Controlling Web Application Behavior
The Deployment Descriptor: web.xml

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Taught by the author of Core Servlets and JSP, More Servlets and JSP, and this tutorial. Available at public venues, or customized versions can be held on-site at your organization. Contact hall@coreservlets.com for details.
Agenda

- Location and purpose of web.xml
- Custom URLs
- Initialization parameters
  - Servlets
  - JSP Pages
- Preloading pages
- Welcome pages
- Error pages

Basics

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Deployment Descriptor: Basics

- **Location**
  - Eclipse: WebContent/WEB-INF/web.xml
  - Deployed: webAppName/WEB-INF/web.xml
    - `install_dir/conf/web.xml` is Tomcat-specific! Ignore it!

- **When processed**
  - Only *required* to be read when server (app) starts
    - Tomcat monitors web.xml and reloads Web app when web.xml changes. Eclipse redeployes app when web.xml changes.

- **Basic format**
  ```xml
  <?xml version="1.0" encoding="ISO-8859-1"?>
  <web-app xmlns="http://java.sun.com/xml/ns/j2ee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee web-app_2_4.xsd"
    version="2.4">
    <!-- "Real" elements go here. All are optional. -->
  </web-app>
  ```

  You should know how to enter the tags that go in here. But never type the huge header in by hand; let Eclipse create it automatically, or copy from existing example.

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Eclipse Structure (IDE-specific) vs. Deployment Structure (Standard)

**Eclipse**

- **Java code**
  - src/subDirMatchingPackage
- **HTML, JSP, Images**
  - WebContent
  - WebContent/randomDir
- **web.xml**
  - WebContent/WEB-INF

**Deployed**

- **Java code**
  - deployDir/webAppName/WEB-INF/classes/subDirMatchingPackage
- **HTML, JSP, Images**
  - deployDir/webAppName
  - deployDir/webAppName/randomDir
- **web.xml**
  - deployDir/webAppName/WEB-INF

**Note**

- On Tomcat, deployDir is `tomcat_installdir/webapps`
Latest web.xml Version: 2.5

```xml
<web-app version="2.5"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://java.sun.com/xml/ns/javaee"
  xmlns:web="http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd"
  xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
  http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd">
  ...
</web-app>

- Works in Tomcat 6, JBoss 5, Glassfish 3
- Supports the updated (unified) expression language
- Few new features in servlets 2.5 vs. 2.4 or JSP 2.1 vs. JSP 2.0
  - But required for JSF 2.0
```

Most Commonly Used web.xml Version: 2.4

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app version="2.4"
  xmlns="http://java.sun.com/xml/ns/j2ee"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee
  http://java.sun.com/xml/ns/j2ee/web-app_2_4.xsd">
  ...
</web-app>

- 2.4 or later required if you use the JSP expression language
- Works in Tomcat 5, Tomcat 6, BEA WebLogic 9.x, Oracle AppServer 10.x, and IBM WebSphere 6.x
Older web.xml Version: 2.3

<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE web-app PUBLIC
  "-//Sun Microsystems, Inc.//DTD Web Application 2.3//EN"
  "http://java.sun.com/dtd/web-app_2_3.dtd">
<web-app>
  ...
</web-app>

- Obsolete: rarely used now
  • Order of entries matters in 2.3 version of web.xml
  • Does not support the JSP expression language
  • Required if using Tomcat 4, BEA WebLogic 8.x, Oracle
    AppServer 9.x, or IBM WebSphere 5.x

The Art of WAR (Files)

• Idea
  - When Eclipse deploys to Tomcat, it just builds a folder
    (described earlier) and puts it in the “webapps” directory
  - But, you can also deploy a single .war file instead of a
    folder. More convenient when emailing or FTPing
    • All servers must support WAR files
  - WAR files are simply ZIP files

• Building WAR files
  - Eclipse can build WAR files automatically
    • R-click project, Export → WAR file
  - You can also do it manually with “jar” or a ZIP utility

• Deploying WAR files
  - Location is server specific (“webapps” folder for Tomcat)
Custom URLs (Servlet Mappings)

Defining Custom URLs

- **Java code**
  ```java
  package myPackage; ...
  public class MyServlet extends HttpServlet { ... }
  ```

- **web.xml entry (in `<web-app...>`...`</web-app>`)**
  - Give name to servlet
    ```xml
    <servlet>
    <servlet-name>MyName</servlet-name>
    <servlet-class>myPackage.MyServlet</servlet-class>
    </servlet>
    ```
  - Give address (URL mapping) to servlet
    ```xml
    <servlet-mapping>
    <servlet-name>MyName</servlet-name>
    <url-pattern>/MyAddress</url-pattern>
    </servlet-mapping>
    ```

- **Resultant URL**
  - `http://hostname/webappName/MyAddress`
More Notes on Custom URLs

• Normal usage
  – `<url-pattern>/blah</url-pattern>`
    • Should start with /
  – Resultant URL
    • http://somehost/someApp/blah

• Option: can use wildcards for:
  – File extension (note: no / in this case)
    • `<url-pattern>*.asp</url-pattern>`
  – Directory (still start with /)
    • `<url-pattern>/dir1/dir2/*</url-pattern>`

• Order matters in web.xml version 2.3 (old!)
  – All servlet entries before any servlet-mapping entries

Disabling Invoker Servlet

• Default servlet URL:
  – http://host/webAppPrefix/servlet/ServletName

• Convenient during development, but wrong for deployment
  – Init parameters, security settings, filters, etc. are associated only with custom URLs
  – Default URL is long and cumbersome
  – You might want to hide implementation details

• Disabling it:
  – In each Web application, redirect requests to other servlet
    • `<servlet-mapping>`
      `<servlet-name>...</servlet-name>`
      `<url-pattern>/servlet/*</url-pattern>`
    `</servlet-mapping>`
  – Globally
    • Server-specific mechanism
Disabling Invoker Servlet: Example

```java
public class NoInvokerServlet extends HttpServlet {
    public void doGet(HttpServletRequest request, HttpServletResponse response) throws ServletException, IOException {
        ...  
        String title = "Invoker Servlet Disabled.";
        out.println(docType +
                "<HTML>
                <HEAD><TITLE>" + title + "</TITLE><HEAD>
                <BODY BGCOLOR="#FDF5E6">
                <H2>" + title + "</H2>
                "Sorry, access to servlets by means of URLs that begin with http://host/webAppPrefix/servlet/ has been disabled." +
                "</BODY></HTML>";
    }

    public void doPost(...) { // call doGet }
}
```

Disabling Invoker Servlet: Example (Continued)

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app...>
<!-- Disable the invoker servlet. -->
    <servlet>
        <servlet-name>NoInvoker</servlet-name>
        <servlet-class>
            coreservlets.NoInvokerServlet
        </servlet-class>
    </servlet>
    <servlet-mapping>
        <url-pattern>/servlet/*</url-pattern>
    </servlet-mapping>
</web-app>
```
Disabling Invoker Servlet: Example (Continued)

Failing to Define Custom URLs

• You should always use custom URLs on deployed projects
  – URLs look cleaner and simpler and shorter
  – URLs have more meaningful names
  – You don't expose possibly proprietary class file names
  – You can use web.xml to assign init params later
    • Does not work with …/servlet/myPackage.MyServlet
  – You can apply filters and security settings later (via web.xml) in a more predictable and controllable manner
  – Most importantly of all, you can avoid being added to Marty's "Hall of Shame"
    • The kiss of death for any self-respecting Java EE developer
The Hall of Shame (Deployed Sites with Ugly …/servlet/… URLs)

Init Params

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Who Needs to Customize Servlet Behavior?

- **Author**
  - Change the actual code

- **End user**
  - Supply value in HTML form

- **Deployer**
  - Put initialization values in `web.xml`

- **Parallels applet behavior**
  - Author changes the code
  - End user manipulates GUI controls
  - Deployer uses `PARAM` element inside `APPLET` element in the HTML file.

Types of Initialization

- **Servlets**
  - Call `ServletConfig.getInitParameter` from the `init` method

- **JSP pages**
  - Call `ServletConfig.getInitParameter` from the `jspInit` method. Use `jsp-file` instead of `servlet-class`.

- **Servlet context**
  - Call `ServletContext.getInitParameter`
  - What method to call this from? See lecture on listeners!

- **Filters**
  - See later lecture

- **Listeners**
  - See later lecture
Assigning Init Params: Problems with Invoker Servlet

<servlet>
  <servlet-name>InitTest</servlet-name>
  <servlet-class>moreservlets.InitServlet</servlet-class>
  <init-param>
    <param-name>firstName</param-name>
    <param-value>Larry</param-value>
  </init-param>
  <init-param>
    <param-name>emailAddress</param-name>
    <param-value>ellison@microsoft.com</param-value>
  </init-param>
</servlet>

<servlet-mapping>
  <servlet-name>InitTest</servlet-name>
  <url-pattern>/showInitValues</url-pattern>
</servlet-mapping>

Reading Servlet Initialization Parameters

public class InitServlet extends HttpServlet {
  private String firstName, emailAddress;

  public void init() {
    ServletConfig config = getServletConfig();
    firstName =
      config.getInitParameter("firstName");
    if (firstName == null) {
      firstName = "Missing first name";
    }
    emailAddress =
      config.getInitParameter("emailAddress");
    if (emailAddress == null) {
      emailAddress = "Missing email address";
    }
  }

  public void doGet(...) ... { ... }
}
Servlet Initialization Parameters: Successful Result

Init Parameters:

- First name: Lary
- Email address: ellison@microsoft.com

Servlet Initialization Parameters: Failed Result

Init Parameters:

- First name: Missing first name
- Email address: Missing email address

- One address works; one fails
- This is too hard to remember!
  - Disable invoker servlet, so there is only one address: the one that works!
Assigning JSP Initialization Parameters

```xml
<servlet>
  <servlet-name>InitPage</servlet-name>
  <jsp-file>/InitPage.jsp</jsp-file>
  <init-param>
    <param-name>firstName</param-name>
    <param-value>Bill</param-value>
  </init-param>
  <init-param>
    <param-name>emailAddress</param-name>
    <param-value>gates@oracle.com</param-value>
  </init-param>
</servlet>
```

Assigning JSP Initialization Parameters (Continued)

```xml
<servlet-mapping>
  <servlet-name>InitPage</servlet-name>
  <url-pattern>/InitPage.jsp</url-pattern>
</servlet-mapping>
```

- If you leave invoker turned on and have declaration on previous page:
  - Initialized JSP page could be accessed with `http://host/webAppPrefix/servlet/InitPage`. Yuck!
  - Assign URL back to original URL of JSP page instead.
Reading JSP Initialization Parameters

...  
<UL>
  <LI>First name: <%= firstName %>
  <LI>Email address: <%= emailAddress %>
</UL>
...

private String firstName, emailAddress;

public void jspInit() {
  ServletConfig config = getServletConfig();
  firstName = config.getInitParameter("firstName");
  if (firstName == null) { firstName = "No first name"; }
  emailAddress = config.getInitParameter("emailAddress");
  if (emailAddress == null) { emailAddress = "No email"; }
}
%

This results in ugly and hard-to-maintain JSP pages. Consider using MVC and never using direct init params in JSP.

JSP Initialization Parameters: Result

Init Parameters:

- First name: Bill
- Email address: gates@oracle.com
Assigning Application-Wide Initialization Parameters

- web.xml element: context-param
  ```xml
  <context-param>
    <param-name>support-email</param-name>
    <param-value>blackhole@mycompany.com</param-value>
  </context-param>
  ```
- Read with the getInitParameter method of ServletContext (not ServletConfig)
- Problem: who should call getInitParameter?
  - load-on-startup gives partial solution
  - Listeners give much better answer

Loading Servlets or JSP Pages When Server Starts

- What if servlet or JSP page defines data that other resources use?
  ```xml
  <servlet>
    <servlet-name>...</servlet-name>
    <servlet-class>...</servlet-class>
  </servlet>
  <load-on-startup>1</load-on-startup>
  ```
- You can also specify relative order of multiple preloaded resources
  ```xml
  <load-on-startup>1</load-on-startup>
  ...
  <load-on-startup>2</load-on-startup>
  ```
Welcome and Error Pages

Specifying Welcome Pages

- What result do you get for http://host/webAppPrefix/someDirectory/?
  - index.jsp?
  - index.html?
  - index.htm?
  - default.htm?
  - A 404 error?
  - A directory listing?
  - Answer: it depends on the server.

- Make at least the file ordering portable:

  ```xml
  <welcome-file-list>
  <welcome-file>index.jsp</welcome-file>
  <welcome-file>index.html</welcome-file>
  </welcome-file-list>
  ```
Designating Pages to Handle Errors

- Pages to use for specific HTTP status codes
  - Use the `error-code` element
    - Within `error-page`
- Pages to use when specific uncaught exceptions are thrown
  - Use the `exception-type` element
    - Within `error-page`
- Page-specific error pages
  - Use `<%@ page errorPage="Relative URL" %>`
    - In individual JSP page, not in `web.xml`

Error Pages and Status Codes

```xml
<web-app...>
  <error-page>
    <error-code>404</error-code>
    <location>/WEB-INF/NotFound.jsp</location>
  </error-page>
  ...
</web-app>
```
Error Pages and Status Codes: Result

A Dangerous Computation

```java
package moreServlets;

/** Exception used to flag particularly onerous programmer blunders. Used to illustrate the exception-type web.xml element. */

public class DumbDeveloperException extends Exception {
    public DumbDeveloperException() {
        super("Duh. What was I *thinking*?");
    }

    public static int dangerousComputation(int n) throws DumbDeveloperException {
        if (n < 5) {
            return(n + 10);
        } else {
            throw(new DumbDeveloperException());
        }
    }
}
```
A Risky Page

```html
<!DOCTYPE HTML PUBLIC
"-//W3C//DTD HTML 4.0 Transitional//EN">
<html>
<head><title>Risky JSP Page</title></head>
<body bgcolor="#FDF5E6">
<h2>Risky Calculations</h2>
<% @ page import="moreservlets.*" %>
<% int n = ((int)(10 * Math.random())); %>
<ul>
  <li>n: <%= n %></li>
  <li>dangerousComputation(n):
     <%= DumbDeveloperException.dangerousComputation(n) %></li>
</ul>
</body></html>
```

Declaring Error Page for DDE

```xml
<web-app...>
  <error-page>
    <exception-type>
      morejavax.servlets.DumbDeveloperException
    </exception-type>
    <location>/WEB-INF/DDE.jsp</location>
  </error-page>
  ...
</web-app>```
WEB-INF/DDE.jsp

<!DOCTYPE HTML PUBLIC
"-//W3C//DTD HTML 4.0 Transitional//EN">

<HTML>
<HEAD><TITLE>Dumb</TITLE></HEAD>

<BODY BGCOLOR="#FDF5E6">
<H2>Dumb Developer</H2>

We're brain dead. Consider using our competitors.
</BODY></HTML>

Error Pages and Exceptions: Results

Risky Calculations
- n: 4
- dangerousComputation(n): 14

Dumb Developer

We're brain dead. Consider using our competitors.
Other Capabilities

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Session Timeouts

- **You can explicitly deactivate sessions**
  - `session.invalidate()`
- **You can also set session timeout**
  - `session.setMaxInactiveInterval(...)`
- **You can set Web-app-wide default timeout**
  
  `<session-config>
  <session-timeout>
  time-in-minutes
  </session-timeout>
  </session-config>`
  
  - A value of 0 or negative number indicates that default sessions should never automatically time out
- **If no session-config**
  - Default session timeout is server-specific
Deactivating Scripting or Expression Language (2.4+ only)

- **Disabling scripting**
  - Used when you want to enforce pure-MVC approach
    ```xml
    <jsp-property-group>
    <url-pattern>*.jsp</url-pattern>
    <scripting-invalid>true</scripting-invalid>
    </jsp-property-group>
    
- **Disabling Expression Language**
  - Used when you have JSP 1.2 pages that might accidentally contain `{$blah}`. Note that EL is disabled automatically if you use version 2.3 of web.xml.
    ```xml
    <jsp-property-group>
    <url-pattern>*.jsp</url-pattern>
    <el-ignored>true</el-ignored>
    </jsp-property-group>
    
Other web.xml Capabilities

- **Documenting Web app**
  - icon, display-name, description
- **Mapping files to MIME types**
  - mime-mapping
- **Allowing execution on multiple systems in cluster**
  - distributable
- **Setting encodings for groups of pages (2.4 only)**
  - page-encoding within jsp-property-group
- **Implicit includes (2.4 only)**
  - include-prelude, include-coda within jsp-property-group
    - Includes files at beginning/end of each of set of JSP pages
- **More that we'll see later in the course**
  - Designating security settings
  - Declaring filters
  - Setting up listeners
  - Specifying tag library validators
Summary

- **URLs**
  - servlet (servlet-class, servlet-name, load-on-startup)
  - servlet-mapping (servlet-name, url-pattern)
- **Init parameters**
  - init-param
- **Welcome pages**
  - welcome-file-list
- **Error pages**
  - error-page (error-code, exception-type)
- **Default session timeouts**
  - session-config (session-timeout)
- **Disabling scripting or EL**
  - jsp-property-group
    - (url-pattern, scripting-invalid/el-ignored)

Questions?

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