

# Deconstructing ColdFusion

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**VERACODE**

# Hi

- Chris Eng
  - Senior Director of Research at Veracode
- Previously
  - Technical Director and Consultant at @stake (and Symantec, through acquisition)
  - Security Researcher/Electrical Engineer at NSA
- Other
  - Frequent speaker at security conferences
  - Contributor to various industry projects, mostly around classification and metrics
  - Advisory board for SOURCE Conferences (Boston and Barcelona)
  - Developed @stake WebProxy
- Brandon Creighton
  - Security Researcher at Veracode
- Previously
  - Engineer/architect at VeriSign MSS (ex-Guardent); focus on high-volume security event storage & transmission
- Other
  - Operations/goon volunteer at several conferences (DEFCON, SOURCE BOS, HOPE 5)
  - Ninja Networks party badge firmware dev
  - Old stuff: Stint as the maintainer of OpenBSD/vax (~1999-2002)

## Motivations

- Few resources available on securing or testing ColdFusion apps
  - ColdFusion 8 developer security guidelines from 2007  
[http://www.adobe.com/devnet/coldfusion/articles/dev\\_security\\_coldfusion\\_security\\_cf8.pdf](http://www.adobe.com/devnet/coldfusion/articles/dev_security_coldfusion_security_cf8.pdf)
  - “Securing Applications” section of ColdFusion 9 developer guide is similar, almost entirely about authentication methods  
[http://help.adobe.com/en\\_US/ColdFusion/9.0/Developing/coldfusion\\_9\\_dev.pdf](http://help.adobe.com/en_US/ColdFusion/9.0/Developing/coldfusion_9_dev.pdf)
  - OWASP ColdFusion ESAPI started May 2009, abandoned (?) June 2009  
<http://code.google.com/p/owasp-esapi-coldfusion/source/list>
  - EUSec presentation from 2006 focused mostly on the infrastructure footprint and deployment issues (admin interfaces, privilege levels, etc.)  
<http://eusecwest.com/esw06/esw06-davis.pdf>
- Veracode was developing ColdFusion static analysis support, so we had to do this research anyway
- No platform 0-days here; this is all about ***vulnerabilities in custom apps***

## Agenda

- ColdFusion Background and History
- Platform Architecture and CFML Crash Course
- Finding Vulnerabilities in ColdFusion Applications
- ColdFusion Behind the Curtain

# COLDFUSION BACKGROUND AND HISTORY



## ColdFusion History

- Originally released in 1995 by Allaire
  - Motivation: make it easier to connect simple HTML pages to a database
  - Initially Windows only with built-in web server
- Migration to J2EE with ColdFusion 6 in 2002
  - Everything compiled to Java classes before being run
  - Apps can be bundled up as WARs/EARs, including admin interface if desired
  - Bundled with JRun
- Latest version is ColdFusion 9 released in 2009
  - Most recent features focus on integration with other technologies, e.g. Flash, Flex, AIR, Exchange, MS Office, etc.

## Historical Vulnerabilities

- In the recent past
  - CVE-2010-2861: Unauthenticated directory traversal in Administrative interface
  - CVE-2009-3467 and CVE-2010-1293: Unspecified XSS vulnerabilities
  - CVE-2009-1876: Unspecified double-encoded null character infoleak
- Lots of XSS in sample apps, administrator UI, error pages
- Source code disclosure (canonicalization issues, sample apps)
- Authorization vulnerabilities related to administrative UI
- Prior to ColdFusion 6 (Allaire/Macromedia days)
  - Arbitrary file retrieval
  - XOR used to encrypt passwords
  - Predictable session identifiers (may have been sequential, IIRC)
  - Various DoS conditions and buffer overflows

Source: National Vulnerability Database

## Who Uses ColdFusion Anyway?

- Lots of people, believe it or not. Let's start by asking Google...

Search Term	Hits
ext:asp	1,110,000,000
ext:aspx	1,320,000,000
<b>ext:cfm</b>	<b>213,000,000</b>
ext:jsp	556,000,000
ext:php	6,530,000,000
ext:pl	598,000,000
ext:py	8,210,000
ext:rb	372,000

Source: Google, October 25, 2010



## Who Uses ColdFusion Anyway?

- “More than **770,000 developers** at over **12,000 companies** worldwide rely on Adobe® ColdFusion® software to rapidly build and deploy Internet applications. And with more than **125,000 ColdFusion servers** deployed, ColdFusion is one of the most widely adopted web technologies in the industry.”



Bank of America



citi



Smithsonian



PGA

BT



CISCO



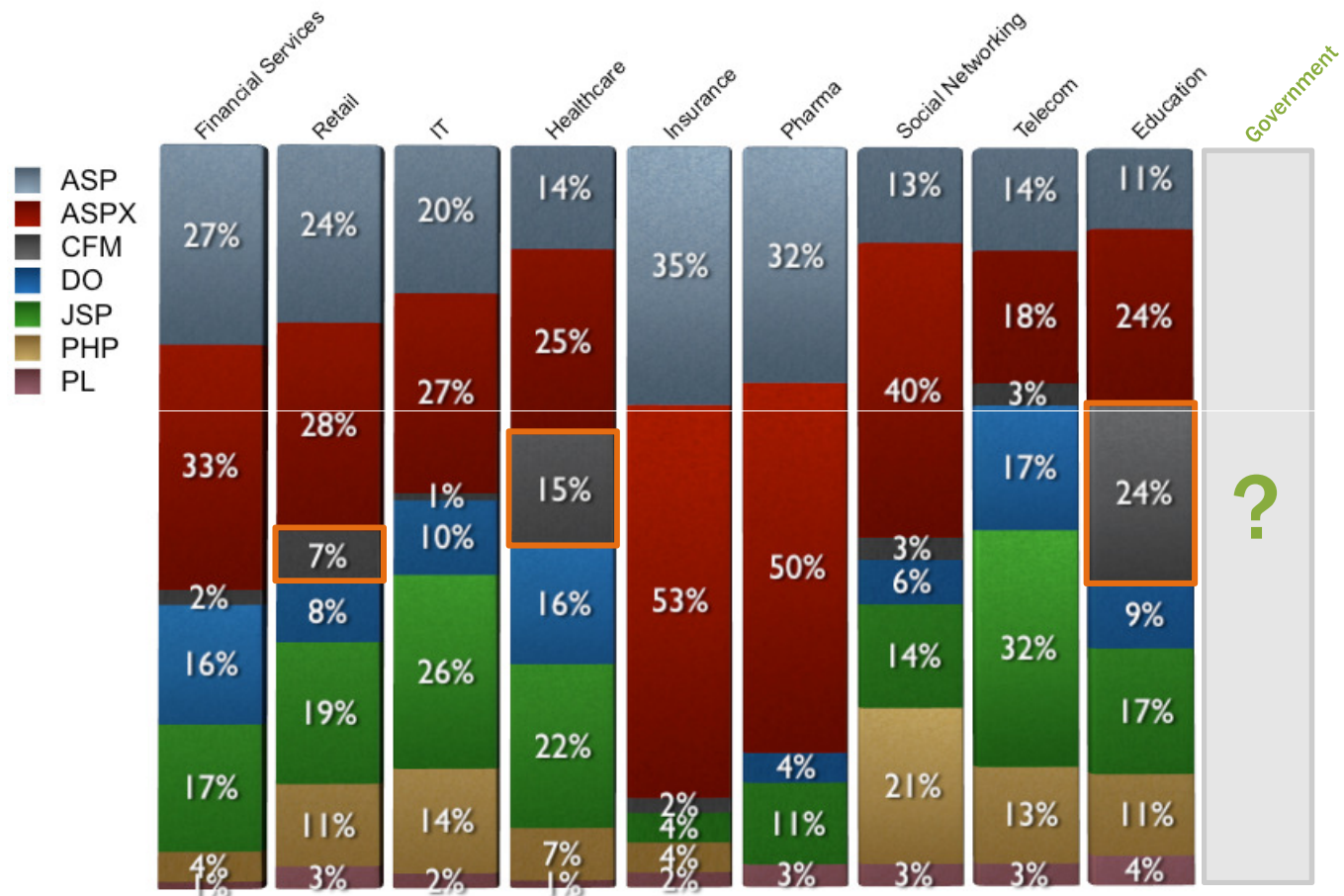
verizon



BOEING



# ColdFusion Prevalence by Vertical



Source: WhiteHat Website Security Statistics Report, 9th Edition, May 2010

# PLATFORM ARCHITECTURE AND CFML CRASH COURSE



## A Simple CFML Page

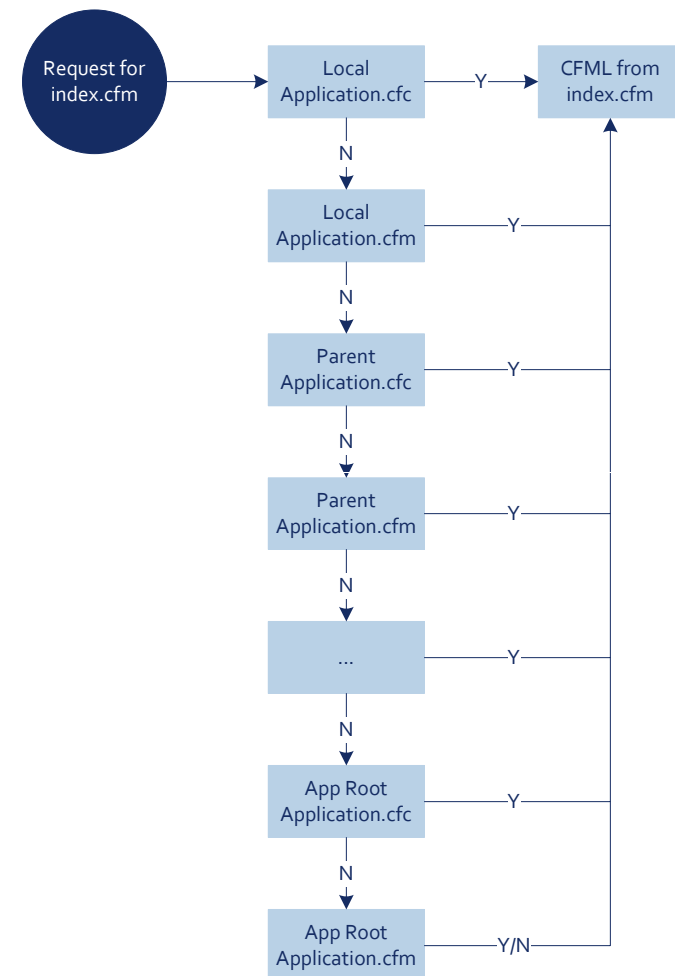
```
<cfset greeting="Hello">
<cfset today = Now()>
<html>
  <head>
    <title>Hello World!</title>
  </head>
  <body>
    <cfoutput>
      #greeting#, World!<br>
      Today is #DateFormat(Now(),"dddd, mmmm d, yyyy")#.
    </cfoutput>
  </body>
</html>
```

# CFML Building Blocks

- Pages
  - Main entry points of a CF application
  - Similar to an HTML page (or PHP, JSP, etc.) except using CFML tags
  - .cfm extension
- Components
  - Contain reusable functions / variables for use by other code
  - Written entirely in CFML
  - .cfc extension
- Functions (UDFs)
  - Defined inside components or pages
  - Called using CFINVOKE or inside a CFSCRIPT block/expression
  - Can be exposed as an entry point inside components

## CFML Page Lifecycle, Part I

- When a page is requested, search for (and execute) Application.cfc or Application.cfm first
- Application.cfm is a plain old CFML file, while Application.cfc defines hooks into application events
- Common uses for this mechanism:
  - Login management
  - Centralized data validation
  - Messing with session variables
  - Error handling

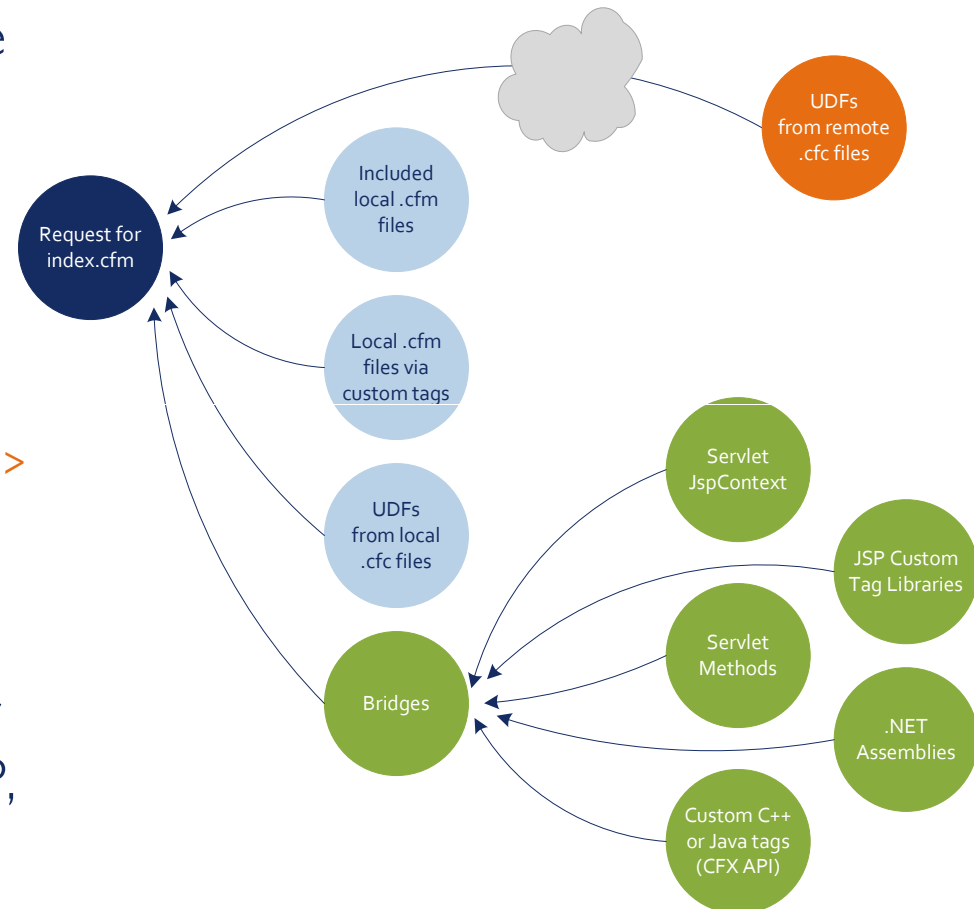


## Inside Application.cfc

- **onApplicationStart**: application start (can access request variables)
- **onApplicationEnd**: application timeout/server shutdown
- **onSessionStart**: new session (can access request variables)
- **onSessionEnd**: session ends
- **onRequestStart**: called before every request (can access request variables)
- **onRequest**: called after onRequestStart code ends (can access request variables)
- **onRequestEnd**: called after request has been processed (can access request variables)
- **onMissingTemplate**: called when an unknown page has been requested (can access request variables)
- **onError**: when an uncaught exception occurs (can access request variables sometimes; check Event value)

## CFML Page Lifecycle, Part 2

- A single page can include code from many different locations
- Custom tags are similar to local includes, but with different dataflow behavior
  - `<cf_foo>` is kind of like `<cfinclude template="foo.cfm">` except that changes made to variables are not visible in the calling page
- There are also built-in tags for interacting with remote HTTP, FTP, LDAP, SMTP, and POP servers





## Variables are Dynamically Scoped

- Silos of global variables named “scopes” can be confusing
- Variable accesses can be fully-qualified (prefixed with scope name) or not qualified at all

```
<cfoutput>#foo#</cfoutput>
```

```
<cfoutput>#URL.foo#</cfoutput>
```

- The unqualified scope can be temporarily “enhanced” with the results of a query row or loop iteration, e.g.

```
<cfquery name="qry" datasource="myDataSource">
```

```
  SELECT col1, col2, col3 FROM myTable
```

```
</cfquery>
```

```
<cfoutput query="qry">#col1#, #col2#, #col3#</cfoutput>
```

```
<cfoutput query="qry">#qry.col1#, #qry.col2#, #qry.col3#</cfoutput>
```

- Output without iteration is also possible:

```
<cfoutput> #qry.col1#, #qry.col2#, #qry.col3# </cfoutput>
```

## Variable Scopes (Much More on This Later)

Scope	Description
Variables	the variable binding stack local to the current page
Application	global to every page in an app; set in application.cfc
Arguments	arguments to a function (may be tainted if called by a remote UDF)
Attributes	used to pass data to .cfm custom tag pages/threads
Caller	used within custom tags; reference to the calling page's Variables scope
Request	persistent across all code for the lifetime of the request; useful within custom tags and cfincluded pages
This	struct/component "member variables"
ThisTag	analogous to Request scope for custom tag pages
URL	parameters present in HTTP query string
Form	parameters present in HTTP POST body
Cookie	HTTP request cookies
CGI	CGI variables, some server-defined and some tainted
Session	persistent across a single site visit
Client	client-specific persistent storage; outlasts session variables

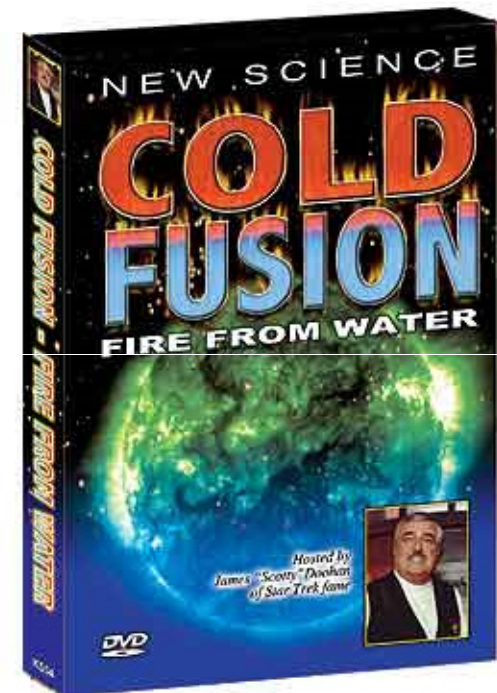
## Variable “Types” in ColdFusion

- The CF type system hasn't changed significantly since the 90s
- Implicit conversions to/from strings are the norm
- Instead of type checks, validation often done with pattern matches:
  - CFPARAM and CFARGUMENT “type” attributes
    - `<cfparam name="phoneno" type="telephone">` will throw an exception if “phoneno” is set and is not formatted as a standard US/NANPA phone number
    - Types “boolean”, “creditcard”, “date”, “time”, “eurodate”, “eurotime”, “email”, “float”, “numeric”, “guid”, “integer”, “range”, “regex”, “ssn”, “telephone”, “URL”, “uuid”, “usdate”, “variablename”, “xml”, “zipcode” all check the string representation of the variable against regexes
    - Limited type checks are possible: “array”, “query”, “struct”, and “string”
- Numerous opaque types reused among contexts
  - Example: queries are used for database queries, directory iteration, ldap queries, http/ftp requests, and others

## CF Expressions

- Automatic interpolation with #-expressions inside cfoutput and attributes:
  - `<cfoutput>#URL.foo#</cfoutput>`
  - `<cfloop query = "MyQuery" startRow = "#Start#" endRow = "#End#">  
    <cfoutput>#MyQuery.MyColName#</cfoutput><br>  
</cfloop>`
- Dynamic scoping can hinder analysis
  - `<cfset foo="bar">` vs. `<cfset "#foo#"="#bar#">`
  - `SetVariable("foo", "bar")` vs. `SetVariable(foo, bar)`
- Dynamic evaluation functions
  - `Evaluate()` and `PrecisionEvaluate()`
  - `IIF()`
  - `DE()` – used in conjunction with the other two

# FINDING VULNERABILITIES IN COLDFUSION APPLICATIONS




## XSS? How to FAIL with scriptProtect

- Using scriptProtect attribute
  - Replaces blacklisted tags such as `<script>`, `<object>`, etc. with `<InvalidTag>` when rendering user-supplied input
  - Doesn't block injection, aside from the most basic attack strings
- Example
  - `<cfapplication scriptProtect="all">`  
`<cfoutput>You typed #URL.foo#</cfoutput>`
  - Requesting page with `?foo=<script>alert("foo")</script>` will return  
`You typed <InvalidTag>alert("foo")</script>`
- Trivial to circumvent
  - One of many possibilities: requesting page with  
`?foo=`  
will happily execute the `alert()` call
- Other regexes can be added to the blacklist, but it's still a blacklist (look for neo-security.xml if you insist)

The web site you are accessing has experienced an unexpected error.  
Please contact the website administrator.

The following information is meant for the website developer for debugging purposes.

Error Occurred While Processing Request

The value  cannot be

Resources:

- Enable Robust Exception Inform of errors. In the Administrator, Settings, and select the Robust
- Check the [ColdFusion documentation](#) to verify that you are using the correct syntax.
- Search the [Knowledge Base](#) to find a solution to your problem.

Browser Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US) AppleWebKit/534.13 (KHTML, like Gecko) Chrome/9.0.597.107 Safari/534.13  
Remote Address 10.0.5.98  
Referrer  
Date/Time 07-Mar-11 02:23 PM

The page at 10.0.5.50:8500 says:

foo

OK

## So What? I Have Encoding Functions

- HTMLFormat() and HTMLCodeFormat() don't perform sufficient HTML encoding
  - They only encode <, >, ", and &
  - Ineffective for unquoted or single-quoted tag attributes, or within script blocks
    - `<img #HTMLFormat(URL.foo)#>`
    - `<img alt='#HTMLFormat(URL.foo)#'>`
    - `<script>#HTMLFormat(URL.foo)#</script>`
    - `<script>var x='#HTMLFormat(URL.foo)#';</script>`
    - etc.
  - XMLFormat() encodes single quotes, but still won't prevent XSS in all situations, e.g. inside Javascript or CSS blocks
- Context-specific encoders? No built-ins, have to roll your own...



# No Problem, I'll Just Whitelist (or Cast)!

- This should work, right?
  - `<cfoutput>#int(URL.count)#</cfoutput>`
  - `<cfset safenum=NumberFormat(FORM.bar)>`
  - `<cfoutput>#JavaCast("boolean", URL.booly)#</cfoutput>`
- Default error page
  - scriptProtect is enabled on the default error page, but we already saw how (in)effective that is

The following information is meant for the website developer for debugging purposes.

**Error Occurred While Processing Request**

The value foo cannot be converted to a number.

Resources:

- Enable Robust Exception Information to provide greater detail about the source of errors. In the Administrator, click Debugging & Logging > Debug Output Settings, and select the Robust Exception Information option.
- Check the [ColdFusion documentation](#) to verify that you are using the correct syntax.
- Search the [Knowledge Base](#) to find a solution to your problem.

Browser Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US; rv:1.9.2.3)  
Gecko/20100401 Firefox/3.6.3 (.NET CLR 3.5.30729)

Remote Address 10.0.5.220

Referrer

Date/Time 24-May-10 02:36 PM

## What If I Use a Custom Error Page?

- Maybe you can avoid XSS risks in the default error page by defining your own custom error page?

```
<cferror template="errorhandler.cfm" type="exception">
```

- Custom error template might contain:

```
<cfoutput>
```

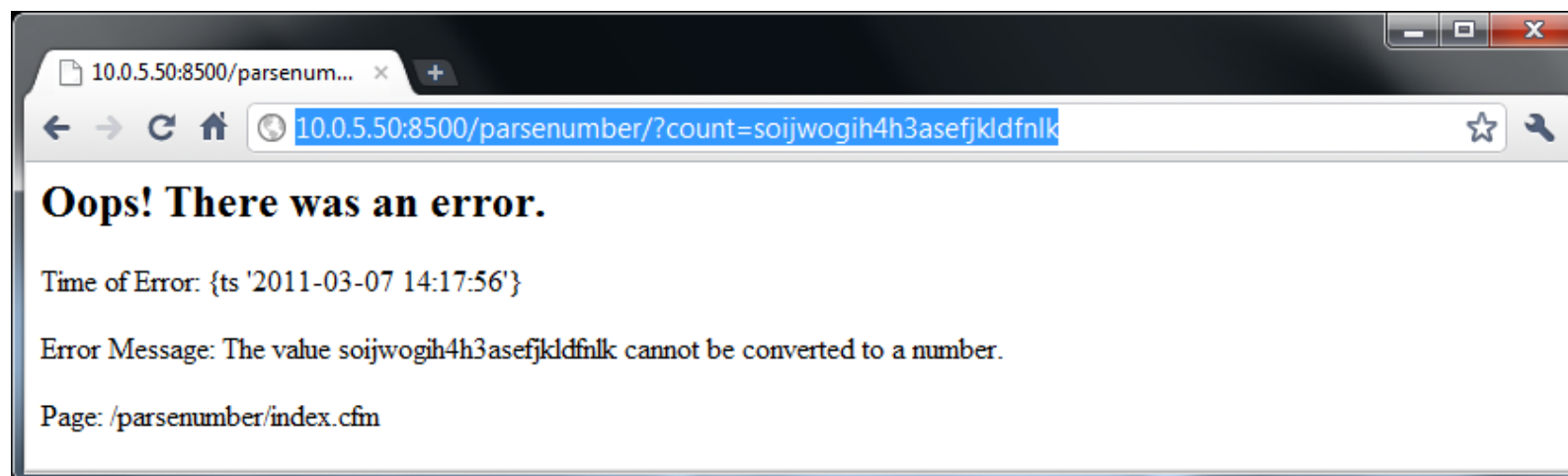
```
  <h2>Oops! There was an error.</h2>
```

```
  <p>Time of Error: #error.dateTime#</p>
```

```
  <p>Error Message: #error.message#</p>
```

```
  <p>Page: #error.template#</p>
```

```
</cfoutput>
```



Page type	Error variable	Description
Validation only	error.validationHeader	Validation message header text.
	error.invalidFields	Unordered list of validation errors.
	error.validationFooter	Validation message footer text.
Request and Exception	error.diagnostics	Detailed error diagnostics from ColdFusion. <b>XSS</b>
	error.mailTo	E-mail address (same as value in cferror.MailTo).
	error.dateTime	Date and time when error occurred.
	error.browser	Browser that was running when error occurred.
	error.remoteAddress	IP address of remote client.
	error.HTTPReferer	Page from which client accessed link to page where error occurred.
	error.template	Page executing when error occurred.
	error.generatedContent	The content generated by the page up to the point where the error occurred.
	error.queryString	URL query string of client's request.
Exception only	error.message	Error message associated with the exception. <b>XSS</b>
	error.rootCause	The root cause of the exception. This structure contains the information that is returned by a <code>cfcatch</code> tag. For example, for a database exception, the SQL statement that caused the error is in the <code>error.RootCause.Sql</code> variable. For Java exceptions, this variable contains the Java servlet exception reported by the JVM as the cause of the "root cause" of the exception.
	error.tagContext	Array of structures containing information for each tag in the tag stack. The tag stack consists of each tag that is currently open.
	error.type	Exception type.

## What If I Use Exception Handling?

- This code will catch the exception when trying to convert a non-numeric string to an integer:

```
<cftry>
<cfoutput>#int(URL.count)#</cfoutput>
<cfcatch><cfoutput>
  <h2>Exception caught!</h2>
  <p>Exception type: #cfcatch.type#</p>
  <p>Exception message: #cfcatch.message#</p>
</cfoutput></cfcatch>
</cftry>
```



<b>cfcatch variable</b>	<b>Content</b>
<code>cfcatch.type</code>	Type: Exception type, as specified in <code>cfcatch</code> .
<code>cfcatch.message</code>	Message: Exception's diagnostic message, if provided; otherwise, an empty string; in the <code>cfcatch.message</code> variable. <span style="color: red; font-weight: bold;">XSS</span>
<code>cfcatch.detail</code>	Detailed message from the CFML interpreter or specified in a <code>cfthrow</code> tag. When the exception is generated by ColdFusion (and not <code>cfthrow</code> ), the message can contain HTML formatting and can help determine which tag threw the exception.
<code>cfcatch.tagcontext</code>	An array of tag context structures, each representing one level of the active tag context at the time of the exception.
<code>cfcatch.NativeErrorCode</code>	Applies to <code>type="database"</code> . Native error code associated with exception. Database drivers typically provide error codes to diagnose failing database operations. Default value is -1.
<code>cfcatch.SQLState</code>	Applies to <code>type="database"</code> . SQLState associated with exception. Database drivers typically provide error codes to help diagnose failing database operations. Default value is -1.
<code>cfcatch.Sql</code>	Applies to <code>type="database"</code> . The SQL statement sent to the data source.
<code>cfcatch.queryError</code>	Applies to <code>type="database"</code> . The error message as reported by the database driver.
<code>cfcatch.where</code>	Applies to <code>type="database"</code> . If the query uses the <code>cfqueryparam</code> tag, query parameter name-value pairs.
<code>cfcatch.ErrNumber</code>	Applies to <code>type="expression"</code> . Internal expression error number.
<code>cfcatch.MissingFileName</code>	Applies to <code>type="missingInclude"</code> . Name of file that could not be included.
<code>cfcatch.LockName</code>	Applies to <code>type="lock"</code> . Name of affected lock (if the lock is unnamed, the value is "anonymous").
<code>cfcatch.LockOperation</code>	Applies to <code>type="lock"</code> . Operation that failed (Timeout, Create Mutex, or Unknown).
<code>cfcatch.ErrorCode</code>	Applies to <code>type="custom"</code> . String error code.
<code>cfcatch.ExtendedInfo</code>	Applies to <code>type="application"</code> and <code>"custom"</code> . Custom error message; information that the default exception handler does not display.

## Common SQL Injection Mistakes

- Using CFQUERY without CFQUERYPARAM (also CFSTOREDPROC without CFPROCPARAM)

```
<cfquery name="getContent" dataSource="myData">  
  SELECT * FROM pages WHERE pageID = #Page_ID# OR  
  title = '#Title_Search#'</cfquery>
```

- #Title\_Search# is not injectable; CF will automatically escape single quotes for expressions inside the CFQUERY tag  
#Page\_ID# is still injectable because it's not quoted

- Using CFQUERYPARAM

```
<cfquery name="getContent" dataSource="myData">  
  SELECT * FROM pages WHERE pageID =  
  <cfqueryparam value="#Page_ID#" cfsqltype="cf_sql_integer"></cfquery>
```

(For unknown reasons, cfsqltype is an optional attribute)

## Other Common Vulnerabilities

- We won't waste time rehashing all of the common web vulnerabilities
  - Of course you can have CSRF, insecure cryptographic storage, broken authentication/authorization, etc. in a ColdFusion app
  - Nothing unique enough to warrant discussion here
- Here are some tags to watch out for; it should be obvious why they are dangerous if not properly restricted
  - <cffile>
  - <cfdirectory>
  - <cfexecute>
  - <cfregistry>
  - <cfobject>
  - <cfinclude>

## Directly Invoking UDFs

- Every method in a .cfc file is a potential entry point, e.g. <http://example.com/foo.cfc?method=xyzzzy&arga=vala&argb=valb>
- This URL will invoke method xyzzzy on an anonymous instance of component foo.cfc, with arguments arga="vala" and argb="valb" (also valid with POST variables, although method must be passed in the query string)
- In a source code review, look for sensitive functionality implemented as UDFs, with the access attribute set to "remote"  
e.g. `<cffunction name="ListCategories" access="remote" returntype="query">`





## Search Order for 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. Local (function-local, UDFs and CFCs only)	7. CGI
2. Arguments	8. Cffile
3. Thread local (inside threads only)	9. URL
4. Query (not a true scope; variables in query loops)	10. Form
5. Thread	11. Cookie
6. Variables	12. Client

- For example, in applications with sloppy variable naming, you can almost always override POST (Form) parameters with GET (URL) parameters

## Exploiting Unscoped Variables

- Consider this logic to process a user login (yes, it's contrived)

```
<cfif AuthenticateUser(FORM.username, FORM.password) and  
    IsAdministrator(FORM.username)>  
    <cfset Client.admin = "true">  
<cfelse>  
    <cfset Client.admin = "false">  
</cfif>
```

- Other pages check whether the admin variable is true before performing restricted actions

```
<cfif admin eq "true">  
    Put privileged functionality here!  
<cfelse>  
    Sorry, only admins can access this!  
</cfif>
```

- Putting `?admin=true` in the URL will bypass this check because URL variables precede Client variables in the search order
- Compare reads/writes of variables to identify scoping inconsistencies

## Exploiting User-Supplied Variable Scope

- Code similar to the following

```
<cfloop item="x" collection="#URL#">  
  <cfscript>SetVariable(x, Evaluate("URL." & x));</cfscript>  
</cfloop>
```

...

```
<cfif Client.username eq "admin">  
  Put privileged functionality here!  
<cfelse>  
  Sorry, only admins can access this!  
</cfif>
```

- Attack by putting `?client.username=admin` in the URL
- Beware of any variable assignments with user-supplied LHS!  
e.g. `<cfset "#URL.varname#" = "#URL.varvalue#">`

## Undefined Variables

- CFPARAM's "default" attribute only sets a variable *if it's not set already*
- Assume undefined, unqualified variables are filled with request data!
- It's common to see code like:

```
<cfparam name="pagenum" default="1">  
<cfoutput>  
    Now showing page #pagenum#.  
</cfoutput>
```

- This is exploitable; GET and POST variables will override pagenum
- Instead, use CFSET or an assignment inside CFSCRIPT

## Environment Variables

- Legitimate variables in the CGI scope can be manipulated and in some cases overridden via HTTP headers

- For example:

```
GET /index.cfm HTTP/1.0  
Host: example.com
```

The CF expression `#CGI.HTTP_HOST#` will contain “example.com”

```
GET /index.cfm HTTP/1.0  
HTTP_HOST: evil.com  
Host: example.com
```

The CF expression `#CGI.HTTP_HOST#` will contain “evil.com”

- And you can override a lot more than you might expect...

# Why Are We Allowed To Override These?

- HTTP\_USER\_AGENT ----> fooooooooooooo
- WEB\_SERVER\_API ----> fooooooooooooo
- PATH\_TRANSLATED ---->  
C:\ColdFusion9\wwwroot\test\cgione.cfm
- CONTENT\_TYPE ----> fooooooooooooo
- HTTP\_ACCEPT\_LANGUAGE ----> fooooooooooooo
- HTTP\_REFERER ----> fooooooooooooo
- HTTP\_ACCEPT ----> fooooooooooooo
- CERT\_SERVER\_ISSUER ----> fooooooooooooo
- CERT\_SERVER\_SUBJECT ----> fooooooooooooo
- HTTP\_ACCEPT\_ENCODING ----> fooooooooooooo
- SERVER\_SOFTWARE ----> fooooooooooooo
- SERVER\_NAME ----> 10.0.5.93
- CF\_TEMPLATE\_PATH ---->  
C:\ColdFusion9\wwwroot\test\cgione.cfm
- CERT\_FLAGS ----> fooooooooooooo
- HTTPS\_SERVER\_ISSUER ----> fooooooooooooo
- CONTEXT\_PATH ---->
- HTTP\_COOKIE ----> fooooooooooooo
- SERVER\_PROTOCOL ----> HTTP/1.1
- CERT\_SECRETKEYSIZE ----> fooooooooooooo
- REQUEST\_METHOD ----> GET
- HTTPS\_SECRETKEYSIZE ----> fooooooooooooo
- AUTH\_PASSWORD ----> fooooooooooooo
- HTTPS ----> fooooooooooooo
- CERT\_SERIALNUMBER ----> fooooooooooooo
- CERT\_SUBJECT ----> fooooooooooooo
- SERVER\_PORT ----> 8500
- CERT\_KEYSIZE ----> fooooooooooooo
- SCRIPT\_NAME ----> /test/cgione.cfm
- REMOTE\_ADDR ----> 10.0.5.220
- SERVER\_PORT\_SECURE ----> 0
- REMOTE\_HOST ----> matsutake.veracode.local
- HTTPS\_KEYSIZE ----> fooooooooooooo
- HTTP\_HOST ----> fooooooooooooo
- HTTP\_CONNECTION ----> fooooooooooooo
- AUTH\_USER ----> fooooooooooooo
- REMOTE\_USER ----> fooooooooooooo
- PATH\_INFO ----> fooooooooooooo
- QUERY\_STRING ----> key=QUERY\_STRING
- CERT\_ISSUER ----> fooooooooooooo
- CERT\_COOKIE ----> fooooooooooooo
- HTTPS\_SERVER\_SUBJECT ----> fooooooooooooo
- GATEWAY\_INTERFACE ----> fooooooooooooo
- AUTH\_TYPE ----> fooooooooooooo
- CONTENT\_LENGTH ----> fooooooooooooo

## Persistence Issues

- Client scope variables can be configured in Application.cfm in the CFAPPLICATION tag (attribute “clientmanagement”) or this.clientmanagement in Application.cfc
  - Keyed to browser via CFTOKEN/CFID cookies; actual variable storage may be client-side (other cookies) or server-side (in a database or the Windows registry)
  - All of these cookies persist by default, so watch for cookie theft/stuffing attacks
- When client scope is enabled, tampering is possible if cookie storage is enabled (“clientStorage” attribute/variable)  
e.g. `<cfapplication clientManagement="yes" clientStorage="Cookie">`
  - No encryption or MAC; everything is in plain text

## For Reference: Spot the Tainted Data

- URL.any\_variable
- FORM.any\_variable
- COOKIE.any\_variable
- FLASH.any\_variable
- CGI.some\_variables
  - e.g. PATH\_INFO, QUERY\_STRING, CONTENT\_TYPE, CONTENT\_LENGTH, HTTP\_REFERER, HTTP\_USER\_AGENT, etc.
  - More on this later
- SESSION.some\_variables
  - Depends on application logic
- CLIENT.any\_variable
  - Only when client variables are enabled and storage is cookie-based
- CFFUNCTION arguments, when access="remote"



# COLDFUSION BEHIND THE CURTAIN



## Proprietary Classfile Format

- CF can compile pages/components to sets of Java classes using the cfcompile utility
- One class per page plus one for every UDF
- All class generated for a single CFM/CFC file are placed in one file, concatenated; a custom ClassLoader is used by CF to load them up
- Names of the resulting concatenated files are identical to those of the source files
- Separately, ColdFusion Administrator can be used to bundle a directory as an EAR/WAR

## A Way to Slice Them: cfexplode

- Free, open-source Java utility written by Brandon Creighton at Veracode, available from Google Code:  
<http://code.google.com/p/cfexplode/>
- Splits concatenated classfiles into many; can accept individual compiled CFC/CFM files or full WAR/EAR/JAR zip archives

```
% java -jar cfexplode.jar outdir index.cfm
% ls -l outdir
total 40
-rw-r--r-- 1 cstone cstone  3534 2010-07-16 15:23 index.cfm.0.class
-rw-r--r-- 1 cstone cstone  2095 2010-07-16 15:23 index.cfm.3534.class
-rw-r--r-- 1 cstone cstone 31234 2010-07-16 15:23 index.cfm.5629.class
```

- Individual classes easily analyzable (even with the free JAD and JD-GUI)

## Page/Component/Function Java Classes

- CFM/CFC: main point of entry is `CFPage.runPage()`
  - Other methods called beforehand set up data: variable bindings (`bindPageVariables()`), function names (`registerUDFs()`), data sources
- `<cffunction>`: main point of entry is `UDFMethod.runFunction()`
  - Argument validation is done by the runtime; any types specified in `<cfargument>` tags are translated into a static Map instance named “metaData”
- `CfJspPage` (base class).`pageContext` is a plain old `JspContext`, so `pageContext.getOut()` returns a `JspWriter`; this is used to do the bulk of the output
  - `getOut()` also used for things that aren't actually output to the screen, such as database queries
- Occasionally, parts of the body are factored out of `runPage` into separate private methods named `factor0()`, `factor1()`, `factor2()`..

## CF Variables in Java: Static References

- Static references, usually used for local bindings

```
<cfset vfoo="value 1">
<cfparam name="pbar"
  default="value2">
<html>
  <cfoutput>
    vfoo: #vfoo#    pbar: #pbar#
  </cfoutput>
</html>
```

- When compiled:

```
protected final Object runPage()
{
  // ...
  VF00.set("value 1");
  _whitespace(out, "\n");
  checkSimpleParameter(PBAR,
"value2");
  out.write("\n\n<html>\n    ");
  // ...
  out.write("\n          vfoo: ");
  out.write(Cast._String(
_autoscalarize(VF00)));
  out.write("    pbar: ");
  out.write(Cast._String(
_autoscalarize(PBAR)));
  _whitespace(out, "\n    ");
  // ...
}
```

## CF Variables in Java: Static References

- How variables are bound to the page

```
private Variable PBAR;  
private Variable VF00;  
protected final void bindPageVariables(VariableScope varscope,  
                                         LocalScope locscope)  
{  
    super.bindPageVariables(varscope, locscope);  
    PBAR = bindPageVariable("PBAR", varscope, locscope);  
    VF00 = bindPageVariable("VF00", varscope, locscope);  
}
```

## CF Variables in Java: Dynamic References

- Dynamic references, explicitly-scoped variables

```
<html>
<cfoutput>
  #url.quux#
</cfoutput>
</html>
```

- When compiled:

```
protected final Object runPage()
{
  // ...
  out.write("<html>\n  ");
  _whitespace(out, "\n  ");
  out.write(Cast._String(
    _resolveAndAutoscalarize("URL", _new String[] { "QUUX" })))
  );
  // ...
}
```

## Other Ways to Set/Access Variables

- Bind the name “scope” to a variable that represents the results of the query
  - `<cfquery name="scope">`
- Looping over query results
  - `<cfoutput query="resultset">`
  - `<cfloop query>`
- Structure member accesses
  - `<cfset x=StructNew(>`
  - `<cfset x.member="val1">`
- `<cfdump>` tag for dumping variable contents
- Other I/O: files, HTTP requests, LDAP requests, mail messages



## WAR/Application Structure

- CFMs/CFCs handled by different Servlets (CfmServlet and CFCServlet, respectively)
- These locate the class(es) necessary based on URL and parameters, then invoke their runPage()/runFunction() methods
- Chain of coldfusion.filter.FusionFilter classes (not related to J2EE Servlet filters); these handle client-scope propagation
- Even if the “Include CF Administrator” option is unchecked, many pages/components inside the CFIDE/ directory are included inside every WAR
  - Mapped by default
  - Access may not be password-protected; easily disabled by a change to neo-security.xml (see <http://kb2.adobe.com/cps/404/kb404799.html>)

## WAR Structure: Other Servlets

- \*.jsp: JSPLicenseServlet; passthrough for jrun.jsp.JSPServlet
- /flex2gateway/\*, /flashservices/gateway/\*, /CFFormGateway/\*:  
FLEX/plain Flash Remoting gateways for CFC methods
  - /flashservices/gateway/path1.path2.component  $\Rightarrow$  path1/path2/component.cfc
  - Gateways can be used in ActionScript NetServices.createGatewayConnection()
  - Used internally by <cfgrid> and other built-in cf tags that generate Flash-based UI automatically
- GraphServlet: handles /CFIDE/GraphData.cfm (not actually a cfm file); used by the cfchart tag.
- CFFileServlet: handles /CFFileServlet/\*, and serves up files from a cache directory; used by <cfimage>
- /cform-internal/\*: FLEX FileManagerServlet; serves a handful of dynamically-generated images and js files
- /WSRPProducer/\*: WSRP portlet management Axis service

**FINAL  
THOUGHTS**



## Conclusions

- ColdFusion designed to be simple for “developers” to use, but it’s actually very complicated underneath
- It’s easy to make coding mistakes (or overlook vulnerabilities during code review) if you don’t understand ColdFusion internals
  - Request lifecycle
  - Error handling
  - Variable scopes and precedence
- Like many web application platforms, ColdFusion has a bunch of “features” that are useful for debugging but also open up holes
- ColdFusion-generated Java classes are pretty ugly; use **cfexplode** to help reverse engineer them
- The attack surface is huge by default; strip out unnecessary components before deploying

## More Resources

- Whitepapers, webcasts, and other educational resources
  - <http://veracode.com/resources>
- Veracode ZeroDay Labs Blog
  - <http://veracode.com/blog>
- Download the cfexplode tool
  - <http://code.google.com/p/cfexplode/>
- Contact info
  - Email: [ceng@veracode.com](mailto:ceng@veracode.com), [bcreighton@veracode.com](mailto:bcreighton@veracode.com)
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