulator), and short message service center (SMSC) server simulator that are provided with ColdFusion.

The application presents users with a drill-down menu of tools that they can use, including a weather report, stock information, status and configuration information, and language tools such as a dictionary.

The code for this application is relatively complex and is distributed among 13 files. The following brief description provides an overview of how it works. To get a full understanding of how the application works, see the source code.

- The top level, menu, directory contains two files: `Application.cfm` and `main.cfc`.
- The `Application.cfm` file consists of a single `cfapplication` tag that enables session management and names the application. Session variables maintain the current state information of the session, such as the active menu, and so on.
- The `main.cfc` file contains the master CFC; the event gateway configuration in ColdFusion Administrator uses it as the listener CFC. The main CFC file processes CFEvent structures from the event gateway. It does the following:
  - Inspects the `gatewayType` field to determine the rest of the structure contents. This is necessary because different event gateways put the message in fields with different names.
  - If a `Session.menu` variable does not exist, initializes the menu system. To do so, it calls methods in two other CFCs: `menu` and `menunode`. These two CFCs contain the menu system code.
  - Calls the `session.menu.process` method to process the user’s input. This method can dispatch a message to an individual application for processing, if appropriate.
- The `apps` directory contains several CFCs. Each file contains the code for a single application, such as the weather report or dictionary lookup (`definition.cfc`).

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>(Optional) The JMS correlation ID to associate with the message. The default is null.</td>
</tr>
<tr>
<td>message</td>
<td>Text of the message to publish.</td>
</tr>
</tbody>
</table>
| asBytes | (Optional) How to publish the message:  
  - If omitted, no, or false, send the message as text.  
  - If any other value, send the message as byte-encoded UTF-8. |
**Use the menu application with the Socket event gateway**

1. On the Gateway Settings page in the ColdFusion Administrator, click the Start SMS Test Server button.

2. On the Gateways page in the ColdFusion Administrator, start the SMS Menu App - 5551212 event gateway by clicking the green play button (third button from the left in the Actions column). If the Status does not say Running after a few seconds, click Refresh to check that the server started.

3. In the `cf_root\WEB-INF\cfusion\bin` directory on J2EE configurations or the `cf_root\bin` directory on server configurations, run the SMSClient.bat file (on Windows) or SMSClient.sh file (on UNIX or Linux) to start the SMS phone simulator. The simulator is preconfigured by default to “call” the default SMS event gateway configuration.

4. Enter any character by typing or by using the mouse to click the simulator keypad, and press Enter on your keyboard or click Send on the simulator.

5. The menu application responds with the top-level menu. Enter L for language tools such as a dictionary and thesaurus, S to get stock quotes or weather forecasts, or C to get information about the server. Press Enter on your keyboard or click Send on the simulator.

6. The application displays a submenu. For example, if you select S in step 5, the options are Q for a stock quote, W for weather, or B to go back to the previous menu. Enter your selection.

7. The application requests information such as a Zip code for the weather, stock symbol for a price, word for the dictionary, and so on. Enter and send the required information (or enter B to go back to the menu).

8. The application gets and displays the requested information. Depending on the application, you might also be prompted to enter M to get more. Enter M (if there is more information available), another term, or B to return to the previous menu.

9. Continue by entering menu items and detailed information requests.

10. To exit, select File > Exit from the menu bar.
Chapter 57: Using the Instant Messaging Event Gateways

You can develop an application that uses either of two instant message (IM) event gateway types provided with ColdFusion: an IBM Lotus Sametime gateway, and an Extensible Messaging and Presence Protocol (XMPP) gateway.

You should be familiar with ColdFusion event gateway principles and programming techniques (see “Using Event Gateways” on page 1060).

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About ColdFusion and instant messages

ColdFusion includes two instant messaging gateway types: one for messaging using the XMPP protocol, and one for IBM Lotus Instant Messaging (Sametime). These gateway types use identical interfaces for sending and receiving messages and for managing the IM presence information and infrastructure. This chapter, therefore, refers to IM gateways, and only describes the two types where there are differences.

The ColdFusion IM gateways act as IM clients and let you do the following:

• Send and receive instant messages.
• Send and respond to buddy or friend requests and manage buddy/friend information.
• Set and get status and other information.
• Receive and handle messages from the IM server.

About XMPP

XMPP (Extensible Messaging and Presence Protocol) is an open, XML-based protocol for instant messaging. It is the core protocol of the Jabber Instant Messaging and Presence technology that is developed by the Jabber Software Foundation. As of November 2004, XMPP was defined by four Internet Engineering Task Force (IETF) specifications (RFCs), numbers 3920-3922. RFC 3920 covers the XMPP core, and 3921, covers instant messaging and presence. Numerous XMPP servers and clients are available. ColdFusion supports the IETF XMPP protocol.

The following websites provide additional information about the XMPP protocol:

• Jabber Software Foundation: www.jabber.org/. This site includes information on available XMPP servers and clients.
• IETF has copies of the internet standards for XMPP: www.ietf.org/rfc/.
The xmpp.org website was under development as of December 2004; at that time it included several useful links, including links to relevant specifications: www.xmpp.org/.

**About IBM Lotus Instant Messaging (Sametime)**

IBM Lotus Instant Messaging, commonly referred to as Lotus Sametime, is the IBM product for real-time collaboration. For more information about this product, see [www.lotus.com/sametime](http://www.lotus.com/sametime).

*Note: In the Enterprise Edition, to use the Lotus Sametime event gateway, you must disable FIPS-140 Compliant Strong Cryptography by adding the following to the JVM arguments in the ColdFusion Administrator:*

-Dcoldfusion.disablejsafe=false

**About IM application development and deployment**

The following sections introduce the ColdFusion IM application development tools and process, and discuss IM messaging providers.

**ColdFusion IM gateway classes**

ColdFusion provides the following instant messaging gateway classes:

**XMPPGateway**: The class for the XMPP event gateway type

**SAMETIMEGateway**: The class for the IBM Lotus Instant Messaging event gateway

You implement your IM application by configuring a gateway instance in ColdFusion Administrator that uses one of these gateway classes and creating a ColdFusion application that uses the gateway instance to communicate with an instant messaging server.

**Application development and deployment process**

The following is a typical process for developing and deploying an IM application:

1. Design your application.
2. Configure an IM event gateway instance to use an available XMPP or Lotus Sametime server.
3. Write your CFCs, CFM pages, and any other application elements.
4. Test your application using your XMPP or Lotus Sametime server and an appropriate client application.
5. Deploy the application (see “Deploying event gateways and applications” on page 1075).

**How the IM event gateway and provider interact**

Each IM event gateway instance has a single instant messaging ID. You must establish the ID and its related password on the IM server using server-specific tools, such as a standard instant messaging client. In ColdFusion, you set the ID, password, and other gateway-specific information in a gateway configuration file, and you create a gateway instance that uses this file.

When you start the gateway, it logs onto the IM server with the ID and password, and receives and sends the messages for the ID. The gateway sends incoming messages to a CFC, which you specify when you configure the gateway instance in the ColdFusion Administrator. The gateway passes outgoing messages from this CFC and from other CFML code to the IM server.

The IM event gateway also provides a number of helper methods for managing the gateway and its configuration information.
Incoming message handling
You write the following ColdFusion CFC methods to handle incoming messages and requests from the IM event gateway. These CFCs receive messages from the IM server and can respond to them by setting a return value.

<table>
<thead>
<tr>
<th>CFC method</th>
<th>Message type</th>
</tr>
</thead>
<tbody>
<tr>
<td>onIncomingMessage</td>
<td>Standard message from IM users.</td>
</tr>
<tr>
<td>onAddBuddyRequest</td>
<td>Requests from others to add the gateway ID to their buddy list.</td>
</tr>
<tr>
<td>onAddBuddyResponse</td>
<td>Responses from others to requests from your gateway to add them to your buddy lists. Also used by buddies to ask to be removed from your list.</td>
</tr>
<tr>
<td>onBuddyStatus</td>
<td>Presence status messages from other users.</td>
</tr>
<tr>
<td>onIMServerMessage</td>
<td>Error and status messages from the IM server.</td>
</tr>
</tbody>
</table>

For more information on these methods, see “Handling incoming messages” on page 1087.

Outgoing message handling
Applications send outgoing instant messages using the CFML `SendGatewayMessage` method. Incoming message-handling CFC methods can also send messages, including responses to requests from others to add the ColdFusion gateway’s ID to their buddy list. For more information on sending messages, see “Sending outgoing messages” on page 1087.

IMGatewayHelper methods
The ColdFusion IM gateway provides the IMGatewayHelper class, a gateway helper that you can access by calling the CFML `GetGatewayHelper` function. The IMGatewayHelper class has methods that let you do the following:

- Get and set gateway configuration information and get gateway statistics
- Get and set the gateway online presence status
- Manage the gateway’s buddy list
- Manage permissions for others to get information about the gateway status.

For more information on using GatewayHelper methods, including lists of all the methods, see “Using the GatewayHelper object” on page 1093.

Configuring an IM event gateway
You provide IM-specific configuration information to the IM event gateway in a configuration file. You specify the configuration file location when you configure the IM event gateway instance in the ColdFusion Administrator. ColdFusion provides sample XMPP and Lotus Sametime event gateway configuration files in the `cf_root\WEB-INF\cfusion\gateway\config` directory on J2EE configurations, and `cf_root\gateway\config` directory on server configurations. The configuration file can have the following information.

*Note: The default value in the table is the value the gateway uses if the configuration file omits the property, not the value in the default configuration files.*
### Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>userID</td>
<td>none</td>
<td>(Required) The IM user ID to use to connect to the IM server.</td>
</tr>
<tr>
<td>password</td>
<td>none</td>
<td>(Required) Password for the user.</td>
</tr>
<tr>
<td>secureprotocol</td>
<td>none</td>
<td>XMPP only. Required if you set <code>securerequirement</code> to true. The protocol to use for secure communications. The following values are valid:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• TSL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• SSL</td>
</tr>
<tr>
<td>securerequirement</td>
<td>false</td>
<td>XMPP only. Specifies whether the gateway must use secure communications. The following values are valid:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• true</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• false</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If this value is true, you must specify a <code>secureprotocol</code> value, and connections succeed only if a secure connection is established.</td>
</tr>
<tr>
<td>serverip</td>
<td>XMPP: jabber.org</td>
<td>Address of XMPP or Lotus Sametime server to which to send messages. Can be a server name or IP address.</td>
</tr>
<tr>
<td></td>
<td>Sametime: stdemo3.dfw.ibm.com</td>
<td></td>
</tr>
<tr>
<td>serverport</td>
<td>XMPP: 5222</td>
<td>Port on the server to which to send the messages. If the XMPP <code>secureprotocol</code> parameter is set to SSL, <code>speechify 5223</code>.</td>
</tr>
<tr>
<td></td>
<td>Sametime:1533</td>
<td></td>
</tr>
<tr>
<td>retries</td>
<td>-1</td>
<td>Integer number of times to retry connecting to the IM server on gateway startup or if the Gateway gets disconnected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = do not to retry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1 = try forever</td>
</tr>
<tr>
<td>retryinterval</td>
<td>5</td>
<td>Real number of seconds to wait between connection attempts. The minimum is 1 second.</td>
</tr>
<tr>
<td>onIncomingMessageFunction</td>
<td>onIncomingMessage</td>
<td>Name of CFC method to call to handle an incoming message. If you specify the property without a value, such as <code>onIncomingMessageFunction=</code>, the gateway does not send this event to a CFC.</td>
</tr>
<tr>
<td>onAddBuddyRequestFunction</td>
<td>onAddBuddyRequest</td>
<td>Name of CFC method to call to handle an incoming buddy request. If you specify the property without a value, the gateway does not send this event to a CFC.</td>
</tr>
<tr>
<td>onAddBuddyResponseFunction</td>
<td>onAddBuddyResponse</td>
<td>Name of CFC method to call to handle an incoming response to a buddy request sent by ColdFusion. If you specify the property without a value, the gateway does not send this event to a CFC.</td>
</tr>
<tr>
<td>onBuddyStatusFunction</td>
<td>onBuddyStatus</td>
<td>Name of CFC method to call to handle an incoming buddy status message, such as if you specify the property without a value, the gateway does not send this event to a CFC.</td>
</tr>
<tr>
<td>onIMServerMessageFunction</td>
<td>onIMServerMessage</td>
<td>Name of CFC method to call to handle an incoming message method. If you specify the property without a value, the gateway does not send this event to a CFC.</td>
</tr>
</tbody>
</table>

**Note:** If you do not have a CFC method to handle any of the event types, you must specify the corresponding property without a value. Use the following entry in the configuration file, for example, if you do not have a method to handle `IMServerMessage` events: `onIMServerMessageFunction=`
Handling incoming messages

The IM event gateway handles five types of messages, and your CFC must implement a listener method for each message type. The following table describes the message-handling CFC methods and the messages they handle. It lists the default CFC method names; however, you can change the names in the gateway configuration file.

<table>
<thead>
<tr>
<th>CFC method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>onIncomingMessage</td>
<td>Standard message from an IM user. The application processes the message body appropriately; for example, it could display the message in an interface window. This method can return a response message to the sender.</td>
</tr>
<tr>
<td>onAddBuddyRequest</td>
<td>Request from another IM user to add your application's IM ID to their buddy list. The CFC must determine whether to accept or reject the request, or to take no action. No action might be appropriate in cases where the request must be reviewed offline for approval and responses are sent at a later time. The CFC returns a message with the decision as a command value and optionally a text message specifying the reason. If you accept the request, the requestor automatically gets added to the list of IDs that can get status information for the gateway. If you specify no action, ColdFusion does not respond.</td>
</tr>
<tr>
<td>onAddBuddyResponse</td>
<td>Response from another IM user to a request from the gateway to be added to their buddy list. The response message is accept or decline. Your application can handle this response as appropriate; for example, to add or remove the ID from a list of message recipients. This method does not return a value.</td>
</tr>
<tr>
<td>onBuddyStatus</td>
<td>Message indicating a gateway buddy's status. Received when a buddy's status changes; for example, from OFFLINE to ONLINE. This method does not return a value.</td>
</tr>
<tr>
<td>onIMServerMessage</td>
<td>Status messages from the IM server, such as warning or error messages. The messages you might receive depend on the IM server that sends them. For information on the server messages, see the documentation for the IM server that your gateway instance uses. This method does not return a value.</td>
</tr>
</tbody>
</table>

For detailed information on each method, including examples of their use, see “IM Gateway CFC incoming message methods” on page 1368 in the CFML Reference. For an example that uses these functions, see “Sample IM message handling application” on page 1088.

Sending outgoing messages

You use the SendGatewayMessage CFML function or the return value of a CFC listener method to send outgoing messages. The ColdFusion IM gateway accepts the following outgoing message commands:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>submit</td>
<td>(Default) Sends a normal message to another IM user.</td>
</tr>
</tbody>
</table>
In typical use, a ColdFusion application uses the accept, decline, and noact commands in the return value of the onAddBuddyRequest method, and uses the submit command (or no command, because submit is the default command) in SendGatewayMessage CFML functions and the return value of the onIncomingMessage CFC method.

The SendGatewayMessage CFML function can send any command, and might be used to send an accept or decline message. One possible use is in an application where someone must review all buddy requests before they are added. In this case, the onAddBuddyRequest CFC method could initially send a noact command in its return value, and save the request information in a database. Administrators could use a separate ColdFusion application to review the request information. This application could use the SendGatewayMessage function with an accept or decline command to act on the request and inform the requestor.

The following example onIncomingMessage method of a listener CFC echoes incoming IM messages to the message originator:

```cfml
<cffunction name="onIncomingMessage" output="no">
  <cfargument name="CFEvent" type="struct" required="yes">
  <cfset retValue.MESSAGE = "echoing: " & CFEVENT.DATA.message>
  <cfset retValue.BuddyID = arguments.CFEVENT.DATA.SENDER>
  <cfreturn retValue>
</cffunction>
```

### Sample IM message handling application

The application described in this section consists of two CFCs: an employee phone directory lookup CFC that responds to an onIncomingMessage event, and a Gateway management CFC that responds to all other events. This example shows how an application can respond to events and send outgoing messages.

You can configure a gateway to use both CFCs by entering the paths to the two CFCs, separated by a comma, in the CFC Path field of the Add/Edit ColdFusion Event Gateways form on the Gateways page in the ColdFusion Administrator.
Phone directory lookup CFC

The following CFC implements a simple employee phone directory lookup application. The user sends an instant message containing some part of the name to be looked up (a space requests all names). The onIncomingMessage response depends on the number matches.

- If there is no match, the onIncomingMessage function returns a message indicating that there are no matches.
- If there is one match, the function returns the name, department, and phone number.
- If there are up to ten matches, the function returns a list of the names preceded by a number that the user can enter to get the detailed information.
- If there are over ten matches, the function returns a list of only the first ten names. A more complex application might let the user get multiple lists of messages to provide access to all names.
- If the user enters a number, and previously got a multiple-match list, the application returns the information for the name that corresponds to the number.

The following listing shows the CFC code:

```cfcomponent>
<cffunction name="onIncomingMessage">
<cfargument name="CFEvent" type="struct" required="YES">
<!--- Remove any extra white space from the message. --->
<cfset message = Trim(arguments.CFEvent.data.MESSAGE)>
<!--- If the message is numeric, a previous search probably returned a list of names. Get the name to search for from the name list stored in the Session scope. --->
<cfif isNumeric(message)>
<cfscript>
  if (structKeyExists(session.users, val(message))) {
    message = session.users[val(message)];
  }
</cfscript>
</cfif>
<!--- Search the database for the requested name. --->
<cfquery name="employees" datasource="cfdocexamples">
  select FirstName, LastName, Department, Phone 
  from Employees 
  where 0 = 0 
  <!--- A space indicates the user entered a first and last name. --->
  <cfif listlen(message, " ") eq 2>
    and FirstName like '#listFirst(message, " ")#%' 
    and LastName like '#listLast(message, " ")#%' 
  </cfif>
  <!--- No space: the user entered a first or a last name. --->
  <cfelse>
    and (FirstName like '#listFirst(message, " ")#%' 
      or LastName like '#listLast(message, " ")#%')
  </cfif>
</cfquery>
<!--- Generate and return the message. --->
<cfscript>
  retrunVal = structNew();
  retrunVal.command = "submit";
  retrunVal.buddyID = arguments.CFEvent.data.SENDER;

  // No records were found.
  if (employees.recordCount eq 0) {
    retrunVal.message = "No records found for '#message#";
  }
</cfscript>
</cffunction>
</cfcomponent>
```
}  
//One record was found.
else if (employees.recordCount eq 1) {
   // Whitespace in the message text results in bad formatting,
   // so the source cannot be indented.
   retrunVal.message = "Requested information:
   #employees.firstName# #employees.lastName#
   #employees.Department#
   #employees.Phone#";
}
//Multiple possibilities were found.
else if (employees.recordCount gt 1) {
   //If more than ten were found, return only the first ten. 
   if (employees.recordCount gt 10) 
   { 
      retrunVal.message = "First 10 of #employees.recordCount# records";
   }else{
      retrunVal.message = "Records found: #employees.recordCount#";
   }
   // The session.users structure contains the found names.
   // The record key is a number that is also returned in front of the
   // name in the message.
   session.users = structNew();
   for(i=1; i lte min(10, employees.recordCount); i=i+1)
   { 
      // These two lines are formatted to prevent extra white space.
      retrunVal.message = retrunVal.message & "
      #i# - #employees.firstName[i]# #employees.lastName[i]#;
   }
   // The following two lines must be a single line in the source
   session.users[i]="#employees.firstName[i]#
   #employees.lastName[i]#";
}
return retrunVal;
</cffunction>
</cffunction>

Status and request-handling CFC
The following CFC handles all IM events, except onIncomingMessage. It maintains an Application scope buddyStatus structure that contains information on the gateway buddies. This structure limits the interactions that are needed with the IM server to get buddy and status information. The application also logs significant events, such as requests to add buddies and error messages from the IM server. In particular, it does the following:

• The onBuddyStatus function updates the Application scope buddy status structure when the gateway gets an event message indicating that a buddy’s status has changed.
• The onAddBuddyRequest function searches for the requested buddy’s name in a data source. If it finds a single instance of the name, it adds the buddy and updates the status in the Application scope buddyStatus structure. If it doesn’t find name, it declines the buddy request. If it finds multiple instances of the name, it tells the gateway to take no action. It also logs all actions.
• The onAddBuddyResponse function adds the buddy to the Application scope buddy status structure if the buddy request is accepted, and sets the current status. It logs all responses.
• The onIMServerMessage function logs all messages that it receives.
This example uses the IM_ID column of the Employees database of the cfdocexamples database that is included with ColdFusion. The entries in this column assume that you use an XMPP server “company.” To run this example you must configure an XMPP server with this name and with clients with names in this database, or you must change the database entries to match IM server clients. You must also configure a gateway instance in the ColdFusion Administrator that uses this server.

The following listing shows the CFC code:

```coldfusion
<cfcomponent>
<cffunction name="onBuddyStatus">
<cfargument name="CFEvent" type="struct" required="YES">
<cflock scope="APPLICATION" timeout="10" type="EXCLUSIVE">
<cfscript>
// Create the status structures if they don't exist.
if (NOT StructKeyExists(Application, "buddyStatus")) {
    Application.buddyStatus=StructNew();
}
if (NOT StructKeyExists(Application.buddyStatus, CFEvent.Data.BUDDYNAME)) {
    Application.buddyStatus[CFEvent.Data.BUDDYNAME]=StructNew();
}
// Save the buddy status and timestamp.
Application.buddyStatus[CFEvent.Data.BUDDYNAME].status=CFEvent.Data.BUDDYSTATUS;
Application.buddyStatus[CFEvent.Data.BUDDYNAME].timeStamp=CFEvent.Data.TIMESTAMP;
</cfscript>
</cflock>
</cffunction>

<cffunction name="onAddBuddyRequest">
<cfargument name="CFEvent" type="struct" required="YES">
<cfquery name="buddysearch" datasource="cfdocexamples">
    select IM_ID 
    from Employees 
    where IM_ID = '"CFEvent.Data.SENDER"'
</cfquery>
<cflock scope="APPLICATION" timeout="10" type="EXCLUSIVE">
<cfscript>
// If the name is in the DB once, accept; if it is missing, decline.
// If it is in the DB multiple times, take no action.
if (buddysearch.RecordCount IS 0) {
    action="decline";
    reason="Invalid ID";
}
else if (buddysearch.RecordCount IS 1) {
    action="accept";
    reason="Valid ID";
//Add the buddy to the buddy status structure only if accepted.
if (NOT StructKeyExists(Application, "buddyStatus")) {
    Application.buddyStatus=StructNew();
}
if (NOT StructKeyExists(Application.buddyStatus, CFEvent.Data.SENDER)) {
    Application.buddyStatus[CFEvent.Data.SENDER]=StructNew();
}
Application.buddyStatus[CFEvent.Data.SENDER].status= "Accepted Buddy Request";
Application.buddyStatus[CFEvent.Data.SENDER].timeStamp=
```
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```coldfusion
<cflock scope="APPLICATION" timeout="10" type="EXCLUSIVE">
    <!--- Log the request and decision information. --->
    <cflog file="#CFEvent.GatewayID#Status" text="onAddBuddyRequest; SENDER: #CFEvent.Data.SENDER# MESSAGE: #CFEvent.Data.MESSAGE# TIMESTAMP: #CFEvent.Data.TIMESTAMP# ACTION: #action#">
    <cfscript>
        if (NOT StructKeyExists(Application, "buddyStatus")) {
            Application.buddyStatus=StructNew();
        }
        if (#CFEVENT.Data.MESSAGE# IS "accept") {
            //Create a new entry in the buddyStatus record for the buddy.
            if (NOT StructKeyExists(Application.buddyStatus, CFEvent.Data.SENDER)) {
                Application.buddyStatus[CFEvent.Data.SENDER#]=StructNew();
            }
            //Set the buddy status information to indicate buddy was added.
            Application.buddyStatus[CFEvent.Data.SENDER].status="Buddy accepted us";
            Application.buddyStatus[CFEvent.Data.SENDER].timeStamp=CFEvent.Data.TIMESTAMP;
            Application.buddyStatus[CFEvent.Data.SENDER].message=CFEvent.Data.MESSAGE;
        }
    </cfscript>
</cflock>
<!--- Log the information for all responses. --->
<cflog file="#CFEvent.GatewayID#Status" text="onAddBuddyResponse; BUDDY: #CFEvent.Data.SENDER# RESPONSE: #CFEvent.Data.MESSAGE# TIMESTAMP: #CFEvent.Data.TIMESTAMP#">
</cffunction>

<cffunction name="onIMServerMessage">
    <!--- This function just logs the message. --->
    <cfargument name="CFEvent" type="struct" required="YES">
    <cflog file="#CFEvent.GatewayID#Status" text="onIMServerMEssage; SENDER: #CFEvent.OriginatorID# MESSAGE: #CFEvent.Data.MESSAGE# TIMESTAMP: #CFEvent.Data.TIMESTAMP#">
</cffunction>
```
Using the GatewayHelper object

The CFML `GetGatewayHelper` function returns a GatewayHelper object with several methods that manage your gateway and buddy list. The GatewayHelper methods let you do the following:

- Get and set gateway configuration information and get gateway statistics.
- Get and set the gateway online status.
- Manage the gateway’s buddy list
- Manage permissions for others to get information about the gateway status.

The following sections briefly describe the class methods. For detailed information about each method, see “IM Gateway GatewayHelper class methods” on page 1378 in the CFML Reference.

Gateway configuration information and statistics methods

The following table describes the methods that you can use to get and set configuration information and get gateway statistics:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>getName</td>
<td>Returns the gateway’s user name.</td>
</tr>
<tr>
<td>getNickName</td>
<td>Returns the gateway’s display name (nickname).</td>
</tr>
<tr>
<td>getProtocolName</td>
<td>Returns the name of the instant messaging protocol (JABBER for XMPP, or SAMETIME).</td>
</tr>
<tr>
<td>numberOfMessagesReceived</td>
<td>Returns the number of messages received by the gateway since it was started.</td>
</tr>
<tr>
<td>numberOfMessagesSent</td>
<td>Returns the number of messages sent by the gateway since it was started.</td>
</tr>
<tr>
<td>setNickName</td>
<td>Sets the gateway’s display name (nickname).</td>
</tr>
</tbody>
</table>

Gateway online status methods

The following table describes the methods that you can use to get and set the gateway’s online availability status (presence information):

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>getCustomAwayMessage</td>
<td>Returns the gateway’s custom away message if it has been set by the setStatus method.</td>
</tr>
<tr>
<td>getStatusAsString</td>
<td>Returns the online status of the gateway.</td>
</tr>
<tr>
<td>getStatusTimeStamp</td>
<td>Returns the date/time that the gateway changed its online status.</td>
</tr>
<tr>
<td>isOnline</td>
<td>Returns True if the gateway is connected to the IM server; otherwise, returns false.</td>
</tr>
<tr>
<td>setStatus</td>
<td>Changes the gateway’s online status; for example, to away or idle.</td>
</tr>
</tbody>
</table>

Gateway buddy management methods

The following table describes the methods that you can use to manage the gateway’s buddy list:
Gateway permission management methods

The IM gateways can manage the information that other users can get about the gateway’s online status.

Note: XMPP permission management is included in the XMPP 1.0 specification, but several XMPP servers that were available at the time of the ColdFusion release do not support permission management.

The following table describes the gateway permission management methods:

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>addBuddy</td>
<td>Adds a buddy to the gateway’s buddy list and tells the IM server to send the gateway messages with the buddy’s online state.</td>
</tr>
<tr>
<td>getBuddyInfo</td>
<td>Gets information about the specified user from the buddy list, deny list, and permit list.</td>
</tr>
<tr>
<td>getBuddyList</td>
<td>Returns the gateway’s buddy list.</td>
</tr>
<tr>
<td>removeBuddy</td>
<td>Removes the specified user name from the gateway’s buddy list and tells the IM server to stop sending the gateway messages with the user’s online state.</td>
</tr>
</tbody>
</table>

GatewayHelper example

This example lets you use the XMPP or SameTime GatewayHelper class to get and set status and other information, including managing buddy lists and view permissions lists.

```coldfusion
<cfapplication name="gateway_tool" sessionmanagement="yes">

<!--- Set the gateway buddy name to default values. --->
<cfparam name="session.gwid" default="XMPP Buddy Manager">
<cfparam name="session.buddyid" default="hlichtin2@mousemail">

<!--- Reset gateway and buddy ID if form was submitted. --->
<cfif isdefined("form.submitbuddy")>
  <cfset session.buddyid=form.buddyid>
  <cfset session.gwid=form.gwid>
</cfif>

<!--- Display the current gateway and buddy ID. --->
<h3>Using the GatewayHelper</h3>
```
<!---- Form to display and reset gateway and Buddy ID. --->
cfform action="#cgi.script_name#" method="post" name="changeIDs">
    Current buddy ID: <cfinput type="text" name="buddyid" value="#session.buddyid#"><br>
    Current gateway ID: <cfinput type="text" name="gwid" value="#session.gwid#"><br>
</cfform>

<!---- When a buddy is set, display the links and forms to get and set information etc. Where form input is required, the form uses a GET method so all selections are represented by a url.cmd variable. --->

<cfform>
<h3>Select one of the following to get or set.</h3>
<ul>
    <li><a href="#/cgi.script_name#?cmd=buddyinfo">buddyinfo</a></li>
    <li>LIST: <a href="#/cgi.script_name#?cmd=buddylist">buddylist</a> | <a href="#/cgi.script_name#?cmd=permitlist">permitlist</a> | <a href="#/cgi.script_name#?cmd=denylist">denylist</a></li>
    <li>ADD: <a href="#/cgi.script_name#?cmd=addbuddy">addbuddy</a> | <a href="#/cgi.script_name#?cmd=addpermit">addpermit</a> | <a href="#/cgi.script_name#?cmd=adddeny">adddeny</a></li>
    <li>REMOVE: <a href="#/cgi.script_name#?cmd=removebuddy">removebuddy</a> | <a href="#/cgi.script_name#?cmd=removepermit">removepermit</a> | <a href="#/cgi.script_name#?cmd=removedeny">removedeny</a></li>
    <!--- NOTE: This list does not include OFFLINE because the gateway resets itself to online. --->
    <li>setStatus (XMPP):</li>
    <cfloop list="ONLINE,AWAY,DND,NA,FREE_TO_CHAT" index="e">
        <a href="#/cgi.script_name#?cmd=setstatus&status=#e#">#e#</a> |
    </cfloop>
    <li>setStatus (Sametime):</li>
    <cfloop list="ONLINE,AWAY,DND,IDLE" index="e">
        <a href="#/cgi.script_name#?cmd=setstatus&status=#e#">#e#</a> |
    </cfloop>
    <li>
        <form action="#cgi.script_name#" method="get">
            setStatus with CustomAwayMessage:
            <input type="hidden" name="cmd" value="setstatus2">
            <select name="status">
                <cfloop list="ONLINE,OFFLINE,AWAY,DND,INVISIBLE,NA,GOSSIP,NOT_AT_HOME,NOT_AT_DESK,NOT_IN_OFFICE,ON_VACATION,STEPED_OUT,CUSTOM_AWAY" index="e">
                    <option value="#e#">#e#</option>
                </cfloop>
            </select>
            <input type="text" name="custommsg" value="(custom away massage)" size="30"/>
            <input type="submit"/>
        </form>
        <li>
            <form action="#cgi.script_name#" method="get">
                setNickName:
                <input type="hidden" name="cmd" value="setnickname">
                <input type="text" name="nickname" value="(enter nickname)"/>
                <input type="submit"/>
            </form>
        </li>
</ul>
<!--- INFO: --->
<a href="#/cgi.script_name#?cmd=getname">getname</a> | 
<a href="#/cgi.script_name#?cmd=getnickname">getnickname</a> | 
<a href="#/cgi.script_name#?cmd=getcustomawaymessage">getcustomawaymessage</a> | 
<a href="#/cgi.script_name#?cmd=getprotocolname">getprotocolname</a> | 
<a href="#/cgi.script_name#?cmd=getstatusasstring">getstatusasstring</a> |
<a href="#cgi.script_name?cmd=isonline">isonline</a>

MESSAGE COUNT:
<a href="#cgi.script_name?cmd=numberofmessagesreceived">numberofmessagesreceived</a> | 
<a href="#cgi.script_name?cmd=numberofmessagessent">numberofmessagessent</a>

RUNNING TIME: <a href="#cgi.script_name?cmd=getsignontimestamp">getsignontimestamp</a> | 
<a href="#cgi.script_name?cmd=getstatustimestamp">getstatustimestamp</a>

setPermitMode:
<cfloop
list="PERMIT_ALL, DENY_ALL, PERMIT_SOME, DENY_SOME, IGNORE_IN_LIST, IGNORE_NOT_IN_LIST"
index="e">
<a href="#cgi.script_name?cmd=setpermitmode&mode=#e#">#e#</a> | 
</cfloop> <span class="note">doesn't work for XMPP</span>

setPlainTextMode:
<cfloop list="PLAIN_TEXT, RICH_TEXT" index="e">
<a href="#cgi.script_name?cmd=setplaintextmode&mode=#e#">#e#</a> | 
</cfloop>

getPermitMode:

getsignontimestamp:
getstatustimestamp:

setPermitMode:
<cfloop
list="PERMIT_ALL, DENY_ALL, PERMIT_SOME, DENY_SOME, IGNORE_IN_LIST, IGNORE_NOT_IN_LIST"
index="e">
<a href="#cgi.script_name?cmd=setpermitmode&mode=#e#">#e#</a> | 
</cfloop> <span class="note">doesn't work for XMPP</span>

setPlainTextMode:
<cfloop list="PLAIN_TEXT, RICH_TEXT" index="e">
<a href="#cgi.script_name?cmd=setplaintextmode&mode=#e#">#e#</a> | 
</cfloop>

getPermitMode:

<!--- The url.cmd value exists if one of the previous links or forms has been submitted, and identifies the type of request. --->

<cfif isdefined("url.cmd")>

<cfset helper = getGatewayHelper(session.gwid)>

<cfswitch expression="#LCase(url.cmd)#">
<cfcase value="buddylist,buddyinfo">
<cfset ret=helper.getBuddyList()>
</cfcase>
<cfcase value="denylist">
<cfset ret=helper.getDenyList()>
</cfcase>
<cfcase value="permitlist">
<cfset ret=helper.getPermitList()>
</cfcase>
<cfcase value="addbuddy">
<cfset ret=helper.addBuddy("#session.buddyid#", "#session.buddyid#", ")">
</cfcase>
<cfcase value="addpermit">
<cfset ret=helper.addPermit("#session.buddyid#", "#session.buddyid#", ")">
</cfcase>
<cfcase value="removedeny">
<cfset ret=helper.removeDeny("#session.buddyid#", ")">
</cfcase>
</cfswitch>

</cfif>
<cfset ret=helper.setStatus(url.status, "")>
</cfcase>
<cfcase value="setstatus2">
  <cfset ret=helper.setStatus(url.status, url.custommsg)>
</cfcase>
<cfcase value="getcustomawaymessage">
  <cfset ret=helper.getCustomAwayMessage()>
</cfcase>
<cfcase value="getname">
  <cfset ret=helper.getName()>
</cfcase>
<cfcase value="getnickname">
  <cfset ret=helper.getNickname()>
</cfcase>
<cfcase value="getprotocolname">
  <cfset ret=helper.getProtocolName()>
</cfcase>
<cfcase value="getsignontimestamp">
  <cfset ret=helper.getSignOnTimeStamp()>
</cfcase>
<cfcase value="getstatusasstring">
  <cfset ret=helper.getStatusAsString()>
</cfcase>
<cfcase value="getstatustimestamp">
  <cfset ret=helper.getStatusTimeStamp()>
</cfcase>
<cfcase value="isonline">
  <cfset ret=helper.isOnline()>
</cfcase>
<cfcase value="numberofmessagesreceived">
  <cfset ret=helper.numberOfMessagesReceived()>
</cfcase>
<cfcase value="numberofmessagessent">
  <cfset ret=helper.numberOfMessagesSent()>
</cfcase>
<cfcase value="setnickname">
  <cfset ret=helper.setNickName(url.nickname)>
</cfcase>
<cfcase value="setpermitmode">
  <cfset ret=helper.setPermitMode(url.mode)>
</cfcase>
<cfcase value="getpermitmode">
  <cfset ret=helper.getPermitMode()>
</cfcase>
<cfcase value="setplaintextmode">
  <cfset ret=helper.setPlainTextMode(url.mode)>
</cfcase>
<cfcase value="getplaintextmode">
  <cfset ret=helper.getPlainTextMode()>
</cfcase>
<cfdefaultcase>
  <cfset ret[1]="Error; Invalid command. You shouldn't get this.">
  </cfdefaultcase>
</cfswitch>
<br>
<!-- Display the results returned by the called GatewayHelper method. --->
<br>
<cfdump var="#ret#">
<br>
<!-- If buddy information was requested, loop through buddy list to get information for each buddy and display it. --->

<cfif comparecase(url.cmd, "buddyinfo") is 0 and arraylen(ret) gt 0>
<br>
<b>Buddy info for all buddies</b><br>
<cfloop index="i" from="1" to="#arraylen(ret)#">
<cfdump var="#helper.getBuddyInfo(ret[i])#" label="#ret[i]#"></cfloop>
</cfif>
</cfoutput>
Chapter 58: Using the SMS Event Gateway

You can develop an application that uses the short message service (SMS) event gateway type provided with Adobe ColdFusion. ColdFusion provides tools for developing SMS applications.

You should be familiar with ColdFusion event gateway principals and programming techniques (see “Using Event Gateways” on page 1060). Although not required, a basic knowledge of SMS is helpful.

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Sending outgoing messages ....................................................... 1107
ColdFusion SMS development tools .......................................... 1111
Sample SMS application .......................................................... 1113

About SMS and ColdFusion

Short Message Service (SMS) is a system designed for sending short, often text, messages to and from wireless devices, such as mobile phones or pagers. SMS is widely used in Europe and Asia and is becoming increasingly popular in the United States and elsewhere. Some uses for SMS include the following:

- Performing banking transactions
- Sending authentication codes, for example, to be used to access web resources
- Voting, such as popularity voting for reality television shows
- Initiating an action (such as a server reboot) and getting a response
- Notifying users of events such as package shipments or restaurant table availability, or providing stock or weather alerts
- Sending person-to-person text messages
- Presenting interactive text-based menus on a cell phone
- Providing cellular phone updates, such as direct download of logos
- Providing telematics and mobile or remote wireless device applications, such as soda machines, vehicle tracking, smart gas pumps, and so on

SMS protocol features include, but are not limited to, the following:

- Authentication verification is built in.
- Communications can be secure.
- Store and forward communication is performed in near real time.
- Communications can be two-way and session-aware.
- Mobile devices such as cell phones already include support; there is nothing to install on the client.
About SMS
The following discussion simplifies SMS technology and describes only a typical use with a ColdFusion application. For a more complete discussion of SMS, see the publicly available literature, including the several books that discuss SMS.

In a ColdFusion SMS application, a mobile device such as a mobile phone communicates (via intermediate steps) with a message center, such as a short message service center (SMSC). For example, a mobile phone user calls a telephone number that the SMS provider has associated with your account; the SMSC gets the messages that are sent to this number. The SMSC can store and forward messages. A ColdFusion application can initiate messages to wireless devices, or it can respond to incoming messages from the devices.

The SMSC communicates with a ColdFusion SMS event gateway using short message peer-to-peer protocol (SMPP) over TCP/IP. Information is transferred by exchanging Protocol Data Units (PDUs) with structures that depend on the type of transaction, such as a normal message submission, a binary data submission, or a message intended for multiple recipients.

Because the SMSC is a store-and-forward server, it can hold messages that cannot be immediately delivered and try to deliver them when the receiving device is available. The time that a message is held on the server for delivery is configured by the SMSC provider. For example, AT&T Wireless saves messages for 72 hours; after that time, any undelivered messages are deleted. Your messages can request a different time-out (by specifying a ValidityPeriod field). The message can also use a registeredDelivery field to tell the SMSC to inform the you about whether and when the message is delivered.

SMS communication can be secure. Voice and data communications, including SMS message traffic between the SMSC and the mobile device is encrypted as part of the GSM standard. The mobile user’s identity is also authenticated by the SMSC before the encrypted communication session begins. You must secure the communications between ColdFusion and the SMSC. Typically, you do this by using a secure hardware or software VPN connection around the SMPP connection.

The following image shows the SMS path between mobile devices and ColdFusion gateways:
Using the SMS event gateway, ColdFusion establishes a two-way (transceiver) connection to the SMSC of the telecommunications carrier or other SMPP account provider. The SMPP provider assigns an address for your account, and you associate an event gateway instance with the address. Addresses are normally telephone numbers, but carriers often support “short code” addresses that do not require a full 10-digit number. You also configure the gateway instance to communicate with the provider's specified TCP/IP address using a system ID and a password.

*Note:* The ColdFusion SMS event gateway conforms to the SMPP 3.4 specification, which you can download from the SMS Forum at [www.smsforum.net/](http://www.smsforum.net/).

A ColdFusion application can initiate and send messages to SMS-enabled devices by specifying the destination mobile device telephone number, or mobile devices can send messages to a ColdFusion listener CFC by using the gateway instance's telephone number. Incoming messages include the sender's number, so listener CFCs can respond to messages sent by mobile devices.

**About SMS application development and deployment**

The following sections introduce the ColdFusion SMS application development tools and process, and discuss SMS messaging providers:

- ColdFusion SMS application tools
- Application development and deployment process
- About SMS providers

**ColdFusion SMS application tools**

ColdFusion provides the following tools for developing SMS applications:

- **SMSGateway:** The class for the SMS event gateway type
- **SMS test server:** A lightweight SMSC simulator
- **SMS client simulator:** A graphical interface for sending and receiving SMS messages with the SMS test server

You implement your SMS application by creating a ColdFusion application that uses an instance of the SMSGateway class to communicate with one or more SMSCs. You can use the SMS testing server and client simulator to test your application without requiring an outside SMS service provider.

**Application development and deployment process**

The following is a typical process for developing and deploying an SMS application:

1. Design your application.
2. Configure an SMS event gateway instance to use the ColdFusion SMS test server.
3. Write your ColdFusion CFCs, CFM pages, and any other application elements.
4. Test your application using the test server and client simulator.
5. Establish an SMPP account with a telecommunications provider.
6. Reconfigure your event gateway, or create a new event gateway instance, to use your telecommunications provider's SMSC. Configure the gateway using the information supplied by your provider.
7. Test your application using the telecommunications provider's SMSC and target mobile devices.
8. Make the application publicly available.
About SMS providers
Before you can deploy an SMS application, you must establish an account with a provider that supports SMPP 3.4 over TCP/IP. There are generally two kinds of providers:

• Telecommunications carriers such as nation-wide cellular phone providers
• Third-party SMPP aggregators

The type of provider and specific provider you use should depend on your needs and provider capabilities and price structures. Less expensive providers may have slower response times. Telecommunications carriers might be more expensive but might provide more throughput and faster SMPP response times.

How the SMS event gateway and provider SMSC interact
This section provides a brief overview of the interactions between the ColdFusion SMS event gateway and the SMPP provider’s SMSC. It is designed to help you to understand the basics of SMPP interactions, and defines the terms necessary to for you to understand gateway configuration and message handling. For more details, see the SMPP specification, which is available at www.smsforum.net/.

A typical interaction between an SMSC and a ColdFusion SMS event gateway instance consists of messages, or PDUs sent between the two entities, such as a mobile device and a ColdFusion event gateway instance (and therefore, and event gateway application). The following sections describe these interactions and how you handle them in ColdFusion.

Gateway binding
The event gateway must bind to the SMSC before they can communicate. The SMS event gateway instance initiates a binding by sending a bind_transceiver PDU to the SMSC, which includes the gateway’s ID and password. If the initial bind request fails, the gateway retries the bind at the rate specified by the gateway configuration file retry-interval value until either the bind is successful or the gateway reaches the maximum number of retries, specified by the retries configuration value. If the bind operation fails, ColdFusion logs an error to the eventgateway.log file, and you must restart the gateway instance in the ColdFusion Administrator to establish the connection.

Note: Some SMSCs can send a prohibited status in response to a bind request. If the gateway receives such a status response, it sets the retry interval to one minute and the maximum number of retries to 15. The SMS gateway detects SMPP 5.0-compliant and AT&T prohibited status responses.

When the SMSC accepts the bind request, it returns a bind_transceiver_resp PDU. The binding remains in effect until the gateway instance shuts down and sends an unbind PDU to the SMSC. Because the gateway binds as a transceiver, it can initiate messages to the SMSC, and the SMSC can send messages to it.

Incoming PDU handling
If the ColdFusion SMS event gateway gets an Unbind PDU from the SMSC, it sends an unbind_resp PDU to the SMSC, does a restart, and attempts to rebind to the SMSC.

When the event gateway receives an EnquireLink or any other request PDU from the SMSC, it sends a default response to the SMSC.

The gateway receives incoming messages from the SMSC in deliver_sm PDUs; it does not handle data_sm PDUs. Deliver_sm PDUs can contain user- or application-generated messages, or disposition responses for messages that the gateway has sent. The gateway extracts the short message field and source and destination addresses from the PDU, puts them in a CFEvent object, and sends the object to ColdFusion event gateway services for delivery to the listener CFC. For information on how the CFML application must handle these incoming messages, see “Handling incoming messages” on page 1105.
Outgoing message handling
The gateway supports three types of outgoing messages from ColdFusion applications. The CFML sendGatewayMessage function or a listener CFC method cfreturn tag can specify the following commands:

submit: Sends a submit_sm PDU with the message contents to the SMSC. This PDU sends a message to a single destination.

submitMulti: Sends a submit_multi PDU with the message contents to the SMSC. This PDU sends a message to multiple destinations.

data: Sends a data_sm PDU with the message contents to the SMSC. This is an alternative to the submit command, and is typically used by interactive applications such as those provided via a wireless application protocol (WAP) framework.

The SMS gateway lets you control the contents of all of the fields of these PDUs. For more information on the individual commands, see “Sending outgoing messages” on page 1107.

When you send a message, if the SMSC responds with a status that indicates that the message was rejected or not sent, ColdFusion logs information about the failure in the eventgateway.log file. If the SMSC indicates that the service type is not available (SMPP v5 ESME_RSERTYPUNAVAIL status or AT&T Serviced denied status), and the gateway configuration file transient-retry value is set to yes, the gateway also tries to resend the message.

Outgoing message synchronization and notification
The gateway and SMSC communicate asynchronously: the gateway does not wait for a response from the SMSC for one message before it sends another message. However, you can configure your gateway instance so that the CFML sendGatewayMessage function behaves asynchronously or synchronously.

• In asynchronous mode, the function returns when the message is queued in ColdFusion gateway services.

• In synchronous mode, the function waits until the SMSC receives the message and returns a message ID, or an error occurs.

For more information on configuring message synchronization and sending messages synchronously, see “Controlling SMS message sending and response” on page 1110.

Configuring an SMS event gateway
You provide SMS-specific configuration information to the SMS event gateway in a configuration file. You specify the configuration file location when you configure the SMS event gateway instance in the ColdFusion Administrator.

ColdFusion provides a sample SMS event gateway configuration file in cf_root\WEB-INF\cfusion\gateway\config\sms-test.cfg on J2EE configurations, and cf_root\gateway\config\sms-test.cfg on server configurations. The configuration file contents is described in the following table.

Note: The following configuration information describes the configuration fields, but does not include detailed explanations of SMPP-specific terminology, listings of all valid values of properties that are defined in the SMPP specification, or explanations of how to select appropriate SMPP-specific values for your application. For further information, see documentation on the SMPP 3.4 protocol at www.smsforum.net/ and other publicly available documentation. Your SMS service provider might specify requirements for several of these configuration values. Consult the provider documentation.
<table>
<thead>
<tr>
<th>Property</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ip-address</td>
<td></td>
<td>IP address of the SMSC, as specified by the SMPP provider. For the ColdFusion SMS test server, you normally use 127.0.0.1.</td>
</tr>
<tr>
<td>port</td>
<td>0</td>
<td>Port number to bind to on the SMSC. The ColdFusion SMS test server uses port 7901.</td>
</tr>
<tr>
<td>system-id</td>
<td></td>
<td>Name that identifies the event gateway to the SMSC, as established with the SMPP provider. To connect to the ColdFusion SMS test server, the system-id must be cf.</td>
</tr>
<tr>
<td>password</td>
<td></td>
<td>Password for authenticating the event gateway to the SMSC. To connect to the ColdFusion SMS test server, the password must be cf.</td>
</tr>
<tr>
<td>source-ton</td>
<td>1</td>
<td>Type of Number (TON) of the source address, that is, of the address that the event gateway uses for outgoing messages, as specified in the SMPP specification. Values include 0, unknown; 1, international number; 2, national number.</td>
</tr>
<tr>
<td>source-npi</td>
<td>1</td>
<td>Numeric Plan Indicator (NPI) of the source address as specified in the SMPP specification. Values include 0, unknown; 1, ISDN.</td>
</tr>
<tr>
<td>source-address</td>
<td>empty string</td>
<td>Address (normally, a phone number) of the event gateway. Identifies the sender of outgoing messages to the SMSC.</td>
</tr>
<tr>
<td>addr-ton</td>
<td>1</td>
<td>TON for the incoming addresses that this event gateway serves.</td>
</tr>
<tr>
<td>addr-npi</td>
<td>1</td>
<td>NPI for the incoming addresses that this event gateway serves.</td>
</tr>
<tr>
<td>address-range</td>
<td></td>
<td>The range of incoming addresses (phone numbers) that remote devices can use to send messages to the event gateway instance; often, the same as the source-address.</td>
</tr>
<tr>
<td>message-rate</td>
<td>100</td>
<td>Integer or decimal value that specifies the number of messages the gateway is allowed to send to your service provider per second. 0 is unlimited.</td>
</tr>
<tr>
<td>mode</td>
<td>synchronous</td>
<td>Message transmission mode:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• synchronous The gateway waits for the response from the server when sending a message. In this mode, the SendGatewayMessage CFML function returns the SMS messageID of the message, or an empty string if there is an error.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• asynchronous The gateway does not wait for a response. In this mode, the SendGatewayMessage CFML function always returns an empty string.</td>
</tr>
<tr>
<td>network-retry</td>
<td>no</td>
<td>Gateway behavior when a network error occurs while trying to deliver a message:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• yes The gateway queues the message for delivery when the gateway is able to rebind to the SMSC. Retrying is useful if the gateway is in asynchronous mode, where the CFML SendGatewayMessage function does not return an error.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• no The gateway does not retry sending the message.</td>
</tr>
<tr>
<td>transient-retry</td>
<td>no</td>
<td>Gateway behavior when the SMSC returns an error that indicates a transient error, where it may be able to accept the message in the future:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• yes The gateway attempts to resend the message. Retrying is useful if the gateway is in asynchronous mode, where the CFML SendGatewayMessage function does not return an error.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• no The gateway does not retry sending the message.</td>
</tr>
<tr>
<td>cfc-method</td>
<td>onIncomingMessage</td>
<td>Listener CFC method for ColdFusion to invoke when the gateway gets incoming messages.</td>
</tr>
<tr>
<td>destination-ton</td>
<td>1</td>
<td>Default TON of addresses for outgoing messages.</td>
</tr>
<tr>
<td>destination-npi</td>
<td>1</td>
<td>Default NPI of addresses for outgoing messages.</td>
</tr>
<tr>
<td>service-type</td>
<td>empty string</td>
<td>Type of messaging service; can be empty or one of the following values: CMT, CPT, VMN, VMA, WAP, or USSD.</td>
</tr>
</tbody>
</table>
You can also set the following values in each outgoing message: source-ton, source-npi, source-address, destination-ton, destination-npi, and service-type. The message field names differ from the configuration file property names.

### Handling incoming messages

The SMS event gateway handles messages that are contained in deliver_sm PDUs. These PDUs request the gateway to deliver one of the following types of message:

- A user- or application-generated text message
- A message disposition response

**Note:** The SMS event gateway does not handle messages that are contained in data_sm PDUs.

The event gateway sends the object to event gateway services, which delivers it to the listener CFC. The CFEvent object that the listener CFC receives contains the following fields:

**Note:** SMS messages and any other data that enters through an Event Gateway handler should be considered potentially hostile. For example, if SMS data is archived in a SQL database, an attacker could construct a message that modifies or deletes data, or even takes over the SQL Server. Because of this, you should be sure to perform Event Gateway input validation, just as you would validate web form input.

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CfcMethod</td>
<td>Listener CFC method name</td>
</tr>
<tr>
<td>Data.dataCoding</td>
<td>Character set or the noncharacter data type of the message contents</td>
</tr>
<tr>
<td>Data.destAddress</td>
<td>Address to which the message was sent</td>
</tr>
<tr>
<td>Data.esmClass</td>
<td>Message type</td>
</tr>
<tr>
<td>Data.MESSAGE</td>
<td>Message contents</td>
</tr>
<tr>
<td>Data.messageLength</td>
<td>Length of the MESSAGE field</td>
</tr>
<tr>
<td>Data.priority</td>
<td>Message priority level, in the range 0-3</td>
</tr>
<tr>
<td>Data.protocol</td>
<td>GSM protocol; not used for other networks</td>
</tr>
<tr>
<td>Data.registeredDelivery</td>
<td>Requested type of delivery receipt or acknowledgement, if any</td>
</tr>
</tbody>
</table>
For a detailed description of each field, see “SMS Gateway incoming message CFEvent structure” on page 1404 in the CFML Reference.

The CFC's listener method extracts the message from the Arguments.CFEvent.Data.MESSAGE field and acts on it as appropriate for the application. If necessary, the listener can use two fields to determine the required action:

- CFEvent.Data.esmClass indicates the type of information in the MESSAGE field.
- CFEvent.Data.registeredDelivery indicates whether the sender requested any type of delivery receipt or acknowledgement.

### CFEvent.Data.esmClass field

The CFEvent.Data.esmClass field identifies whether the CFEvent.Data.Message field contains a message, or any of the following types of message disposition responses. For these responses, the CFEvent object Data.MESSAGE field contains the acknowledgment or receipt information.

**SMSC Delivery Receipt:** An indication of the message's final status, sent by the SMSC. The short message text includes the message ID of the original message, the number of messages sent and delivered (for messages sent to a distribution list), the date and time that the message was sent and delivered or otherwise disposed of, the message disposition, a network-specific error code (if available), and the first 20 bytes of the message. For details of the SMSC delivery receipt message structure, see Appendix B of the SMS 3.4 specification.

**SME Delivery Acknowledgement:** An indication from the recipient device that the user has read the short message. Supported by TDMA and CDMA wireless networks only.

**SME Manual/User Acknowledgement:** An application-generated reply message sent in response to an application request message. Supported by TDMA and CDMA wireless networks only.

**Intermediate Delivery Notification:** A provider-specific notification on the status of a message that has not yet been delivered, sent during the SMSC retry lifetime for the message. Intermediate Notification support depends on the SMSC implementation and SMSC service provider. For more information, see your provider documentation.

When you send a message, you can request any combination of message disposition responses in the outgoing message's registered_delivery parameter. If your application requests responses, the listener CFC must be prepared to handle these messages, as appropriate.

### CFEvent.Data.registeredDelivery field

The CFEvent.Data.registeredDelivery field indicates whether the message sender has requested a receipt or acknowledgment. Your application can respond to a request for an SME Delivery Acknowledgement or an SME Manual/User Acknowledgement. (The other notification types are sent by the SMSC only.) For more information on these notification types, see the SMS 3.4 specification. Appendix B contains detailed information on the information that you must put in the shortMessage field of the returned acknowledgment message.

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data.sourceAddress</td>
<td>Address of the device that sent this message</td>
</tr>
<tr>
<td>GatewayType</td>
<td>Always SMS</td>
</tr>
<tr>
<td>OriginatorID</td>
<td>Address of the device that sent the message</td>
</tr>
</tbody>
</table>
Incoming message handling example
The following example code is an SMS-only version of the echo.cfc example that is included in the ColdFusion gateway/cfc/examples directory. This example shows the minimal code needed to receive and respond to an SMS message.

```
<cfcomponent displayname="echo" hint="Process events from the test gateway and return echo">
  <cffunction name="onIncomingMessage" output="no">
    <cfargument name="CFEvent" type="struct" required="yes">
      <!--- Get the message --->
      <cfset data=cfevent.DATA>
      <cfset message=#data.message#>
      <!--- where did it come from? --->
      <cfset orig=#CFEvent.originatorID#>
      <cfset retValue = structNew()>
      <cfset retValue.command = "submit">
      <cfset retValue.sourceAddress = arguments.CFEVENT.gatewayid>
      <cfset retValue.destAddress = arguments.CFEVENT.originatorid>
      <cfset retValue.shortMessage = "echo: " & message>
      <!--- send the return message back --->
      <cfreturn retValue>
  </cffunction>
</cfcomponent>
```

Sending outgoing messages

Your ColdFusion application can send submit, submitMulti, and data commands to the event gateway in an outgoing message. The following sections describe these commands in detail, followed by information on some of the more common options for sending messages.

The submit command
To send a message to a single destination address in an SMPP SUBMIT_SM PDU, the structure used in the Data parameter of a SendGatewayMessage function or the return variable of the CFC listener method normally has the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>command</td>
<td>If present, the value must be &quot;submit&quot;. If you omit this field, the event gateway sends a submit message.</td>
</tr>
<tr>
<td>shortMessage</td>
<td>The Message contents. You must specify one of these fields, but not both. The SMPP specification imposes a maximum size of 254 bytes on the shortMessage field, and some carriers might limit its size further. The messagePayload field can contain up to 64K bytes; it must start with 0x0424, followed by 2 bytes specifying the payload length, followed by the message contents.</td>
</tr>
<tr>
<td>destAddress</td>
<td>The address to which to send the message (required).</td>
</tr>
<tr>
<td>sourceAddress</td>
<td>The address of this application. You can omit this field if it is specified in the configuration file.</td>
</tr>
</tbody>
</table>

You can also set optional fields in the structure, such as a field that requests a delivery receipt. For a complete list of fields, see "submit command" on page 1407 in the CFML Reference. For detailed descriptions of these fields, see the documentation for the SUBMIT_MULTI PDU in the SMPP3.4 specification, which you can download from the SMS Forum at www.smsforum.net/.

Note: To send long messages, you can separate the message into multiple chunks and use a submit command to send each chunk separately. In this case, a CFC would use multiple SendGatewayMessage functions, instead of the cfreturn function.
Example: Using the submit command in sendGatewayMessage function

The following example from a CFM page uses a sendGatewayMessage CFML function with a submit command to send an SMS messages that you enter in the form. This example uses the SMS gateway that is configured in the ColdFusion installation, and will send the message to the SMS client simulator.

```cfml
<h3>Sending SMS From a Web Page Example</h3>
<cfif IsDefined("form.oncethrough") is "Yes">
  <cfif IsDefined("form.SMSMessage") is True AND form.SMSMessage is not "">
    <h3>Sending Text Message: </h3>
    <cfoutput>#form.SMSMessage#</cfoutput><br>
    <cfscript>
      /* Create a structure that contains the message. */
      msg = structNew();
      msg.command = "submit";
      msg.destAddress = "5551234";
      msg.shortMessage = form.SMSMessage;
      ret = sendGatewayMessage("SMS Menu App - 5551212", msg);
    </cfscript>
  </cfif>
</cfif>
</body>
</html>
```

For a simple example of a listener CFC uses the submit command to echo incoming SMS messages to the message originator, see "Incoming message handling example" on page 1107.

The submitMulti command

To send a single text message to multiple recipients using an SMPP SUBMIT_MULTI PDU, the Data parameter of a SendGatewayMessage function or the return variable of the CFC listener method normally has the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>command</td>
<td>Must be &quot;submitMulti&quot;.</td>
</tr>
<tr>
<td>shortMessage</td>
<td>The message contents. You must specify one of these fields, but not both. The SMPP specification imposes a maximum size of 254 bytes on the shortMessage field, and some carriers might limit its size further. The messagePayload field can contain up to 64K bytes; it must start with 0x0424, followed by 2 bytes specifying the payload length, followed by the message contents.</td>
</tr>
<tr>
<td>destAddress</td>
<td>A ColdFusion array of destination addresses (required). You cannot specify individual TON and NPI values for these addresses; all must conform to a single setting.</td>
</tr>
</tbody>
</table>

You can also set optional fields in the structure, such as a field that requests delivery receipts. For a complete list of fields, see “submitMulti command” on page 1409 in the CFML Reference. For detailed descriptions of these fields, see the documentation for the SUBMIT_MULTI PDU in the SMPP 3.4 specification, which you can download from the SMS Forum at www.smsforum.net/.
Example: Using the submitMulti command in an onIncomingMessage method

The following example onIncomingMessage method sends a response that echoes an incoming message to the originator address, and sends a copy of the response to a second address. To test the example, run two instances of the ColdFusion SMS client application. Use the default phone number of 5551212 for the first, and set the second one to have a phone number of 555-1235. (Notice that the second phone number requires a hyphen (-).) Send a message from the first simulator, and the response will appear in both windows.

```cftag
<cffunction name="onIncomingMessage" output="no">
  <cfargument name="CFEvent" type="struct" required="yes">
    <!--- Get the message. --->
    <cfset data=CFEvent.DATA>
    <cfset message="#data.message#">
    <!--- Create the return structure. --->
    <cfset retValue = structNew()>
    <cfset retValue.command = "submitmulti">
    <cfset retValue.sourceAddress = arguments.CFEVENT.gatewayid>
    <cfset retValue.destAddresses=arraynew(1)>
    <!--- One destination is incoming message originator; get the address from CFEvent originator ID. --->
    <cfset retValue.destAddresses[1] = arguments.CFEvent.originatorid>
    <cfset retValue.destAddresses[2] = "555-1235">
    <cfset retValue.shortMessage = "echo: " & message>
    <cfreturn retValue>
</cffunction>
```

The data command

To send binary data to a single destination address in an SMPP DATA_SM PDU, the Data parameter of a SendGatewayMessage function or the return variable of the CFC listener method must have the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>command</td>
<td>Must be &quot;data&quot;.</td>
</tr>
<tr>
<td>messagePayload</td>
<td>Message data. To convert data to binary format, use the ColdFusion toBinary function.</td>
</tr>
<tr>
<td>destAddress</td>
<td>Address to which to send the message.</td>
</tr>
<tr>
<td>sourceAddress</td>
<td>Address of this application; can be omitted if specified in the configuration file.</td>
</tr>
</tbody>
</table>

You can also set optional fields in the structure, such as a field that requests a delivery receipt. For a complete list of fields, see “data command” on page 1411 in the CFML Reference. For detailed descriptions of these fields, see the documentation for the SUBMIT_MULTI PDU in the SMPP3.4 specification, which you can download from the SMS Forum at www.smsforum.net/.

Example: Using the data command

The following example onIncomingMessage method converts an incoming message to binary data, and sends the binary version of the message back to the originator address:

```cftag
<cffunction name="onIncomingMessage" output="no">
  <cfargument name="CFEvent" type="struct" required="yes">
    <!--- Get the message. --->
    <cfset data=CFEvent.DATA>
    <cfset message="#data.message#">
    <!--- Create the return structure. --->
    <cfset retValue = structNew()>
    <cfset retValue.command = "data">
    <cfset retValue.destAddresses[1] = arguments.CFEvent.originatorid>
    <cfset retValue.destAddresses[2] = "555-1235">
    <cfset retValue.shortMessage = "echo: " & message>
    <cfreturn retValue>
</cffunction>
```
Controlling SMS message sending and response

This section describes some of the more common options for sending messages, and how they affect your application. For information on other ways to configure outgoing message, see the SMPP specification.

Synchronization mode

You can specify asynchronous or synchronous message mode in the gateway configuration file.

- If you specify asynchronous mode, the sendGatewayMessage function returns an empty string when the message is submitted by the gateway to service code for sending to the SMSC. ColdFusion logs errors that might occur after this point, such as if a message sent by the gateway to the SMSC times out or if the gateway gets an error response; the application does not get notified of any errors.
- If you specify synchronous mode (the default), the sendGatewayMessage function does not return until the gateway gets a response from the SMSC or the attempt to communicate times out. If the message is sent successfully, the function returns the SMPP message ID string. If an error occurs, the function returns an error string.

Use synchronous mode if your application must determine whether its messages reach the SMSC. Also use synchronous mode if the application requests return receipts.

**Note:** If you use synchronous mode and the SMSC returns the messageID as a hexadecimal string, ColdFusion converts it automatically to its decimal value.

The following example is an expansion of “Example: Using the submit command in sendGatewayMessage function” on page 1108. It checks for a nonempty return value and displays the message number returned by the SMS. This example uses the SMS gateway that is configured when ColdFusion is installed. If you change the gateway specified in the SendGatewayMessage function, make sure that you gateway’s configuration file specifies synchronous mode.

```coldfusion
<h3>Sending SMS From a Web Page Example</h3>
<cfif IsDefined("form.oncethrough") is "Yes">
  <cfif IsDefined("form.SMSMessage") is True AND form.SMSMessage is not ">
    <h3>Sending a Text Message: </h3>
    <cfoutput>#form.SMSMessage#</cfoutput><br><br>
  </cfif>
</cfif>
<cfif isDefined("ret") AND ret NEQ ">
  <h3>Text message sent</h3>
  <cfoutput>The Message Id is: #ret#</cfoutput>
  <br><br>
</cfif>
<hr noshade>
</cfif>

<!--- begin by calling the cfform tag --->
<cfset retValue.destAddress = arguments.CFEvent.originatorid>
<cfset retValue.messagePayload = tobinary(tobase64("echo: " & message))>
<cfreturn retValue>
</cffunction>

```
<cfform>
   SMS Text Message: <cfinput type="Text" name="SMSMessage" value="Sample text Message" required="No" maxlength="160">
   <p><input type = "submit" name = "submit" value = "Submit">
   <input type = "hidden" name = "oncethrough" value = "Yes"></cfform>

**Message disposition notification**

You can request the SMSC to return a message disposition response to indicate the fate of your message. To request a delivery receipt, include a RegisteredDelivery field in the *Data* parameter of a `SendGatewayMessage` function or the return variable of the CFC listener method. This field can have the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(Default) Do not return delivery information.</td>
</tr>
<tr>
<td>1</td>
<td>Return a receipt if the message is not delivered before the time-out.</td>
</tr>
<tr>
<td>2</td>
<td>Return a receipt if the message is delivered or fails.</td>
</tr>
</tbody>
</table>

Some providers also support intermediate delivery notifications. For more information, see your provider's documentation.

To use delivery notification, you must send your message using synchronous mode, so you get a message ID. Your incoming message routine must be able to handle the receipts (see "Handling incoming messages" on page 1105).

**Validity period**

You can change the length of time that the SMSC keeps a message and tries to deliver it. (Often the default value is 72 hours.) For a message sent to an emergency worker, for example, you might want to specify a very short validity period (such as 15 minutes). To change this value, include a validityPeriod field in the *Data* parameter of a `SendGatewayMessage` function or the return variable of the CFC listener method. To specify a time period, use the following pattern: `YYMMDDhhmmsst00R`. In this pattern, `t` indicates tenths of seconds, and `00R` specifies that this is a relative time period, not a date-time value. The time format `000106300000000R`, for example, specifies a validity period of 0 years, 0 months, 1 day, 6 hours, 30 minutes.

**ColdFusion SMS development tools**

ColdFusion provides the following tools for developing SMS applications:

- SMS test server
- SMS client simulator

**SMS test server**

The ColdFusion SMS test server is a lightweight SMSC simulator that listens on TCP/IP port 7901 for SMPP connection requests from other SMS resources, such as ColdFusion SMS gateways or the SMS client simulator. The resource supplies a user name, password, and telephone number (address). The user name and password must correspond to a name and password in the simulator’s configuration file (described later in this section).

After the SMS test server establishes a connection, it listens for incoming messages and forwards them to the specified destination address, if the destination address also corresponds to an existing SMPP connection.
The SMS test server lets you develop SMS applications without having to use an external SMSC supplier such as a telecommunications provider. The server supports the ColdFusion SMS gateway submit and submitMulti commands. It also accepts, but does not deliver messages sent using the SMS gateway data command. It does not include any store and forward capabilities.

Start the SMS test server by clicking the Start SMS Test Server button on the Settings page in the Event Gateways area in the ColdFusion Administrator.

Note: The SMS test server does not automatically restart when you restart ColdFusion. You must manually restart the server if you restart ColdFusion.

The SMS test server reads the cf_root\WEB-INF\cfusion\lib\sms-test-users.txt file on J2EE configurations or cf_root\lib\sms-test-users.txt file on server configurations to get valid user names and passwords. ColdFusion includes a version of this file configured with several names and passwords. One valid combination is user name cf and password cf. You can edit this file to add or delete entries. The file must include a name and password entry for each user that will connect to the test server, and user entries must be separated by blank lines, as the following example shows:

```text
name=cf
cf
name=user1
user1
```

**SMS client simulator**

The ColdFusion SMS client simulator is a simple External Short Message Entity (ESME) that simulates a (limited-function) mobile phone. It can connect to the SMS test server and exchange messages with it.

Note: On UNIX and Linux systems, the client simulator requires X-Windows.

Use the following procedure to use the simulator.

**Use the SMS simulator**

1. Ensure that you have started the SMS test server and configured and started an SMS event gateway instance in ColdFusion Administrator.

2. Run SMSClient.bat in Windows or SMSClient.sh on UNIX or Linux. These files are located in the cf_root\WEB-INF\cfusion\bin directory on J2EE configurations and the cf_root\bin directory on server configurations.

   If you installed a pure Java version of ColdFusion, for example, on Apple OS X systems, enter the following command to start the simulator:

   ```sh
   java -jar cf_root/WEB-INF/cfusion/lib/smpp.jar
   ```

3. A dialog box appears, requesting the server, port, user name, password, and the phone number to use for this device. The simulator sends this phone number as the source address, and accepts SMS messages sent by the SMSC server to it using this number as the destination address.

   To connect to the SMS test server, accept the default values and specify an arbitrary phone number; you can also specify any user name-password pair that is configured in the cf_root\WEB-INF\cfusion\lib\sms-test-users.cfg file or cf_root\lib\sms-test-users.cfg file.

4. Click Connect.

5. The SMS device simulator client appears. In the Send SMS To field, enter a phone number in the address-range property specified in the configuration file of the SMS event gateway that you want to send messages to.
6 Type a message directly into the message field (to the left of the Send button), or use the simulator keypad to enter the message.
7 Click the Send button.

The client simulator has a Connection menu with options to connect and disconnect from the SMSC server, and to check the connection. The connection information appears in a status line at the bottom of the client.

Sample SMS application

The following CFC implements a simple employee phone directory lookup application. The user sends a message containing some part of the name to be looked up (a space requests all names). The onIncomingMessage response depends on the number matches:

- If there is no match, the onIncomingMessage function returns a message indicating that there are no matches.
- If there is one match, the function returns the name, department, and phone number.
- If there are up to ten matches, the function returns a list of the names preceded by a number that the user can enter to get the detailed information.
- If there are over ten matches, the function returns a list of only the first ten names. A more complex application might let the user get multiple lists of messages to provide access to all names.
- If the user enters a number, and previously got a multiple-match list, the application returns the information for the name that corresponds to the number.

The following listing shows the CFC code:

```coldfusion
<cfcomponent>
  <cffunction name="onIncomingMessage">
    <cfargument name="CFEvent" type="struct" required="YES">
      <!--- Remove any extra white space from the message. --->
      <cfset message = Trim(arguments.CFEvent.data.MESSAGE)>
      <!--- If the message is numeric, a previous search probably returned a list of names. Get the name to search for from the name list stored in the Session scope. --->
      <cfif isNumeric(message)>
        <cfscript>
        if (structKeyExists(session.users, val(message))) {
          message = session.users[val(message)];
        }
        </cfscript>
      </cfif>
      <!--- Search the database for the requested name. --->
      <cfquery name="employees" datasource="cfdocexamples">
        select FirstName, LastName, Department, Phone
        from Employees
        where 0 = 0
        <!--- A space indicates the user entered a first and last name. --->
        <cfif listlen(message, " ") eq 2>
          and FirstName like '#listFirst(message, " ")#'%
          and LastName like '#listLast(message, " ")#'%
        </cfifelse>
        <!--- No space: the user entered a first or a last name. --->
        and (FirstName like '#listFirst(message, " ")#' or LastName like '#listFirst(message, " ")#')
      </cfquery>
  </cffunction>
</cfcomponent>
```
</cfquery>

<!---- Generate and return the message.---->
<cfscript>
returnVal = structNew();
returnVal.command = "submit";
returnVal.sourceAddress = arguments.CFEVENT.gatewayid;
returnVal.destAddress = arguments.CFEVENT.originatorid;

// No records were found.
if (employees.recordCount eq 0) {
    returnVal.shortMessage = "No records found for '#message#'';
}
// One record was found.
else if (employees.recordCount eq 1) {
    // Whitespace in the message text results in bad formatting,
    // so the source cannot be indented.
    returnVal.shortMessage = "Requested information:
#employees.firstName# #employees.lastName#
#employees.Department#
#employees.Phone#";
}
// Multiple possibilities were found.
else if (employees.recordCount gt 1) {
    // If more than ten were found, return only the first ten.
    if (employees.recordCount gt 10)
    {
        returnVal.shortMessage = "First 10 of #employees.recordCount# records";
    }else{
        returnVal.shortMessage = "Records found: #employees.recordCount#";
    }
    // The session.users structure contains the found names.
    // The record key is a number that is also returned in front of the
    // name in the message.
    session.users = structNew();
    for(i=1; i lte min(10, employees.recordCount); i=i+1)
    {
        // These two lines are formatted to prevent extra white space.
        returnVal.shortMessage = returnVal.shortMessage & "
#i# - #employees.firstName[i]# #employees.lastName[i]#";
        // The following two lines must be a single line in the source
        session.users[i]="#employees.firstName[i]# #employees.lastName[i]#";
    }
}
return returnVal;
</cfscript>
</cffunction>
</cfcomponent>
Chapter 59: Using the FMS event gateway

The FMS event gateway provides interfaces between the Flash Media Server 2 and the Adobe ColdFusion server so that ColdFusion applications and Adobe Flash clients can share data.

You should be familiar with ColdFusion event gateway principles and programming techniques (see “Using Event Gateways” on page 1060). A basic knowledge of Flash Media Server is also helpful.

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Application development and deployment process ............................................................................. 1117

About Flash Media Server

Flash Media Server 2 is the newest version of Flash Communication Server. Flash Media Server 2 offers traditional streaming media capabilities and a flexible development environment for creating and delivering innovative, interactive media applications. You can use Flash Media Server to create and deliver the following media experiences:

• Video on Demand
• Live web-event broadcasts
• MP3 streaming
• Video blogging
• Video messaging
• Multimedia chat environments

To learn more about and to download the Flash Media Server, go to the Adobe website at http://www.adobe.com/products/flashmediaserver/.

How ColdFusion and Flash Media Server interact through the FMS gateway

The FMS event gateway lets you modify data through the ColdFusion application or the Flash client, and reflect the change in the Flash Media Server shared object. The FMS event gateway listens to the shared object, and notifies ColdFusion when other clients modify shared objects. The FMS event gateway also lets ColdFusion modify shared objects.

ColdFusion provides the following tools for developing FMS applications:

FCSj.jar: The JAR file that implements the Java API to communicate with Flash Media Server.

FMSGateway: The class for the FMS event gateway type. You implement your FMS application by creating a ColdFusion application that uses an instance of the FMSGateway class to communicate with one or more Flash Media Server.
Modifying data in the Flash client

The FMS event gateway listens to Flash Media Server shared objects, and notifies ColdFusion when a shared object is modified by a Flash client. The following steps occur when a Flash client modifies a Flash Media Server shared object:

1. A user modifies data in the Flash client.
2. Flash Media Server updates the appropriate shared object.
3. Flash Media Server notifies the FMS event gateway.
4. The FMS event gateway calls the appropriate methods in CFCs in your ColdFusion application, which perform all actions required, including notifying the FMS Gateway Helper to update the shared object.
5. The FMS Gateway Helper sends a message to the FMS event gateway to update the shared object.
6. The FMS event gateway updates the shared object.
7. Flash Media Server notifies all the Flash clients that it modified the shared object. As a result, the Flash clients reflect the change.

The following image shows the interaction between Flash Media Server, the FMS event gateway, and the ColdFusion application:

Modifying data in the Flash client

Modifying data in a ColdFusion application

The FMS event gateway lets ColdFusion applications modify Flash Media Server shared objects. The following steps occur when data that affects a shared object is modified in a ColdFusion application:

1. The user submits a form that contains data to modify using a ColdFusion page.
2. The ColdFusion page calls the appropriate CFC, which contains a method to update the database.
3. The method in the CFC updates the database and calls a method in the FMS Gateway Helper.
4. The FMS Gateway Helper calls the FMS event gateway to update the appropriate shared object.
5. Flash Media Server updates the shared object.
6. Flash Media Server notifies the Flash client that a shared object has changed.
7. The Flash client makes the changes in its content as appropriate.

The following image shows the interaction between the ColdFusion application and Flash Media Server through the FMS event gateway:
Application development and deployment process

The following is a typical process for developing and deploying an application that uses the FMS event gateway:

1. Design your application.
2. Configure an FMS event gateway instance to use the Flash Media Server.
3. Write your ColdFusion CFCs, CFM pages, and any other application elements.
4. Create or identify a Flash client that manipulates a Flash Media Server shared object to test your ColdFusion application.
5. Test your application using Flash Media Server and the Flash client.
6. Make the application publicly available.

Configuring an FMS event gateway

You provide FMS event gateway-specific configuration information to the FMS event gateway in a configuration file. You specify the configuration file location when you configure the FMS event gateway instance in the ColdFusion Administrator. The configuration file should contain the URL of the Flash Media Server application and the name of the Flash Media Server shared object. The following example is a sample configuration file:

```
# FMS event gateway configuration
#
# This is the URL to the Flash Media Server application.
rtmpurl=rtmp://localhost/SalesDataApp

# This is the shared object you would like this gateway to connect and listen to.
sharedobject=SalesDataSO
```

**FMS event gateway GatewayHelper class methods**

The following table lists the FMS event gateway GatewayHelper class methods:
Data translation

ColdFusion and Flash Media Server use different data types; therefore, data translation is required to pass data from one to the other. In addition to basic data types such as numeric, String, and Boolean, you can pass ColdFusion queries, structures, and arrays to Flash Media Server. You pass a ColdFusion query object to Flash Media Server as an array of java.util.HashMap. Each HashMap object in the array contains a key-value pair for column names and values for each row in the query. When you pass a ColdFusion array to Flash Media Server, the FMS event gateway converts it to a Java array of objects. When you pass a ColdFusion structure, no conversion is required.

The FMS event gateway does not support passing CFCs in shared objects.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
</table>
| setProperty | Sets the property of the Flash Media Server shared object. The following parameters are valid:  
|            | name: The string that contains the name of the shared object.  
|            | value: The shared object.                                                                                                                    |
| getProperty | Gets the property of the Flash Media Server shared object. The following parameters are valid:  
|            | name: The string that contains the name of the shared object.                                                                               |
Chapter 60: Using the Data Services Messaging Event Gateway

Using the Data Services Messaging gateway type provided with ColdFusion, you can create applications that send messages to and receive messages from LiveCycle Data Services ES. You configure the Data Services Messaging gateway and write and test an application that uses the event gateway.

You should be familiar with ColdFusion event gateway principles and programming techniques (see “Using Event Gateways” on page 1060). You should also be familiar with Adobe LiveCycle Data Services ES.

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About Flex and ColdFusion

ColdFusion includes the Data Services Messaging event gateway, which uses the ColdFusion event Gateway Adapter to send messages to and receive messages from the LiveCycle Data Services ES. This means that ColdFusion applications and Flex applications can publish to and consume events from the same event queue.

Note: To use the Data Services Messaging event gateway to interact with a Flex application, the Flex application must be running on LiveCycle Data Services ES.

How ColdFusion and Flex interact

You can send messages from a ColdFusion application to a Flex application, through the Data Services Messaging event gateway. Conversely, you can send messages from a Flex application to a ColdFusion application.

Either the ColdFusion application or the Flex application can initiate sending a message. The following image shows the message handling process in which a message is sent from the Flex application to the ColdFusion application, and then from the ColdFusion application to the Flex application.

1. The Flex application generates a message.
2. The Flex Message Service passes the message to the ColdFusion Event Gateway Adapter.
3 The ColdFusion Event Gateway Adapter sends the message to the Data Services Messaging event gateway, by using Java Remote Method Invocation (Java RMI).

4 The Data Services Messaging event gateway and the ActionScript translator convert ActionScript 3.0 data types to the appropriate ColdFusion values and add the message to the event gateway queue.

5 The ColdFusion server invokes the onIncomingMessage method of the Data Services Messaging event gateway listener CFC.

6 The ColdFusion application generates a message, which it sends to the ColdFusion server.

7 The ColdFusion server sends the message to the Data Services Messaging event gateway.

8 The Data Services Messaging event gateway and the ActionScript translator convert ColdFusion values to the appropriate ActionScript 3.0 data types and then the gateway sends the message to the ColdFusion Event Gateway Adapter.

9 The ColdFusion Event Gateway Adapter sends the message to the Flex Message Service.

10 The Flex Message Service passes the message to the Flex application.

Note: The RMI registry, which facilitates communication between the ColdFusion Event Gateway Adapter and the Data Services Messaging event gateway uses port 1099, which is the default port for Java RMI. You cannot change this port number. To ensure that the RMI registry provides registry service for both Flex Enterprise Services 2 and ColdFusion, start Flex Enterprise Services 2 first, and then start ColdFusion. If you stop Flex, you must restart Flex Enterprise Services 2, and then restart the gateway.

Application development and deployment process

The following is a typical process for developing and deploying a ColdFusion application that communicates with a Flex application through the Data Services Messaging event gateway:

1 Design your application.

2 Configure a Data Services Messaging event gateway instance.

3 Write your ColdFusion CFCs, CFM pages, and any other application elements.

4 Test your application using Flex Enterprise Services 2.

5 Make the application publicly available.

Configuring a Data Services Messaging event gateway

Although you can configure an instance of a Data Services Messaging event gateway by creating a configuration file and specifying that file as the configuration file when you create an instance of the event gateway, you can also provide the configuration information in the message sent from the Flex application. You provide configuration information to the Data Services Messaging event gateway in a configuration file to do either of the following:

• Have the Data Services Messaging event gateway send messages to Flex Enterprise Services 2 on a different computer

• Use the Data Services Messaging event gateway with a specific Flex destination, and ignore any destination specified in the message

The Data Services Messaging event gateway configuration file is a simple Java properties file that contains the following properties:
The following example is a configuration file:

```
# Flex event gateway configuration
#
#
# This is the destination of the messages.
destination=Gateway1
#
# Hostname or IP address of the Flex Enterprise Server
host=127.0.0.1
```

If you create a configuration file, save it in the `cf_root/gateway/config/` directory, with the extension `.cfg`.

## Sending outgoing messages

Your ColdFusion application sends a message to a Flex application by doing the following actions:

1. The ColdFusion application sends an outgoing message, in a `cfreturn` tag in the listener CFC's listener method, or by calling the ColdFusion `SendGatewayMessage` function.
2. A method provided by the Data Services Messaging gateway gets called when you send an outgoing message.

In outgoing messages sent from CFML, the following structure members are translated to the Flex message:

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>body</td>
<td>Body of the message. This is required.</td>
</tr>
<tr>
<td>CorrelationID</td>
<td>Correlation identifier of the message.</td>
</tr>
<tr>
<td>Destination</td>
<td>Flex destination of the message. This is required if it is not specified in the configuration file.</td>
</tr>
<tr>
<td>Headers</td>
<td>If the message contains any headers, the CFML structure that contains the header names as keys and values.</td>
</tr>
<tr>
<td>LowercaseKeys</td>
<td>If the value is set to <code>yes</code>, the structure keys are converted to lowercase during creation of ActionScript types.</td>
</tr>
<tr>
<td>TimeToLive</td>
<td>Number of milliseconds during which this message is valid.</td>
</tr>
</tbody>
</table>

In addition, the Data Services Messaging event gateway automatically provides values for the following Flex message fields:

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>MessageID</td>
<td>A UUID that identifies the message.</td>
</tr>
<tr>
<td>Timestamp</td>
<td>Time the message is sent.</td>
</tr>
<tr>
<td>ClientID</td>
<td>ID of the Data Services Messaging event gateway instance.</td>
</tr>
</tbody>
</table>
**Note:** A single instance of the Data Services Messaging event gateway can send messages to any destination that is registered with the ColdFusion Event Gateway Adapter. However, if the destination is configured in the Data Services Messaging gateway configuration file, the destination in the message is ignored.

### Sending outgoing message example

The following example from a CFM page creates a structure that contains the message. The destination is the destination ID specified in the flex-services.xml file for the instance of the Data Services Messaging event gateway to send the message to. The body is the body of the message. The `SendGatewayMessage` CFML function sends the message to the instance of the gateway.

```cfm
<cfset success = StructNew()>
<cfset success.msg = "Email was sent at " & Now()>
<cfset success.Destination = "gateway1">
<cfset ret = SendGatewayMessage("Flex2CF2", success)>
```

To ensure that properties maintain the correct case, you should define Flex-related information as follows:

```cfm
myStruct['mySensitiveProp']['myOther_sensitiveProp']
```

The following is an example of using headers to send to a specific subtopic of the destination:

```cfm
<cfset var msg = structnew()>
<cfset msg.destination = 'ColdFusionGateway'>
<cfset msg.body = 'somebody'>
<cfset msg['headers']['DSSubtopic'] = 'somesubtopic'>
<cfset sendgatewaymessage('CF2FLEX2', msg)>
```

### Handling incoming messages

When a Flex application sends a message to a ColdFusion application, the Data Services Messaging event gateway sends a CFEvent structure to the `onIncomingMessage` function of the configured CFC, with the following information mapped to the data of the event:

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>body</td>
<td>Body of the message.</td>
</tr>
<tr>
<td>ClientID</td>
<td>ID of the client that sent the message.</td>
</tr>
<tr>
<td>CorrelationID</td>
<td>Correlation identifier of the message.</td>
</tr>
<tr>
<td>Destination</td>
<td>Flex destination of the message.</td>
</tr>
<tr>
<td>Headers</td>
<td>If the message contains any headers, the CFML structure that contains the header names as keys and values.</td>
</tr>
<tr>
<td>Timestamp</td>
<td>Timestamp of the message.</td>
</tr>
</tbody>
</table>

The incoming message data structure also includes the values of messageID and timeToLive from the Flex message.

### Incoming message handling example

The following example puts data that is contained in the body of the message from the Flex application into a structure. It then uses the contents of the structure to generate an e-mail message.

```cfm
<cfcomponent displayname="SendEmail" hint="Handles incoming message from Flex">
<cffunction name="onIncomingMessage" returntype="any">
<cfargument name="event" type="struct" required="true">
```
<!--- Create a structure to hold the message object sent from Flex--->
<cfset messagebody = event.data.body>

<!--- Populate the structure. --->
<cfset mailfrom="#messagebody.emailfrom#">
<cfset mailto="#messagebody.emailto#">
<cfset mailsubject="#messagebody.emailsubject#">
<cfset mailmessage="#messagebody.emailmessage#”>

<!--- Send email with values from the structure. --->
<cfmail from="#mailfrom#" 
to="#mailto#"
subject="#mailsubject#" 
<cfoutput>#mailmessage#</cfoutput> 
</cfmail>
</cffunction>
</cffunction>
</cfcomponent>

If the Flex application sends the message in the header instead of in the body, you create and populate the structure, as the following example shows:
<cfset messageheader = StructNew()>
<cfset messageheader.sendto = event.data.headers.emailto>
<cfset messageheader.sentfrom = event.data.headers.emailfrom>
<cfset messageheader.subject = event.data.headers.emailsubject>
<cfset messageheader.mailmsg = event.data.headers.emailmessage> 

<cfset mailfrom="#messageheader.sentfrom#”>
<cfset mailto="#messageheader.sendto#”>
<cfset mailssubject="#messageheader.subject#”>
<cfset mailmessage="#messageheader.mailmsg#”>

### Data translation

The following table lists the ColdFusion data types and the corresponding Flash or ActionScript data type:

<table>
<thead>
<tr>
<th>ColdFusion data type</th>
<th>Flash data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
<td>String</td>
</tr>
<tr>
<td>Array</td>
<td>[] = Array</td>
</tr>
<tr>
<td>Struct</td>
<td>{} = untyped Object</td>
</tr>
<tr>
<td>Query</td>
<td>ArrayCollection</td>
</tr>
<tr>
<td>CFC</td>
<td>Class = typed Object (if a matching ActionScript class exists, otherwise the CFC becomes a generic untyped Object (map) in ActionScript)</td>
</tr>
<tr>
<td>CFC Date</td>
<td>ActionScript Date</td>
</tr>
<tr>
<td>CFC String</td>
<td>ActionScript String</td>
</tr>
<tr>
<td>CFC Numeric</td>
<td>ActionScript Numeric</td>
</tr>
<tr>
<td>ColdFusion XML Object</td>
<td>ActionScript XML Object</td>
</tr>
</tbody>
</table>
Chapter 61: Using the Data Management Event Gateway

Using the Data Management event gateway type provided with Adobe ColdFusion, you can have ColdFusion applications notify Adobe Flex applications when data managed by a destination has changed. You configure the Data Management event gateway and write an application that uses the event gateway.

You should be familiar with ColdFusion event gateway principles and programming techniques, (see “Using Event Gateways” on page 1060). You should also be familiar with LiveCycle Data Services ES.

About ColdFusion and Flex

ColdFusion includes the Data Management event gateway, which uses the ColdFusion Data Service Adapter to send messages to LiveCycle Data Services ES. This means that ColdFusion applications can notify a Flex application about changes in the data that is managed by the destination.

Note: To use the Data Management event gateway to send messages to a Flex application, the Flex application must be running on LiveCycle Data Services ES.

How ColdFusion and Flex interact

You can send messages from a ColdFusion application to a Flex application through the Data Management event gateway. This gateway type only lets you send messages from a ColdFusion application to a Flex application.

The following image shows the process in which a message is sent from the ColdFusion application to the Flex application:

1. The ColdFusion application generates a message, which it sends to the ColdFusion server.
2. The ColdFusion server sends the message to the Data Management event gateway.
3. The Data Management event gateway and the ActionScript translator convert ColdFusion values to the appropriate ActionScript 3.0 data types, and then the gateway sends the message to the ColdFusion Data Service Adapter.
4 The ColdFusion Data Service Adapter sends the message to the LiveCycle Data Services Message Service.

5 The Message Service passes the message to the Flex application.

If you are running LiveCycle Data Services ES on the ColdFusion server, communication between LiveCycle Data Services ES and ColdFusion does not use RMI.

If you are running LiveCycle Data Services ES remotely, to ensure that the RMI registry provides registry service for both LiveCycle Data Services ES and ColdFusion, start LiveCycle Data Services ES first, and then start ColdFusion. If you stop LiveCycle Data Services ES, you must restart LiveCycle Data Services ES, and then restart the gateway.

If you are running LiveCycle Data Services ES remotely, the RMI registry, which facilitates communication between the ColdFusion Data Service Adapter and the Data Management event gateway uses port 1099. This is the default port for Java RMI. You can change the port number by adding `-Dcoldfusion.rmiport=1234`, replacing 1234 with the appropriate port number, to the Java JVM arguments on both the ColdFusion server and the Flex server.

Application development and deployment process

The following is a typical process for developing and deploying a ColdFusion application that communicates with a Flex application through the Data Management event gateway:

1 Design your application.

2 Configure a Data Management event gateway instance.

3 Write your ColdFusion CFCs, CFM pages, and any other application elements.

4 Test your application using LiveCycle Data Services ES.

5 Make the application publicly available.

Configuring a Data Management event gateway

Although you can configure an instance of a Data Management event gateway by creating a configuration file and specifying that file as the configuration file when you create an instance of the event gateway, you can also provide the configuration information in the message. You provide configuration information to the Data Management event gateway in a configuration file to do either of the following:

- Have the Data Management event gateway send messages to LiveCycle Data Services ES on a different computer.
- Use the Data Management event gateway with a specific Flex destination, and ignore any destination specified in the message.

The Data Management event gateway configuration file is a simple Java properties file that contains the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>destination</td>
<td>A hard-coded destination. If you specify this value, any destination information in the message is ignored.</td>
</tr>
<tr>
<td>host</td>
<td>The host name or IP address of the LiveCycle Data Services ES server. Omit the host name if you are running LiveCycle Data Services ES as part of ColdFusion.</td>
</tr>
</tbody>
</table>

The following example is a configuration file:

# Data Management event gateway configuration
# This is the destination where messages are sent.
destination=myDestination

# Hostname or IP address of the LiveCycle Data Services ES Server
host=127.0.0.1

If you create a configuration file, save it in the cf_root/gateway/config/ directory, with the extension .cfg.

*Note:* A single instance of the Data Management event gateway can send messages to any destination that is registered with the ColdFusion Data Service Adapter. However, if the destination is configured in the Data Management event gateway configuration file, the destination in the message is ignored.

## Sending messages

Your ColdFusion application sends a message to a Flex application by calling the ColdFusion `SendGatewayMessage` function. In messages sent from CFML, the following structure members are translated to the Flex message:

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>destination</td>
<td>Destination of the message. This is required if it is not specified in the configuration file.</td>
</tr>
<tr>
<td>action</td>
<td>Required. The notification action that is being performed: create, delete, deleteID, refreshfill, or update.</td>
</tr>
<tr>
<td>item</td>
<td>Required when action=&quot;create&quot; or action=&quot;delete&quot;. The record that was added or deleted.</td>
</tr>
<tr>
<td>identity</td>
<td>Required when action=&quot;deleteID&quot;. A structure that contains the identity properties (primary key) of the record that was deleted.</td>
</tr>
<tr>
<td>fillparameters</td>
<td>Optional. An array that contains the fills parameters that specify which fill operations to refresh.</td>
</tr>
<tr>
<td>newversion</td>
<td>Required when action=&quot;update&quot;. The record that was updated.</td>
</tr>
<tr>
<td>previousversion</td>
<td>Optional. The previous record, before the update. This is used for conflict resolution.</td>
</tr>
<tr>
<td>changes</td>
<td>Optional when action=&quot;update&quot;. A comma-delimited list or array of property names that were updated in the record. If you omit this, ColdFusion assumes that all properties changed. When you change a large number of records, you may find that specifying the property names improves performance. Required when action=&quot;batch&quot;. An array of structures that contain the changes. You can batch multiple changes and send them in a single notification. The changes can be of different types, for example 5 updates, 1 delete, and 2 creates. Each event structure must contain an action.</td>
</tr>
</tbody>
</table>

### Example

The following example creates a structure for each event type. It then creates a structure that contains the message. The message structure contains an array of event structures to send to Flex. The destination is the destination ID specified in the flex-services.xml file for the instance of the Data Management event gateway to send the message to. The body is the body of the message. The `sendGatewayMessage` CFML function sends the message to the instance of the gateway.

```cfs
<cfscript>
  // Create event
  createEvent = StructNew();
  createEvent.action = "create";
  createEvent.item = newContact;
</cfscript>
```
// Create update notification
updateEvent = StructNew();
updateEvent.action = "update";
updateEvent.previousversion = oldContact;
updateEvent.newversion = updatedContact;

// Create delete notification
identity = StructNew();
identity["contactId"] = newId;
deleteEvent = StructNew();
deleteEvent.action = "deleteID";
deleteEvent.identity = identity;

// Send a batch notification
all = StructNew();
all.destination = "cfcontact";
all.action = "batch";
all.changes = ArrayNew(1);
all.changes[1] = createEvent;
all.changes[2] = updateEvent;
all.changes[3] = deleteEvent;
r = sendGatewayMessage("LCDS", all);
</cfscript>

# Data translation

The following table lists the ColdFusion data types and the corresponding Adobe Flash or ActionScript data type:

<table>
<thead>
<tr>
<th>ColdFusion data type</th>
<th>Flash data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
<td>String</td>
</tr>
<tr>
<td>Array</td>
<td>[] = Array</td>
</tr>
<tr>
<td>Struct</td>
<td>{} = untyped Object</td>
</tr>
<tr>
<td>Query</td>
<td>ArrayCollection</td>
</tr>
<tr>
<td>CFC</td>
<td>Class = typed Object (if a matching ActionScript class exists, otherwise the CFC becomes a generic untyped Object (map) in ActionScript)</td>
</tr>
<tr>
<td>CFC Date</td>
<td>ActionScript Date</td>
</tr>
<tr>
<td>CFC String</td>
<td>ActionScript String</td>
</tr>
<tr>
<td>CFC Numeric</td>
<td>ActionScript Numeric</td>
</tr>
<tr>
<td>ColdFusion XML Object</td>
<td>ActionScript XML Object</td>
</tr>
</tbody>
</table>
Chapter 62: Creating Custom Event Gateways

ColdFusion lets you create event gateways. To do so, you should have a thorough knowledge of Java programming, including Java event-handling and thread-handling concepts, and of the technology to which you are providing the gateway, including the types of messages that you will handle. It also assumes that you have a thorough knowledge of ColdFusion development concepts and practices, including ColdFusion components (CFCs).

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Event gateway architecture

A ColdFusion event gateway listens for events and passes them to ColdFusion for handling by the application’s listener CFC or CFCs. It must implement the coldfusion.eventgateway.Gateway interface, and use the ColdFusion GatewayServices class. The following image expands on the basic event handling architecture diagram to show how a ColdFusion event gateway works:

Receiving messages: The event gateway listener thread receives events from an external event source such as a socket or SMSC server, and calls the GatewayServices addEvent method to send a CFEvent instance to ColdFusion.

Sending messages: The ColdFusion event gateway service calls the event gateway’s outgoingMessage method and passes it a CFEvent instance with the destination and message information. The event gateway forwards the message as appropriate to the external receiver.

The event gateway architecture is not limited to handling messages from external sources, such as SMS devices or IM clients. It can also be used to handle events that are internal to the local system or even the ColdFusion application. Also, a gateway does not have to implement two-way communications.

The sample directory watcher gateway provided with ColdFusion is an example of an internal, one way, gateway. It has a single thread that periodically checks a local directory and sends a message to a CFC when the directory contents change. This gateway does not support outgoing messages. (The code for this gateway is in the gateway/src/examples/watcher directory.)
Another internal gateway, the asynchronous CFML gateway, is provided as part of the ColdFusion product. Unlike most gateways, it does not have a listener thread. Its `outgoingMessage` method gets messages from CFML `SendGatewayMessage` functions, and dispatches them to a CFC `onIncomingMessage` method for handling. This gateway lets ColdFusion support request-free asynchronous processing. For more information on using this gateway, see “Using the CFML event gateway for asynchronous CFCs” on page 1075.

## Event gateway elements

You use the following the elements to create and configure a gateway:

- Gateway interface
- GatewayServices class
- CFEvent class
- GatewayHelper class
- Gateway configuration file
- Gateway development classes

**Note:** The gateway interfaces and classes, with the exception of the GenericGateway class are fully documented in “Gateway development interfaces and classes” on page 1325 in the CFML Reference. All interfaces and classes in this list, including the GenericGateway class, are documented in less detail in the Javadocs located in the ColdFusion gateways\docs directory. The Javadocs documentation lacks examples and does not have the detailed usage information that you find in the CFML Reference.

### Gateway interface

The ColdFusion event gateway must implement the `coldfusion.eventservice.Gateway` interface. The following table lists the interface method signatures:

**Note:** For detailed information on implementing each method, see “Building an event gateway” on page 1133. For reference pages for these methods, see “Gateway interface” on page 1326 in the CFML Reference.

<table>
<thead>
<tr>
<th>Signature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>void setGatewayID(String id)</td>
<td>Sets the gateway ID that uniquely identifies the gateway instance. ColdFusion calls this method before it starts the event gateway, even if the gateway class constructor also sets the ID.</td>
</tr>
<tr>
<td>void setCFCListeners(String[] listeners)</td>
<td>Identifies the CFCs that listen for incoming messages from the event gateway. The array contains one or more paths to the listener CFCs. ColdFusion calls this method before it starts the event gateway, and if the configuration for a running event gateway changes.</td>
</tr>
<tr>
<td>GatewayHelper getHelper()</td>
<td>Returns a <code>coldfusion.eventgateway.GatewayHelper</code> class instance, or null. The GatewayHelper class provides event gateway-specific utility methods to CFML applications. ColdFusion calls this method when a ColdFusion application calls the <code>GetGatewayHelper</code> function.</td>
</tr>
<tr>
<td>String getGatewayID()</td>
<td>Returns the gateway ID.</td>
</tr>
<tr>
<td>int getStatus()</td>
<td>Gets the event gateway status. The interface defines the following status constants: <code>STARTING</code>, <code>RUNNING</code>, <code>STOPPING</code>, <code>STOPPED</code>, <code>FAILED</code>.</td>
</tr>
<tr>
<td>void start()</td>
<td>Starts the event gateway. Starts at least one thread for processing incoming messages. ColdFusion calls this method when it starts an event gateway.</td>
</tr>
</tbody>
</table>
GatewayServices class

The Gateway class uses the coldfusion.eventgateway.GatewayServices class to interact with the ColdFusion event gateway services. This class has the following methods:

<table>
<thead>
<tr>
<th>Signature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GatewayServices</td>
<td>Static method that returns the GatewayServices object. Gateway code can call this method at any time, if required.</td>
</tr>
<tr>
<td>boolean addEvent(CFEvent msg)</td>
<td>Sends a CFEvent instance to ColdFusion for dispatching to a listener CFC. The event gateway uses this method to send all incoming messages to the application for processing. Returns False if the event is not added to the queue.</td>
</tr>
<tr>
<td>int getQueueSize()</td>
<td>Returns the current size of the ColdFusion event queue. This queue handles all messages for all gateways.</td>
</tr>
<tr>
<td>int getMaxQueueSize()</td>
<td>Returns the maximum size of the ColdFusion event queue, as set in the ColdFusion Administrator.</td>
</tr>
<tr>
<td>Logger getLogger()</td>
<td>Returns a ColdFusion Logger object that the event gateway can use to log information in the eventgateway.log log file (the default) or the specified log file. The logfile attribute must be a filename without a file extension, such as mylogfile. ColdFusion puts the file in the ColdFusion logs directory and appends .log to the specified file name. For information on using the logger object, see “Logging events and using log files” on page 1140.</td>
</tr>
</tbody>
</table>

CFEvent class

The Gateway class sends and receives CFEvent instances to communicate with the ColdFusion listener CFC or application. The Gateway notifies ColdFusion of a message by sending a CFEvent instance in a GatewayServices.addEvent method. Similarly, the Gateway receives a CFEvent instance when ColdFusion calls the gateway’s outgoingMessage method.

The CFEvent class extends the java.util.Hashtable class and has the following methods to construct the instance and set and get its fields. (In CFML, you treat CFEvent instances as structures.)
GatewayHelper class

ColdFusion includes a `coldfusion.eventgateway.GatewayHelper` Java marker interface. You implement this interface to define a class that provides gateway-specific utility methods to the ColdFusion application or listener CFC. For example, an instant messaging event gateway might use a helper class to provide buddy list management methods to the application.

The Gateway class must implement a `getHelper` method that returns the helper class or null (if the gateway does not need such a class).

ColdFusion applications call the `GetGatewayHelper` CFML function, which invokes gateway’s `getHelper` method to get an instance of the helper class. The application can then call helper class methods using ColdFusion object dot notation.

The following code defines the `SocketHelper` class, the gateway helper for the `SocketGateway` class. It has an empty constructor and two public methods: one returns the socket IDs; the other closes a specified socket. These classes let an application monitor and end session connections.

```java
public class SocketHelper implements GatewayHelper {
    public SocketHelper() {
    }

    public coldfusion.runtime.Array getSocketIDs () {
        coldfusion.runtime.Array a = new coldfusion.runtime.Array();
    }
}
```

<table>
<thead>
<tr>
<th>Methods</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFEvent(String gatewayID)</td>
<td>CFEvent constructor. The <code>gatewayID</code> parameter must be the value that is passed in the Gateway <code>setGatewayID</code> method.</td>
</tr>
<tr>
<td>void setGatewayType(String type) String getGatewayType()</td>
<td>Identifies the type of event gateway, such as SMS. For the sake of consistency, use this name in the <code>Type Name</code> field when you add an event gateway type on the Gateway Types page in the ColdFusion Administrator.</td>
</tr>
<tr>
<td>void setData(Map data) Map getData()</td>
<td>The event data; includes the message being passed to or from ColdFusion. The content of the field depends on the event gateway type. The Map keys must be strings. Because ColdFusion is not case-sensitive, it converts the Map passed in the <code>setData</code> method to a case-insensitive Map. As a result, do not create entries in the data with names that differ only in case.</td>
</tr>
<tr>
<td>void setOriginatorID(String id) String getOriginatorID()</td>
<td>Identifies the originator of an incoming message or the destination of an outgoing message. The value depends on the protocol or event gateway type.</td>
</tr>
<tr>
<td>void setCFCPath(String path) String getCFCPath()</td>
<td>An absolute path to the application listener CFC that will process the event. By default, ColdFusion uses the first path configured for the event gateway instance on the Event Gateways page in the ColdFusion Administrator.</td>
</tr>
<tr>
<td>void setCFCMethod(String method) String getCFCMethod()</td>
<td>The method in the listener CFC that ColdFusion calls to process this event. By default, ColdFusion invokes the <code>onIncomingMessage</code> method. For the sake of consistency, Adobe recommends that any event gateway with a single listener not override this default. A gateway, such as the ColdFusion XMPP gateway, that uses different listener methods for different message types, uses this method to identify the destination method.</td>
</tr>
<tr>
<td>void setCFTimeout(String seconds) String getCFTimeout ()</td>
<td>The time-out, in seconds, for the listener CFC to process the event request. When ColdFusion calls the listener CFC to process the event, and the CFC does not process the event in the specified time-out period, ColdFusion terminates the request and logs an error in the <code>application.log</code> file. By default, ColdFusion uses the Timeout Request value set on the Server Settings page in the ColdFusion Administrator.</td>
</tr>
<tr>
<td>String getGatewayID()</td>
<td>The event gateway instance that processes the event. Returns the gateway ID that was set in the CFEvent constructor.</td>
</tr>
</tbody>
</table>
Enumeration e = socketRegistry.elements();
while (e.hasMoreElements()) {
   a.add(((SocketServerThread)e.nextElement()).getName());
}
return a;
}

public boolean killSocket (String socketid) {
   try {
      ((SocketServerThread)socketRegistry.get(socketid)).socket.close();
      ((SocketServerThread)socketRegistry.get(socketid)).socket = null;
      socketRegistry.remove(socketid);
      return true;
   }
   catch (IOException e) {
      return false;
   }
}

Gateway configuration file
Gateways can use a configuration file to specify information that does not change frequently. For example, the ColdFusion SMS event gateway configuration file contains values that include an IP address, port number, system ID, password, and so on.

You can specify a configuration file path for each event gateway instance in the ColdFusion Administrator. ColdFusion passes the file path in the gateway constructor when it instantiates the event gateway. The configuration file format and content handling is up to you. It is the responsibility of the gateway class to parse the file contents and use it meaningfully.

One good way to access and get configuration data is to use the java.util.Properties class. This class takes an ISO8859-1 formatted input stream with one property setting per line. Each property name must be separated from the value by an equal sign (=) or a colon (:), as the following example shows:

ip-address=127.0.0.1
port=4445

The example SocketGateway event gateway uses this technique to get an optional port number from a configuration file. For an example of reading a properties file and using its data, see the code in “Class constructor” on page 1133.

Gateway development classes
ColdFusion provides two classes that you can use as building blocks to develop your event gateway classes. Each corresponds to a different development methodology:

• The coldfusion.eventgateway.GenericGateway class is an abstract class from which you can derive your gateway class.
• The EmptyGateway class in the gateway\src\examples directory is a template gateway that you can complete to create your gateway class.

The GenericGateway class
ColdFusion includes a coldfusion.eventgateway.GenericGateway abstract class that implements many of the methods of ColdFusion Gateway interface and provides some convenience methods for use in your gateway class.
You can derive your gateway class from this class, which handles the basic mechanics of implementing a gateway, such as the `getGatewayID` and `SetCFCListeners` methods. Your derived class must implement at least the following methods:

- `startGateway (not start)`
- `stopGateway (not stop)`
- `outgoingMessage`

Your derived gateway class also must implement the following:

- If you support a configuration file, a constructor that takes a configuration file, and configuration loading routines.
- If you use a gatewayHelper class, the `getHelper` method.
- If the event source status can change asynchronously from the gateway, the `getStatus` method.

The example JMS gateway is derived from the generic gateway class. The gateway class JavaDocs in the gateway\docs directory provide documentation for this class. (The CFML Reference does not document this class.)

**The EmptyGateway class**

The gateway\src\examples\EmptyGateway.java file contains an event gateway template that you can use as a skeleton for creating your own event gateway. (The gateway directory is in the cf_root directory in the server configuration and the cf_root\WEB-INF-cfusion directory on J2EE configurations.) This file contains minimal versions of all methods in the coldfusion.eventgateway.Gateway interface. It defines a skeleton listener thread and initializes commonly used Gateway properties. The EmptyGateway source code includes comments that describe the additional information that you must provide to complete an event gateway class.

### Building an event gateway

This section describes how to build an event gateway. To build a Gateway class, you can start with the EmptyGateway.java file as a template. (In the server configuration, this file is located in the cf_root\gateway\src\examples/ directory; in the J2EE configuration, the file is in the cf_root\WEB-INF-cfusion\gateway\src\examples/ directory.) This file defines a nonfunctional event gateway, but has the basic skeleton code for all Gateway class methods.

Wherever possible, the following sections use code based on the sample Socket event gateway to show how to implement event gateway features. (In the server configuration, this file is cf_root\gateway\src\examples\socket\SocketGateway.java; in the J2EE configuration, the file is cf_root\WEB-INF-cfusion\gateway\src\examples\socket\SocketGateway.java.)

### Class constructor

An event gateway can implement any of the following constructors:

- `MyGateway(String gatewayID, String configurationFile)`
- `MyGateway(String gatewayID)`
- `MyGateway()`

When ColdFusion starts, it calls the constructor for each event gateway instance that you configure in ColdFusion. (ColdFusion also calls the gateway `Start` method after the event gateway is instantiated.). ColdFusion first attempts to use the two-parameter constructor.
Because each event gateway instance must have a unique ID, ColdFusion provides redundant support for providing
the ID. If the event gateway implements only the default constructor, ColdFusion provides the ID by calling the event
gateway's setGatewayID method.

If the event gateway does not implement the two-parameter constructor, it does not get configuration file inform-

ation from ColdFusion.

The constructor normally calls the static GatewayServices.getGatewayServices method to access ColdFusion

event gateway services. Although you need not do this, it is a good coding practice.

A minimal constructor that takes only a gateway ID might look like the following:

```java
public MyGateway(String gatewayID) {
    this.gatewayID = gatewayID;
    this.gatewayService = GatewayServices.getGatewayServices();
}
```

The gateway constructor must throw a coldfusion.server.ServiceRuntimeException exception if there is an error that
otherwise cannot be handled. For example, you should throw this exception if the event gateway requires a config-
uration file and cannot read the file contents.

If your gateway uses a configuration file, the constructor should load the file, even if the Start method also loads
the file. You should do this because the constructor does not run in an independent thread, and ColdFusion can
display an error in the ColdFusion Administrator of the file fails to load. If the Start method, which does run in a
separate thread, fails to load the file, ColdFusion logs the error, but it cannot provide immediate feedback in the
administrator.

The sample Socket event gateway has a single constructor that takes two parameters. It tries to load a configuration
file. If you specify a configuration file in the ColdFusion Administrator, or the file path is invalid, it gets an IO
exception. It then uses the default port and logs a message indicating what it did. The following example shows the
Gateway constructor code and the loadProperties method it uses:

```java
public SocketGateway(String id, String configpath) {
    gatewayID = id;
    gatewayService = GatewayServices.getGatewayServices();
    // log things to socket-gateway.log in the CF log directory
    log = gatewayService.getLogger("socket-gateway");
    propsFilePath=configpath;
    try {
        FileInputStream propsFile = new FileInputStream(propsFilePath);
        properties.load(propsFile);
        propsFile.close();
        this.loadProperties();
    }
    catch (IOException e) {
        // Use default value for port and log the status.
        log.warn("SocketGateway(" + gatewayID + ") Unable to read configuration
            file '" + propsFilePath + "': " + e.toString() + ". Using default port
            " + port + ".", e);
    } }

private void loadProperties() {
    String tmp = properties.getProperty("port");
    port = Integer.parseInt(tmp);
}
```
Providing Gateway class service and information routines

Several gateway methods perform event gateway configuration services and provide event gateway information. The ColdFusion event gateway services call many of these methods to configure the event gateway by using information stored by the ColdFusion Administrator, and to get access to resources and information that are needed by event gateway services and applications. Some of these methods can also be useful in event gateway code. The following methods provide these services and information:

- setCFCListeners
- setGatewayID
- getHelper
- getGatewayID
- getStatus

ColdFusion calls the setCFCListeners method with the CFC or CFCs that are specified in the ColdFusion Administrator when it starts a gateway. ColdFusion also calls the method in a running event gateway when the configuration information changes, so the method must be written to handle such changes. The setCFCListeners method must save the listener information so that the gateway code that dispatches incoming messages to gateway services can use the listener CFCs in setCFCPath methods.

ColdFusion calls the setGatewayID method when it starts a gateway. The getGatewayID method must return the value set by this method.

ColdFusion calls the getHelper method when an application calls the CFML GetGatewayHelper function.

The following code shows how the SocketGateway class defines these methods. To create a new gateway, modify the getHelper definition to return the correct class, or to return null if there is no gateway helper class. Most gateways do not need to change the other method definitions.

```java
public void setCFCListeners(String[] listeners) {
    this.listeners = listeners;
}

public GatewayHelper getHelper() {
    // SocketHelper class implements the GatewayHelper interface.
    return new SocketHelper();
}

public void setGatewayID(String id) {
    gatewayID = id;
}

public String getGatewayID() {
    return gatewayID;
}

public int getStatus() {
    return status;
}
```

Starting, stopping, and restarting the event gateway

Because an event gateway uses at least one listener thread, it must have start, stop, and restart methods to control the threads. These methods must also maintain the status variable that the Gateway class getStatus method checks, and change its value among STARTING, RUNNING, STOPPING, STOPPED, and FAILED, as appropriate.

The start method

The start method initializes the event gateway. It starts one or more listener threads that monitor the gateway’s event source and respond to any messages it receives from the source.
The `start` method should return within a time-out period that you can configure for each event gateway type in the ColdFusion Administrator. If it does not, the ColdFusion Administrator has a Kill on Startup Timeout option for each gateway type. If you select the option, and a time-out occurs, the ColdFusion starter thread calls an interrupt on the gateway thread to try to kill it, and then exits.

**Note:** If the `start` method is the listener (for example, in a single-threaded gateway), the method does not return until the gateway stops. Do not set the Kill on Startup Timeout option in the ColdFusion Administrator for such gateways.

If the gateway uses a configuration file, the `start` method should load the configuration from the file. Doing so lets users change the configuration file and restart the gateway without restarting ColdFusion. Applications should also load the configuration file in the constructor; for more information, see “Class constructor” on page 1133.

In the SocketGateway class, the `start` method starts an initial thread. (In a single-threaded Gateway, this would be the only thread.) When the thread starts, it calls a `socketServer` method, which uses the Java ServerSocket class to implement a multithreaded socket listener and message dispatcher. For more information on the listener, see “Responding to incoming messages” on page 1137.

```java
public void start()
{
    status = STARTING;
    listening=true;
    // Start up event generator thread
    Runnable r = new Runnable()
    {
        public void run()
        {
            socketServer();
        }
    };
    Thread t = new Thread(r);
    t.start();
    status = RUNNING;
}
```

The `stop` method

The `stop` method performs the event gateway shutdown tasks, including shutting down the listener thread or threads and releasing any resources. The following example shows the SocketGateway `stop` method:

```java
public void stop()
{
    // Set the status variable to indicate that the server is stopping.
    status = STOPPING;
    // The listening variable is used as a switch to stop listener activity.
    listening=false;
    // Close the listener thread sockets.
    Enumeration e = socketRegistry.elements();
    while (e.hasMoreElements()) {
        try
        {
            ((SocketServerThread)e.nextElement()).socket.close();
        }
        catch (IOException e1)
        {
            // We don't care if a close failed.
            //log.error(e1);
        }
    }
    // Close and release the serverSocket instance that gets requests from the
    // network.
```
if (serverSocket != null) {
    try {
        serverSocket.close();
    } catch (IOException e1) {
    }
    //Release the serverSocket.
    serverSocket = null;
} // Shutdown succeeded; set the status variable.
status = STOPPED;

The restart method
In most cases, you implement the restart method by calling the stop method and the start method consecutively, but you might be able to optimize this process for some services. The following code shows the SocketGateway class restart method:

```java
public void restart() {
    stop();
    start();
}
```

Responding to incoming messages
One or more listener threads respond to incoming messages (events). The threads must include code to dispatch the messages to ColdFusion event gateway services, as follows:

1. Create a CFEvent instance.
2. Create a Map instance that contains the message and any other event gateway-specific information, and pass it to the CFEvent setData method.
3. Call the CFEvent setOriginator method to specify the source of the message. (This is required if the ColdFusion application will send a response.)
4. Call the CFEvent setGatewayType method to specify the event gateway type.
5. Set any other CFEvent fields where the default behavior is not appropriate; for example, call the setCFCPath method to replace the default listener CFC. (For information on default CFEvent fields, see "CFEvent class" on page 1130.)
6. Call the gatewayService.addEvent method to dispatch the CFEvent instance to ColdFusion.
7. Handle cases where the event is not added to the event gateway service queue (the addEvent method returns False).

If your application sends any messages to multiple listener CFCs, the gateway must create and configure a CFEvent instance and call the gatewayService.addEvent method to send the message to each separate listener CFC. The gateway's setCFCListeners method must make the CFC paths available to the gateway for configuring the CFEvent instances.

If your ColdFusion server carries a heavy event gateway message load, the ColdFusion event gateway services event queue might reach the maximum value set in the ColdFusion Administrator. When this happens, the gatewayService.addEvent method returns False and fails. Your code can do any of the following:

- Return a message to the sender to indicate that their message was not received.
• Wait until the queue is available by periodically comparing the values returned by the GatewayService
  `getQueueSize` and `getMaxQueueSize` methods, and retry the `addEvent` method when the queue size is less than
  the maximum.

• Log the occurrence using the logger returned by the GatewayService `getLogger` method. (For more infor-
  mation, see "Logging events and using log files" on page 1140.)

The SocketGateway class implements the listener using a java.net.ServerSocket class object and SocketServerThread
  listener threads. (See the SocketGateway source for the SocketServerThread code.) When the listener thread gets a
  message from the TCP/IP socket, it calls the following `processInput` method to dispatch the message to
  ColdFusion. This method explicitly sets all required and optional CFEvent fields and sends the event to ColdFusion.
  If the `addEvent` call fails, it logs the error.

**Note:** Much of the `processInput` method code supports multiple listener CFCs. A gateway that uses only a single
  listener cfc, would require only the code in the latter part of this method.

```java
private void processInput(String theInput, String theKey) {
    // Convert listeners list to a local array
    // Protect ourselves if the list changes while we are running
    String[] listeners;
    int size = cfcListeners.size();
    if (size > 0) {
        // Capture the listeners list
        synchronized (cfcListeners) {
            listeners = new String[size];
            cfcListeners.toArray(listeners);
        }
    } else {
        // Create a dummy list
        listeners = new String[1];
        listeners[0] = null;
    }
    // Broadcast to all the CFC listeners
    // Send one message at a time with different CFC address on them
    for (int i = 0; i < listeners.length; i++) {
        String path = listeners[i];
        CFEvent event = new CFEvent(gatewayID);
        Hashtable mydata = new Hashtable();
        mydata.put("MESSAGE", theInput);
        event.setData(mydata);
        event.setGatewayType("SocketGateway");
        event.setOriginatorID(theKey);
        event.setCfcMethod(cfcEntryPoint);
        event.setCfcTimeOut(10);
        if (path != null)
            event.setCfcPath(path);
        boolean sent = gatewayService.addEvent(event);
        if (!sent)
            log.error("SocketGateway(" + gatewayID + ") Unable to put message on
            event queue. Message not sent from " + gatewayID + ", thread " + theKey
            + ". Message was " + theInput);
    }
}
```
Responding to a ColdFusion function or listener CFC

The ColdFusion event gateway services call the event gateway's `outgoingMessage` method to handle messages generated when an event gateway application listener CFC's listener method returns a message or any CFML code calls a `SendGatewayMessage` function. This method must send the message to the appropriate external resource.

The `outgoingMessage` method's parameter is a CFEvent instance, containing the information about the message to send out. The CFEvent `getData` method returns a Map object that contains event gateway-specific information about the message, including any message text. All CFEvent instances received by the `outgoingMessage` method contain information in the Data and GatewayID fields.

CFEvent instances returned from listener CFC `onIncomingMessage` methods include the incoming message's originator ID and other information. However, a gateway that might handle messages from the ColdFusion `SendGatewayMessage` function cannot rely on this information being available, so it is good practice to require that all outgoing messages include the destination ID in the data Map.

The `outgoingMessage` method returns a String value. The CFML `sendGatewayMessage` function returns this value to the ColdFusion application. The returned string should indicate the status of the message. By convention, ColdFusion event gateway `outgoingMessage` methods return "OK" if they do not encounter errors and do not have additional information (such as a message ID) to return.

Because event messages are asynchronous, a positive return normally does not indicate that the message was successful delivered, only that the `outgoingMessage` method successfully handled the message. In some cases, however, it is possible to make the `outgoingMessage` method at least partially synchronous. The SMS gateway, for example, provides two `outgoingMessage` modes:

**Asynchronous mode:** The `outgoingMessage` method returns when the message is queued internally for delivery to the messaging provider's short message service center (SMSC)

**Synchronous mode:** The method does not return until the message is delivered to the SMSC, or an error occurs.

This way, an SMS application can get a message ID for later use, such as to compare with a message receipt.

**Example outgoingMessage method**

The following `outgoingMessage` method is similar to the version in the SocketGateway class. It does the following:

1. Gets the contents of a MESSAGE field of the Data Map returned by the CFEvent class `getData` method.
2. Gets the destination from an `outDestID` field in the data Map.
3. Uses the destination's socket server thread to write the message.

```java
public String outgoingMessage(coldfusion.eventgateway.CFEvent cfmsg) {
    String retcode="ok";
    // Get the table of data returned from the event handler
    Map data = cfmsg.getData();
    String message = (String) data.get("MESSAGE");
    // Find the right socket to write to from the socketRegistry hashtable
    // and call the socket thread's writeoutput method.
    // (Get the destination ID from the data map.)
    if (data.get("outDestID") != null)
        ((SocketServerThread)socketRegistry.get(data.get("outDestID"))).writeOutput(message);
    else {
        System.out.println("cannot send outgoing message. OriginatorID is not available.");
        retcode="failed";
    }
    return retcode;
}
```
Logging events and using log files

The GatewayServices.getLogger method returns an instance of the coldfusion.eventgateway.Logger class that you can use to log messages to a file in the ColdFusion logs directory. (You set this directory on the ColdFusion Administrator Logging Settings page.) The method can take no parameter, or one parameter:

- The default GatewayServices.getLogger method uses the eventgateway.log file.
- Optionally, you can specify a log filename, without the .log extension or directory path.

The following example tells ColdFusion to log messages from the gateway to the mygateway.log file in the ColdFusion logs directory:

coldfusion.eventgateway.Logger log =getGatewayServices().getLogger("mygateway");

The Logger class has the following methods, all of which take a message string. The method you use determines severity level that is set in the log message.

- info
- warn
- error
- fatal

You can also pass these methods an exception instance as a second parameter. When you do this, ColdFusion puts the exception information in the exception.log file in the ColdFusion logs directory.

You can use these methods to log any messages that you find appropriate. If you use the default eventgateway.log file, however, remember that it is used by all ColdFusion standard gateways, and might be used by other gateways. As a result, you should limit the messages that you normally log to this file to infrequent normal occurrences (such as gateway startup and shutdown) or errors for which you want to retain data.

ColdFusion uses the following format for the message text, and your application should follow this pattern:

GatewayType (Gateway ID) Message

The SMS event gateway, for example, includes the following exception catching code, which logs a general exception messages and the exception name in the eventgateway.log file, and also (automatically) logs the exception in the exceptions.log file:

catch(Exception e)
{
    logger.error("SMSGateway (" + gatewayID + ") Exception while processing incoming event: " + e, e);
}

Note: When you are developing an event gateway application, you can use the ColdFusion Log viewer to inspect your log files and the standard ColdFusion log files, including the eventgateway.log file and exception.log file. You can use the viewer to filter the display, for example, by selecting different severity levels, or searching for keywords.

Deploying an event gateway

To deploy an event gateway, you deploy and event gateway type and configure one or more event gateway instances.
Deploy a event gateway type in ColdFusion

1. Compile your Gateway class and put it in a JAR file along with any other required classes.

   \textbf{Note:} The ColdFusion class loader includes the gateway \texttt{lib} directory on its classpath and includes any JAR files that are in that directory on the class path.

2. Put the JAR file in the \texttt{cf_root\WEB-INF\cfusion\gateway\lib} directory on J2EE configurations or the \texttt{cf_root\gateway\lib} directory on server configurations. This directory is on the ColdFusion classpath.

3. Ensure that ColdFusion event gateway services are enabled on the ColdFusion Administrator Data & Services > Event Gateway > Settings page.

4. On the ColdFusion Administrator Data & Services > Event Gateways page, click the Manage Gateway Types button to display the Gateway Types page.

5. On the Add/Edit ColdFusion Event Gateway Types form, enter a type name (for example, SMS for the SMS event gateway), a description, and the full Java class name (for example, \texttt{coldfusion.eventgateway.sms.SMSGateway} for the SMS event gateway). If appropriate, change the Startup Timeout settings from the default values.

6. Click the Add Type button to deploy the event gateway type in ColdFusion.

The following procedure describes how to configure an event gateway instance that uses the gateway type.

Configure an event gateway instance

1. If you have just finished deploying the event gateway type, click the Manage Gateway Instances button; otherwise, select Event Gateways > Gateway Instances in the ColdFusion Administrator.

2. On the Add/Edit ColdFusion Event Gateways Instances form do the following:
   - Enter the instance name in the Gateway ID field
   - Select the event gateway type that you added from the Gateway Type drop-down list
   - Specify the paths to the listener CFC or CFCs that will handle the messages.
   - If the event gateway requires a configuration file, enter the path to the file in Gateway Configuration File field.
   - If you do not want the gateway to start up automatically when ColdFusion starts, change the Startup Mode selection to Manual or Disabled

3. Click the Add Gateway Instance button.

4. In the list of configured instances, click the start button (green triangle) on the gateway instance's entry to start the instance.
Chapter 63: Using the ColdFusion Extensions for Eclipse

The ColdFusion Extensions for Eclipse include wizards that help generate code for common tasks and an extension that lets you connect to remote servers from Adobe Flex Builder and Eclipse.

To use the ColdFusion Extensions for Eclipse, you should be familiar with ColdFusion components, as well as accessing and using data in ColdFusion applications. You should also be familiar with Eclipse or Adobe Flex Builder.

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About the ColdFusion Extensions for Eclipse

To make some common coding tasks easier, the ColdFusion Extensions for Eclipse include the following:

- Eclipse RDS Support plug-in, which lets you access files and data sources on a ColdFusion server.
- ColdFusion/Flex Application wizard, which lets you create master and detail pages in an application to create, read, update, and delete records in a database.
- ColdFusion/Ajax Application wizard, which lets you create master and detail pages that use Ajax elements in an application to create, read, update, and delete records in a database.
- RDS CRUD wizard, which lets you dynamically create a ColdFusion component (CFC) based on a table that is registered in the ColdFusion Administrator on a ColdFusion server
- ActionScript to CFC wizard, which lets you create a CFC based on an ActionScript class file.
- CFC to ActionScript wizard, which lets you create an ActionScript file based on a CFC Value Object
- Services Browser, which lets you browse CFCs, manage a list of web services, and generate the CFML code to invoke a web service.

For information about installing the ColdFusion Extensions for Eclipse, see Installing and Using ColdFusion.
Eclipse RDS Support

Remote Development Services (RDS) lets you access files and data sources registered in the ColdFusion Administrator on a ColdFusion server. To use Eclipse RDS Support, you must enable RDS when you install ColdFusion. With Eclipse RDS Support, you can use Flex Builder or CFEclipse as your IDE and access ColdFusion files remotely.

Eclipse RDS Support is supported on all ColdFusion server platforms.

Before you install Eclipse RDS Support, you must have the following installed:

- Eclipse 3.1 or later, or Flex Builder 2 or later
- ColdFusion MX 7.0.1 or later

Configuring RDS

Before using RDS, you must configure ColdFusion servers.

Configure any ColdFusion servers that you want to connect to using RDS

1. In Flex Builder or Eclipse, select Window > Preferences > ColdFusion > RDS Configuration.

2. To configure the default localhost server, select localhost and specify the following:
   - Description
   - Host name (127.0.0.1)
   - Port number (8500 if you are using the built-in web server)
   - Context root, if necessary (For more information about the context root, see Installing and Using ColdFusion.)
   - Password, which is the RDS password

3. To specify additional servers, click New, and specify the following:
   - Description, which can be any name you want
   - Host name (IP address or machine name)
   - Port number (8500 if you are using the built-in web server)
   - Context root, if necessary
   - For more information about the context root, see Installing and Using ColdFusion.
   - Password, which is the RDS password

4. To remove a server definition, select the server and click Remove.

5. To test a connection, select the server and click Test Connection.

Note: If you are using ColdFusion MX 7 or earlier, the message “The RDS server was successfully contacted, but your security credentials were invalid,” appears. The message indicates that the password was not validated, even if it is correct. Click OK to close the message.

Once you have configured the RDS connection to your CF servers, you can view the files, folders and data sources on RDS servers. Each RDS server appears as a node in the RDS Fileview and Dataview, with the name you specified when you configured the RDS server.
View files and folders or data sources do the following
1. In Flex Builder, select Window > Other Views. In Eclipse, select Window > Show View > Other.
2. Select RDS.
3. To access the file system on the RDS server, select RDS Fileview.
4. To access data sources on the RDS server, select RDS Dataview.

Using the RDS Fileview
The RDS Fileview lists all the folders and files on the RDS server. You use the navigation buttons as indicated in the following table:

<table>
<thead>
<tr>
<th>Button</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Refresh" /></td>
<td>Refresh the active RDS server.</td>
</tr>
<tr>
<td><img src="image" alt="Create" /></td>
<td>Create a file in the currently selected folder.</td>
</tr>
<tr>
<td><img src="image" alt="Delete" /></td>
<td>Delete the currently selected file.</td>
</tr>
<tr>
<td><img src="image" alt="Create" /></td>
<td>Create a folder in the currently selected folder.</td>
</tr>
<tr>
<td><img src="image" alt="Delete" /></td>
<td>Delete the currently selected folder.</td>
</tr>
</tbody>
</table>

**Note:** RDS Eclipse Support does not support file operations such as copy and paste, drag and drop, and changing file attributes. However, delete, save, save as, and rename are supported. Also, on ColdFusion servers after ColdFusion 5, the date last modified field does not appear.

To rename a folder or file, right-click the folder or filename.

Using the RDS Dataview
The RDS Dataview lists all the data sources on the RDS server. You use the buttons as indicated in the following table:

<table>
<thead>
<tr>
<th>Button</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Refresh" /></td>
<td>Refresh</td>
<td>Refresh the currently selected item.</td>
</tr>
<tr>
<td><img src="image" alt="Query Viewer" /></td>
<td>Query Viewer</td>
<td>Opens the RDS Query Viewer.</td>
</tr>
</tbody>
</table>

You can build queries using either the RDS Query Viewer or the Visual Query Builder. The RDS Visual Query Builder is similar to the ColdFusion Report Builder Query Builder and the HomeSite Query Builder.

Build and execute a query using the RDS Query Viewer
1. Click the RDS Query Viewer icon on the RDS Dataview tab.
The RDS Query Viewer opens in its own tab, which means that if you have other documents open, the RDS Query Viewer has focus.

2. Do one of the following:
   • Enter the SQL, and double-click the field names and table names as appropriate.
   • Click the Visual Query Builder button.

For more information about using the Visual Query Builder, see "Using Visual Query Builder" on page 1145.

3. To try the query, click Execute query.

The first 50 records of the result set appear.

**Using Visual Query Builder**

You use the Query Builder to define a SQL statement. The following image shows the Query Builder user interface:

![Query Builder Interface](image)

**Build a SQL statement using the Table pane and the Properties panel**

1. Expand a data source.

2. Double-click the columns to be named in the SELECT statement.

   As you select columns, the Query Builder creates the SELECT statement in the area at the lower edge of the pane.

3. If you select columns from more than one table, you must specify the column or columns used to join them by dragging a column from one table to the related column in the second table.

4. (Optional) Specify sort order by doing the following:
   a. Locate the column in the Properties panel.
   b. Click in the Sort Type cell of the column you want to sort by.
c Specify Ascending or Descending.
d (Optional) If you specify multiple sort columns, you specify precedence using the Sort Order cell.

5 (Optional) Specify selection criteria by doing the following:
a Locate the column in the Properties panel.
b Click in the Condition cell.
c Select WHERE.
d Specify WHERE clause criteria in the Criteria cell.

Note: If you specify selection criteria, the Query Builder creates a WHERE clause. To use an INNER JOIN or other advanced selection criteria instead, you must code the SQL manually.

6 (Optional) To specify an aggregate function, GROUP BY, or an expression:
a Locate the column in the Properties panel.
b Click in the Condition cell.
c Select Group By or the aggregate function (such as COUNT).

7 (Optional) To specify SQL manually, type the SQL statement in the SQL pane.

Note: You code SQL manually to use an INNER JOIN instead of a WHERE clause, use an OUTER JOIN, or use a database stored procedure.

8 (Optional) To specify the data type of a query parameter:
a Click the + button under Parameters.
b Enter the name of the parameter.
c Select the data type.

9 Review the SELECT statement that displays in the SQL pane, and use the Table and Properties panes to make adjustments, if necessary.

10 (Optional) Click Test Query.

11 Click Save.

ColdFusion/Flex Application wizard

The ColdFusion/Flex Application wizard creates ColdFusion and Flex files for a create, read, update, delete (CRUD) application. You specify the master, detail, and master/detail pages to include in the application, and the relationship between the application's pages. The wizard lets you use Visual Query Builder to generate the SQL statements. For more information about using Visual Query Builder, see "Using Visual Query Builder" on page 1145.

Designing your application

Before starting the ColdFusion/Flex Application wizard, you should determine which pages to include in your application, including the following:

- Whether each page is a master, detail, or master/detail page
- The fields to display in each page
- The fields that connect one page to another
In the following example, you create an application for an art gallery. The first page lists all the artists that your gallery represents. When a user selects an artist, a page that lists all the works by that artist appears. When the user then selects a work of art, a page that contains details about that piece of art appears. In this example, your application contains the following pages:

- A master page that lists the artists
- A master/detail page in which the master page lists the works of art by the artist selected on the List of Artists master page, and a detail page that contains details about the artwork selected on the Artwork master page.

You may find it helpful to draw a diagram of the tables and fields that you want to include in your application, including which ones to display in your application, as the following image shows:

Start the ColdFusion/Flex Application wizard

1. Configure your RDS servers. For more information, see "Configuring RDS" on page 1143.
2. In Eclipse or Flex Builder, select File > New > Other.
3. Under ColdFusion Wizards, select ColdFusion/Flex Application wizard, and then click Next.
4. After reading the introductory text, click Next.
5. To load the settings from an application you previously created using the ColdFusion/Flex Application wizard, select the configuration file, and then click Load ColdFusion/Flex Application Wizard Settings.
6. Click Next.
7. Select the RDS server on which you want the application to reside.
8. Specify the data source to use. The data source is configured in the ColdFusion Administrator.
   
   Although you specify one default data source at this point, you can access data from other data sources in your application.
9. Click Next.

Specifying form layout

The Form Layout dialog box lets you specify the pages to use in your application. You can create master, detail, or master/detail pages. In your application, you can link master, detail, and master/detail pages as follows:
Create a page

1. Click the plus sign (+).
2. In the Name text box, enter the name for the page.
3. Select the page type (master, detail, or master/detail).
4. Click Edit Master Page, Edit Detail page, or Edit Master Section, depending on the type of form you are creating.

   The Visual Query Builder starts.

5. Use Visual Query Builder to specify the data source, tables, and fields to include in the form, and then click Save to save the query. For more information about using Visual Query Builder, see “Using Visual Query Builder” on page 1145.

6. Repeat steps 1 through 5 for each form in your application.

7. Use the right and left arrows to specify the relationship of the forms in your application. For example, detail forms should appear indented, directly under the related master form in the Navigation Tree panel. You drag and drop items to move them in the tree structure.

8. Click Next.

   The Project information page appears.

9. Specify the following:
   • The context root, if applicable
   • Whether to include a login page in the application
   • The location of the services-config.xml configuration file that the project should use
   • The web root URL
   • Whether to use an existing or new Flex Builder or Eclipse project
   • The project name and the location of the project if it is new

10. Click Finish.

The ColdFusion/Flex Application wizard creates the ColdFusion and Flex files that comprise your application. You can test the application by clicking the Run Main button in Flex Builder or Eclipse, or by browsing to the main application page, which is located at http://<server_name>:<port_number>/<project_name>/bin/main.html. You can also manually modify the application files as appropriate for your needs.

<table>
<thead>
<tr>
<th>Page type</th>
<th>Can link to</th>
</tr>
</thead>
<tbody>
<tr>
<td>master</td>
<td>master, master/detail, detail, master and detail, master and master/detail</td>
</tr>
<tr>
<td>master/detail</td>
<td>master, master/detail</td>
</tr>
</tbody>
</table>
Tips for creating applications with the ColdFusion/Flex Application wizard

Although the ColdFusion/Flex Application wizard greatly simplifies creating CRUD applications, you should keep the following in mind to ensure that you create the application that you designed.

• To adjust UI elements, open the MXML file in Flex Builder or Eclipse design mode.
• When you create a project that has the same name as a project you previously created, the wizard creates a backup folder that contains the files from the project you previously created.
• If you create a master page and a detail page for a table in which there is no primary key defined, the wizard selects the first field in the database as the key value to represent the row.
• In master pages, link a field to the Parameters box to add type validation to the query by using the cfqueryparam tag. Doing this is optional.
• You must select a primary key column in the master form; the wizard chooses the key by default. If you create a master page and do not link it to the id property, you cannot add it to the site tree under another master page.
• Deselect the Display column for fields that your application uses that you do not want to appear in your application.
• Specify the sort order for the field by which to sort data in the page, and specify any other conditions as appropriate.
• Change the labels for fields by clicking the field name in the Label column, and then entering a new field name.
• In a detail page, create a combo box that is populated by dynamic data. To do this, change the value in the Input Control column for the field to use to populate the combo box to be ComboBox, click the Input Lookup Query (sub-select) column in that field, and then use the Visual Query Builder to specify the data to use.
• When you create a detail page, display of the primary key is disabled automatically.
• When you create a detail page, input controls are assigned by default. You can change them from the default values, which appear as follows:
  • Boolean and bit values appears as a check box.
  • Memo and CLOB values appear as a text area.
  • Everything else appears as a text input control.

ColdFusion/Ajax Application wizard

The ColdFusion/Ajax Application wizard creates a ColdFusion create, read, update, and delete (CRUD) application that contains Ajax elements. For information about using the wizard, see “ColdFusion/Flex Application wizard” on page 1146.

You start the wizard just as you start the ColdFusion/Flex Application wizard, except that you select the ColdFusion/Ajax Application wizard. Unlike the ColdFusion/Flex Application wizard, the ColdFusion/Ajax Application wizard does not generate login screens.

ActionScript to CFC wizard

The ActionScript to CFC wizard lets you create a ColdFusion component (CFC) based on an ActionScript class file.
Use the ActionScript to CFC wizard
1. In Flex Builder or Eclipse, go to the Project Navigator.
2. Right-click an ActionScript class file.
3. Select ColdFusion Wizards > Create CFC.
4. Enter the location of the CFC file in the Save to Project Folder text box, or click Browse and select the location.
5. Enter the filename of the CFC in the CFC Filename text box.
6. To replace an existing file, select Overwrite file.
7. To create get and set methods in the CFC, in addition to property definitions, select Generate Get/Set Methods.
8. To specify the property scope, select public or private.
9. Click Finish.

CFC to ActionScript wizard

The CFC to ActionScript wizard lets you create an ActionScript file based on a ColdFusion component (CFC) Value Object.

Use the CFC to ActionScript wizard
1. In Flex Builder or Eclipse, go to the Project Navigator.
2. Right-click a CFC Value Object file.
3. Select ColdFusion Wizards > Create AS Class.
4. Enter the location of the ActionScript file in the Save to Project Folder text box, or click Browse and select the location.
5. Enter the class package in the AS Class Package text box.
6. Enter the filename of the ActionScript class file in the AS Class Name text box.
7. To replace an existing file, select Overwrite file.
8. Enter the path to the CFC in the Path to CFC text box.
10. Click Finish.

RDS CRUD wizard

The Remote Development Services (RDS) CRUD Wizard lets you dynamically create a ColdFusion component (CFC) based on a table that is registered in the ColdFusion Administrator on a ColdFusion server. To use the RDS CRUD wizard, you must have the Eclipse RDS Support plug-in installed. (The Eclipse RDS Support plug-in is installed when you install the ColdFusion wizards.)

The RDS CRUD Wizard lets you create the following types of CFCs:
- ActiveRecord style CRUD CFC, which includes all of the properties, get and set methods, and SQL methods in one CFC. The CFC includes the following methods:
init() or init(primary key value)
load(primary key value)
save()
delete()

• Bean/DAO style CRUD CFCs, which creates two related CFCs:
  • A Bean CFC, also called a Value Object, which contains the property definitions and get and set methods.
  • The DAO CFC, which contains the following methods:
    read(primary key value)
    create(cfc instance)
    update(cfc instance)
    delete(cfc instance)

• Data Service assembler CFC, which includes a Bean (also referred to as a Value Object), a DAO CFC, and an assembler CFC. The assembler CFC is required to take advantage of the Flex Data Services feature

Use the RDS CRUD wizard
1 In Flex Builder or Eclipse, go to the RDS Dataview by doing the following:
   a Select Window > Show View > Other.
   b Select RDS.
   c Select RDS Dataview.
2 Right click a table name.
3 Select ColdFusion Wizards > Create CFC.
4 Enter the project folder where you want to save the CFC in the CFC Folder text box.
5 Enter the CFC package in the CFC Package Name text box.
6 (Optional) Select the Primary Key column if a primary key is not defined in the database.
7 (Optional) To specify the primary key column in addition to the other values specified in the CFC, select the Primary Key is Controlled by the User option. If the primary key is automatically generated by the database (the identity field), do not select this option.
8 To replace existing files, select the Overwrite Files If They Already Exist option.
9 Select one of the following CFC Types:
   • Active Record CFC
   • Bean CFC & DAO CFC
   • Flex Data Service Assembler CFCs
10 Enter the names of the CFCs in the appropriate text boxes.
11 To create an ActionScript Value Object:
   a Select the Create an ActionScript Value Object in Addition to the CFCs option.
   b Enter the location for the ActionScript Value Object in the AS Folder text box, or click Browse to browse to the location.
To create get and set methods in the ActionScript Class file, select Generate Get/Set Methods.

12 Click Finish.

**Services Browser**

The ColdFusion Services Browser lets you view all of the CFCs and web services on your computer.

**Use the Services Browser**

1 In Flex Builder or Eclipse, select Window > Show View > Other.

2 Select ColdFusion > Services Browser.

The Services Browser can do the following:

- Browse components
- Manage web services

**Browsing components**

The Service Browser lists the following components:

- Components that the ColdFusion component browser lists
  - The ColdFusion component browser is located at cf_root/wwwroot/CFIDE/componentutils/componentdoc.cfm.
- Components that are located in any directories specified in the ColdFusion Administrator Mappings page
- Components that are located in any directories specified in the ColdFusion Administrator Custom Tag paths page

You can restrict the list of CFCs according to whether the functions in a CFC are remote, public, or private.

A sample element of the list appears as follows:

```xml
<cfcomponent>
  <cffunction name="echo" output="No" returntype="string">
    <cfargument name="echoString" required="Yes">
    <cfreturn "echo: #arguments[1]#">
  </cffunction>

  <cffunction name="getArtists" returntype="query" hint="query the database and return the results.">
    <cfquery name="artists" datasource="cfcodeexplorer" select=*>
```

The first line of the listing contains the path. The second line includes the name of the CFC. The next two lines contain the names of the functions in the CFC. The function name is followed by any argument, a colon, then the type of the return value. The listing echo(echoString):STRING indicates that the echo function has an argument named echoString, and that it returns a string. The myCFC CFC appears as follows:

```xml
<cfcomponent>
  <cffunction name="echo" output="No" returntype="string">
    <cfargument name="echoString" required="Yes">
    <cfreturn "echo: #arguments[1]#">
  </cffunction>

  <cffunction name="getArtists" returntype="query" hint="query the database and return the results.">
    <cfquery name="artists" datasource="cfcodeexplorer" select=*>
```
Managing web services

The Services Browser lets you manage a list of web services by adding or deleting WSDL URLs from a list. In addition, when you are editing a ColdFusion file, you can use the Services Browser to generate CFML code to invoke a web service or to create a web service object. Similarly, when you are editing an ActionScript file, you can use the Services Browser to generate ActionScript.

To view the list of web services, click the Show Web Services button in the top right corner of the Services Browser view.

Add a web service to the list

1. Right-click in the Services Browser view.
2. Select Add WSDL.
3. Enter a valid WSDL URL.
4. Click OK.

Delete a web service from the list

1. Right-click in the Services Browser view.
2. Select Delete WSDL.

Invoke a web service in ColdFusion

1. Place your mouse pointer where you want to insert the code.
2. View the list of web services.
3. Highlight a web service or a method in a web service and right-click.
4. Select Insert CFinvoke.

The code that the Service Browser generates appears in the ColdFusion file. The following is an example of the code that the Service Browser generates:

```cfml
<cfinvoke
    webservice="http://arcweb.esri.com/services/v2/MapImage.wsdl"
    method="convertMapCoordToPixelCoord"
    returnVariable="convertMapCoordToPixelCoord" />
    <cfinvokeargument name="mapCoord" type="" /> 
    <cfinvokeargument name="viewExtent" type="" /> 
    <cfinvokeargument name="mapImageSize" type="" />
</cfinvoke>
```

Create a web service object in ColdFusion

1. Place your mouse pointer where you want to insert the code.
2. View the list of web services.
3. Highlight a web service or a method in a web service and right-click.
4. Select Insert CFinvoke.
The code that the Service Browser generates appears in the ColdFusion file. The following is an example of the code that the Service Browser generates:

createObject("webservice",
"http://arcweb.esri.com/services/v2/MapImage.wsdl").convertMapCoordToPixelCoord(mapCoord, viewExtent, mapImageSize);
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