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Controlling the Structure of Generated Servlets: The JSP page Directive

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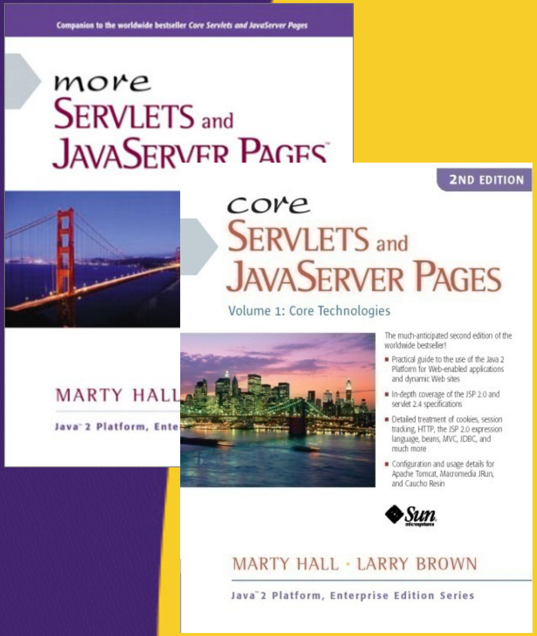
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Agenda

- Understanding the purpose of the page directive
- Designating which classes are imported
- Specifying the MIME type of the page
- Generating Excel spreadsheets
- Participating in sessions
- Setting the size and behavior of the output buffer
- Designating pages to handle JSP errors
- Controlling threading behavior

Purpose of the page Directive

- **Give high-level information about the servlet that will result from the JSP page**
- **Can control**
  - Which classes are imported
  - What class the servlet extends
  - What MIME type is generated
  - How multithreading is handled
  - If the servlet participates in sessions
  - The size and behavior of the output buffer
  - What page handles unexpected errors

The import Attribute

- **Format**
  - <%@ page import="package.class" %>
  - <%@ page import="package.class1,...,package.classN" %>
- **Purpose**
  - Generate import statements at top of servlet definition
- **Notes**
  - Although JSP pages can be almost anywhere on server, classes used by JSP pages must be in normal servlet dirs
  - E.g.:
    .../WEB-INF/classes or
    .../WEB-INF/classes/*directoryMatchingPackage*
    - *Always* use packages for utilities that will be used by JSP!

The Importance of Using Packages

- **What package will the system think that SomeHelperClass and SomeUtilityClass are in?**

```
...
public class SomeClass {
  public String someMethod(...) {
    SomeHelperClass test = new SomeHelperClass(...);
    String someString =
      SomeUtilityClass.someStaticMethod(...);
    ...
  }
}
```

The Importance of Using Packages (Continued)

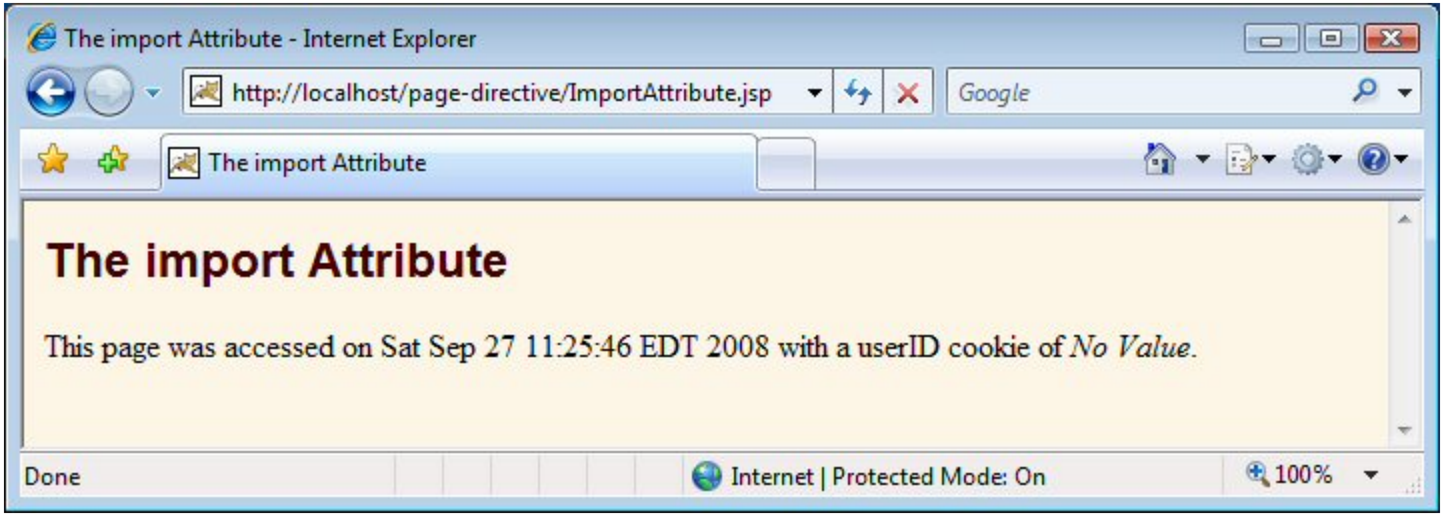
- **What package will the system think that SomeHelperClass and SomeUtilityClass are in?**

```
...
<%
  SomeHelperClass test = new SomeHelperClass(...);
  String someString =
    SomeUtilityClass.someStaticMethod(...);
%>
```

The import Attribute: Example (Code)

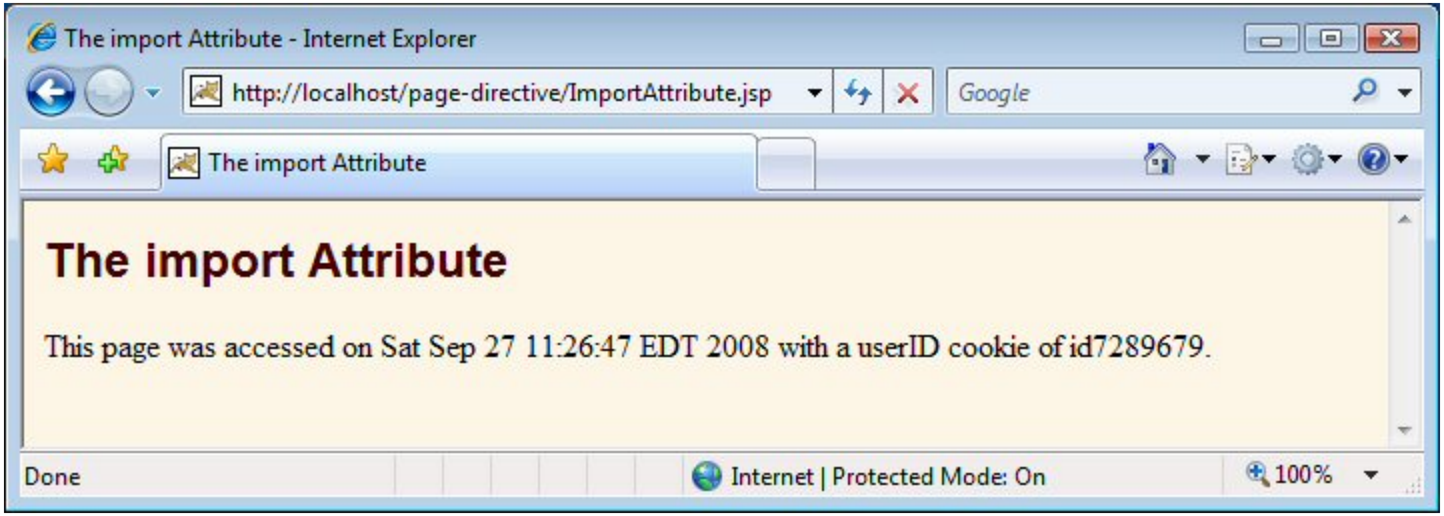
```
…<H2>The import Attribute</H2>
<%@ page import="java.util.*,coreservlets.*" %>
<%!
private String randomID() {
  int num = (int)(Math.random()*10000000.0);
  return("id" + num);
}
private final String NO_VALUE = "<I>No Value</I>";
%>
<%
String oldID =
  CookieUtilities.getCookieValue(request, "userID",
                                 NO_VALUE);
if (oldID.equals(NO_VALUE)) {
  String newID = randomID();
  Cookie cookie = new LongLivedCookie("userID", newID);
  response.addCookie(cookie);
}
%>
This page was accessed on <%= new Date() %> with a userID
cookie of <%= oldID %>.
</BODY></HTML>
```

The import Attribute: Example (Results)


The import Attribute - Internet Explorer
http://localhost/page-directive/ImportAttribute.jsp
Google
The import Attribute
Done
Internet | Protected Mode: On
100%

The import Attribute

This page was accessed on Sat Sep 27 11:25:46 EDT 2008 with a userID cookie of *No Value*.


The import Attribute - Internet Explorer
http://localhost/page-directive/ImportAttribute.jsp
Google
The import Attribute
Done
Internet | Protected Mode: On
100%

The import Attribute

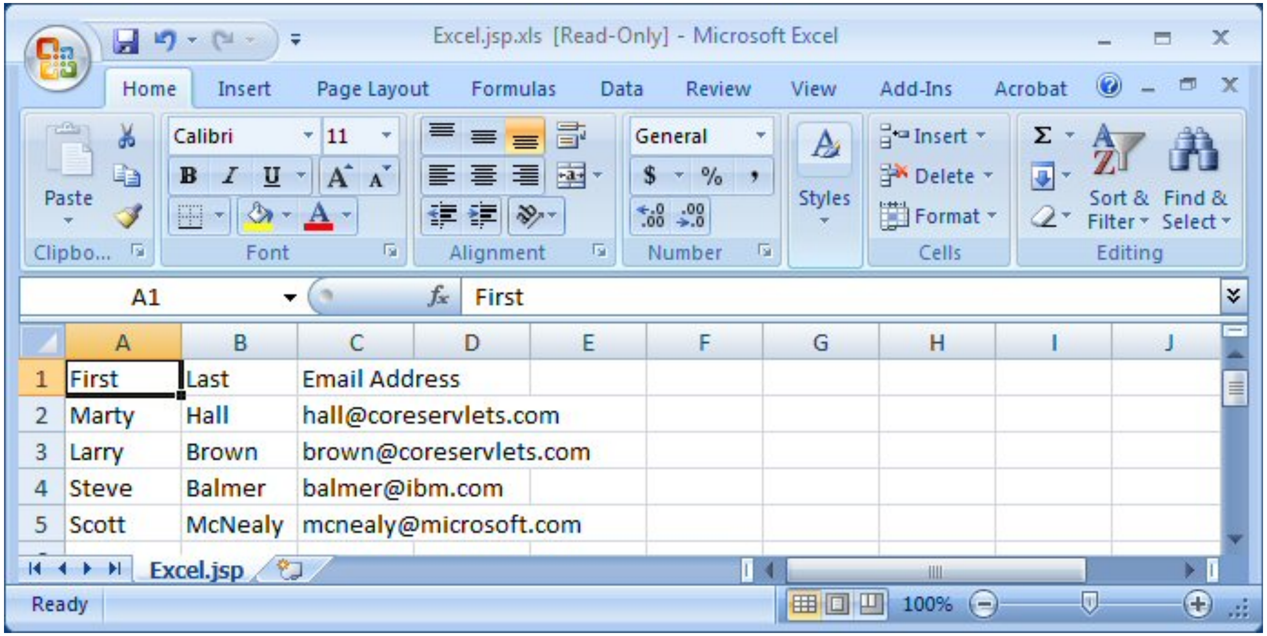
This page was accessed on Sat Sep 27 11:26:47 EDT 2008 with a userID cookie of id7289679.

The contentType and pageEncoding Attributes

- **Format**
  - <%@ page contentType="MIME-Type" %>
  - <%@ page contentType="MIME-Type; charset=Character-Set" %>
  - <%@ page pageEncoding="Character-Set" %>
- **Purpose**
  - Specify the MIME type of the page generated by the servlet that results from the JSP page
- **Notes**
  - Attribute value cannot be computed at request time
  - See section on response headers for table of the most common MIME types

Generating Excel Spreadsheets

```
First   Last    Email Address
Marty   Hall    hall@coreservlets.com
Larry   Brown   brown@coreservlets.com
Steve   Balmer  balmer@ibm.com
Scott   McNealy mcnealy@microsoft.com
<%@ page contentType="application/vnd.ms-excel" %>
<%-- There are tabs, not spaces, between cols. --%>
```



	A	B	C	D	E	F	G	H	I	J
1	First	Last	Email Address							
2	Marty	Hall	hall@coreservlets.com							
3	Larry	Brown	brown@coreservlets.com							
4	Steve	Balmer	balmer@ibm.com							
5	Scott	McNealy	mcnealy@microsoft.com							

Conditionally Generating Excel Spreadsheets

- **You cannot use the contentType attribute for this task, since you cannot make contentType be conditional.**
  - The following *always* results in the Excel MIME type

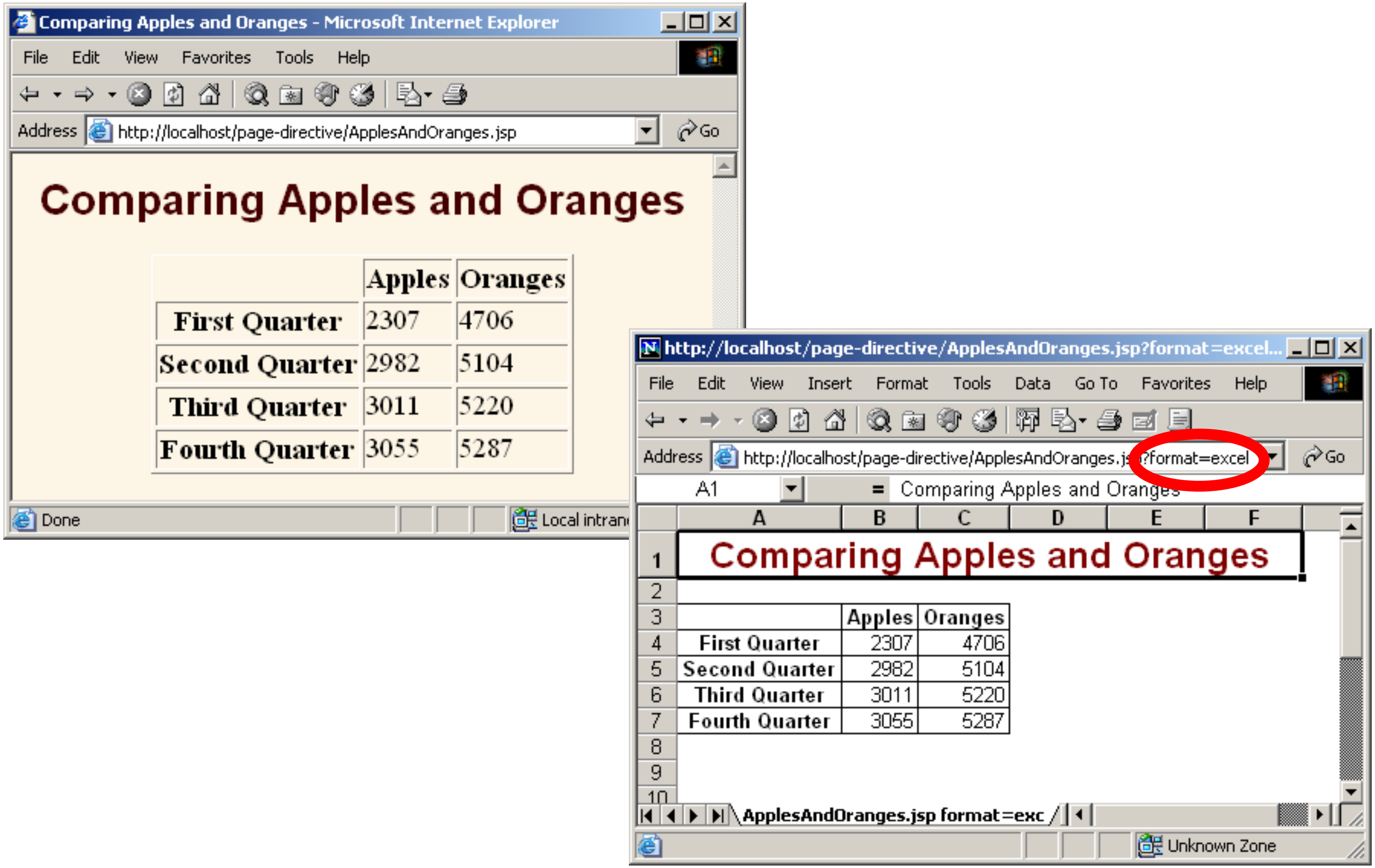
```
<% boolean usingExcel = checkUserRequest(request); %>
<% if (usingExcel) { %>
<%@ page contentType="application/vnd.ms-excel" %>
<% } %>
```

- **Solution: use a regular JSP scriptlet with response.setContentType**

Conditionally Generating Excel Spreadsheets (Code)

```
…
<BODY>
<CENTER>
<H2>Comparing Apples and Oranges</H2>
<%
String format = request.getParameter("format");
if ((format != null) && (format.equals("excel"))) {
  response.setContentType("application/vnd.ms-excel");
}
%>
<TABLE BORDER=1>
  <TR><TH></TH>         <TH>Apples<TH>Oranges
  <TR><TH>First Quarter <TD>2307  <TD>4706
  <TR><TH>Second Quarter<TD>2982  <TD>5104
  <TR><TH>Third Quarter <TD>3011  <TD>5220
  <TR><TH>Fourth Quarter<TD>3055  <TD>5287
</TABLE>
</CENTER></BODY></HTML>
```

Conditionally Generating Excel Spreadsheets (Results)



Comparing Apples and Oranges - Microsoft Internet Explorer

Address: http://localhost/page-directive/ApplesAndOranges.jsp

Comparing Apples and Oranges

	Apples	Oranges
First Quarter	2307	4706
Second Quarter	2982	5104
Third Quarter	3011	5220
Fourth Quarter	3055	5287

http://localhost/page-directive/ApplesAndOranges.jsp?format=excel...

Address: http://localhost/page-directive/ApplesAndOranges.jsp?format=excel

A1 = Comparing Apples and Oranges

	A	B	C	D	E	F
1	Comparing Apples and Oranges					
2						
3		Apples	Oranges			
4	First Quarter	2307	4706			
5	Second Quarter	2982	5104			
6	Third Quarter	3011	5220			
7	Fourth Quarter	3055	5287			
8						
9						
10						

ApplesAndOranges.jsp format=exc

The session Attribute

- **Format**
  - <%@ page session="true" %> <%-- Default --%>
  - <%@ page session="false" %>
- **Purpose**
  - To designate that page not be part of a session
- **Notes**
  - By default, it is part of a session
  - Saves memory on server if you have a high-traffic site
  - *All* related pages have to do this for it to be useful

The isELIgnored Attribute

- **Format**
  - <%@ page isELIgnored="false" %>
  - <%@ page isELIgnored="true" %>
- **Purpose**
  - To control whether the JSP 2.0 Expression Language (EL) is ignored (true) or evaluated normally (false).
- **Notes**
  - If your web.xml specifies servlets 2.3 (corresponding to JSP 1.2) or earlier, the default is true
    - But it is still legal to change the default—you are permitted to use this attribute in a JSP-2.0-compliant server regardless of the web.xml version.
  - If your web.xml specifies servlets 2.4 (corresponding to JSP 2.0) or earlier, the default is false

The buffer Attribute

- **Format**
  - <%@ page buffer="*size*kb" %>
  - <%@ page buffer="none" %>
- **Purpose**
  - To give the size of the buffer used by the out variable
- **Notes**
  - Buffering lets you set HTTP headers even after some page content has been generated (as long as buffer has not filled up or been explicitly flushed)
  - Servers are allowed to use a larger size than you ask for, but not a smaller size
  - Default is system-specific, but must be at least 8kb

The errorPage Attribute

- **Format**
  - <%@ page errorPage="Relative URL" %>
- **Purpose**
  - Specifies a JSP page that should process any exceptions thrown but not caught in the current page
- **Notes**
  - The exception thrown will be automatically available to the designated error page by means of the "exception" variable
  - The web.xml file lets you specify *application-wide* error pages that apply whenever certain exceptions or certain HTTP status codes result.
    - The errorPage attribute is for *page-specific* error pages

The isErrorPage Attribute

- **Format**
  - <%@ page isErrorPage="true" %>
  - <%@ page isErrorPage="false" %> <%-- Default --%>
- **Purpose**
  - Indicates whether or not the current page can act as the error page for another JSP page
- **Notes**
  - A new predefined variable called exception is created and accessible from error pages
  - Use this for emergency backup only; explicitly handle as many exceptions as possible
    - Don't forget to always check query data for missing or malformed values

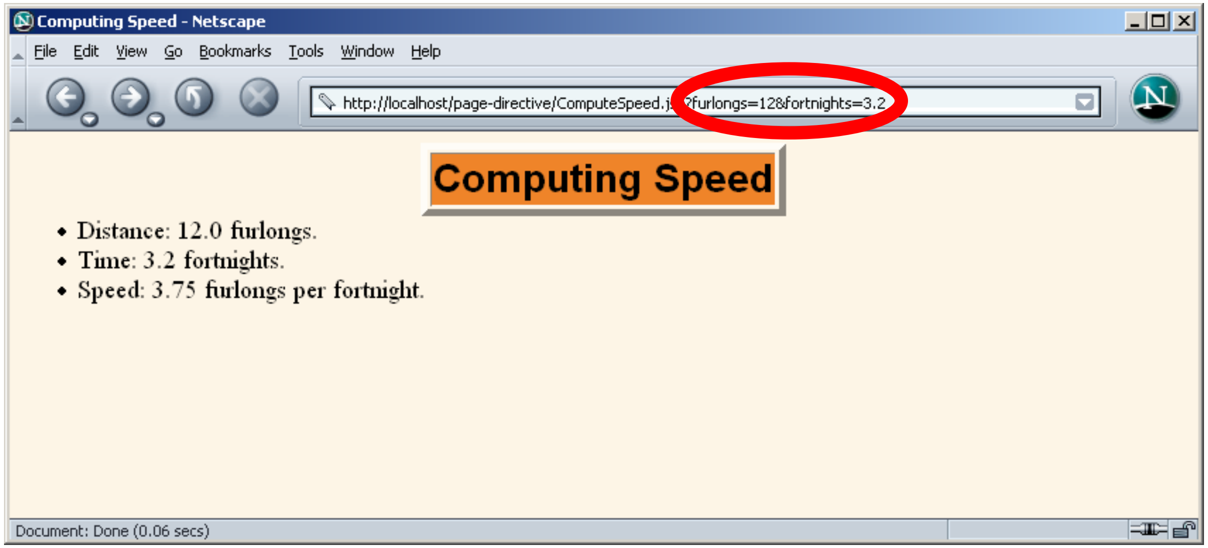
Error Pages: Example

```
…<BODY>
<%@ page errorPage="/WEB-INF/SpeedErrors.jsp" %>
<TABLE BORDER=5 ALIGN="CENTER">
  <TR><TH CLASS="TITLE">Computing Speed</TABLE>
<%!
private double toDouble(String value) {
  return(Double.parseDouble(value));
}
%>
<%
double furlongs = toDouble(request.getParameter("furlongs"));
double fortnights =
   toDouble(request.getParameter("fortnights"));
double speed = furlongs/fortnights;
%>
<UL>
  <LI>Distance: <%= furlongs %> furlongs.
  <LI>Time: <%= fortnights %> fortnights.
  <LI>Speed: <%= speed %> furlongs per fortnight.
</UL>
</BODY></HTML>
```

Error Pages: Example (Continued)

```
…<BODY>
<%@ page isErrorPage="true" %>
<TABLE BORDER=5 ALIGN="CENTER">
  <TR><TH CLASS="TITLE">
      Error Computing Speed</TABLE>
<P>
ComputeSpeed.jsp reported the following error:
<I><%= exception %></I>. This problem occurred in the
following place:
<PRE>
<%@ page import="java.io.*" %>
<% exception.printStackTrace(new PrintWriter(out)); %>
</PRE>
</BODY></HTML>
```

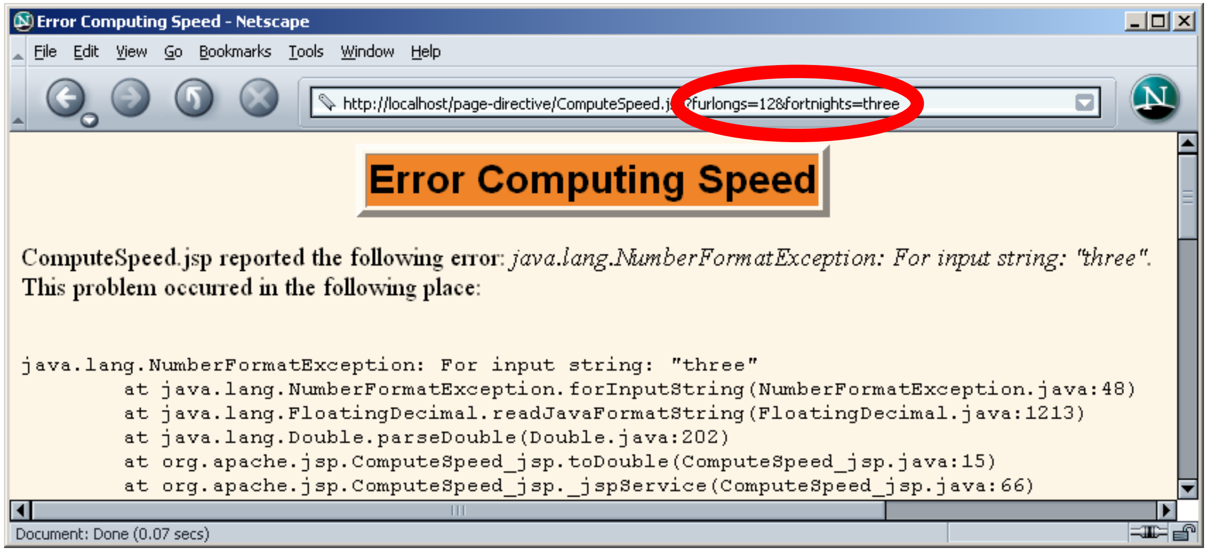
Error Pages: Results



http://localhost/page-directive/ComputeSpeed.j?furlongs=12&fortnights=3.2

Computing Speed

- Distance: 12.0 furlongs.
- Time: 3.2 fortnights.
- Speed: 3.75 furlongs per fortnight.



http://localhost/page-directive/ComputeSpeed.j?furlongs=12&fortnights=three

Error Computing Speed

ComputeSpeed.jsp reported the following error: *java.lang.NumberFormatException: For input string: "three"*. This problem occurred in the following place:

```
java.lang.NumberFormatException: For input string: "three"
	at java.lang.NumberFormatException.forInputString(NumberFormatException.java:48)
	at java.lang.FloatingDecimal.readJavaFormatString(FloatingDecimal.java:1213)
	at java.lang.Double.parseDouble(Double.java:202)
	at org.apache.jsp.ComputeSpeed_jsp.toDouble(ComputeSpeed_jsp.java:15)
	at org.apache.jsp.ComputeSpeed_jsp._jspService(ComputeSpeed_jsp.java:66)
```

The extends Attribute

- **Format**
  - <%@ page extends="package.class" %>
- **Purpose**
  - To specify parent class of servlet that will result from JSP page
- **Notes**
  - Use with extreme caution
  - Can prevent system from using high-performance custom superclasses
  - Typical purpose is to let you extend classes *that come from the server vendor* (e.g., to support personalization features), not to extend your own classes.

The isThreadSafe Attribute

- **Format**
  - <%@ page isThreadSafe="true" %> <%-- Default --%>
  - <%@ page isThreadSafe="false" %>
- **Purpose**
  - To tell the system when your code is not threadsafe, so that the system can prevent concurrent access
    - Normally tells the servlet to implement SingleThreadModel
- **Notes**
  - Avoid this like the plague
    - Causes degraded performance in some situations
    - Causes incorrect results in others

Example of Non-Threadsafe Code (IDs Must Be Unique)

- What's wrong with this code?

```
<%! private int idNum = 0; %>
<%
String userID = "userID" + idNum;
out.println("Your ID is " + userID + ".");
idNum = idNum + 1;
%>
```

Is isThreadSafe Needed Here?

- No! It is not needed. Synchronize normally:

```
<%! private int idNum = 0; %>
<%
synchronized(this) {
  String userID = "userID" + idNum;
  out.println("Your ID is " + userID + ".");
  idNum = idNum + 1;
}
%>
```

- Better performance in high-traffic environments
- `isThreadSafe="false"` will totally fail if server uses pool-of-instances approach

Summary

- **Used frequently**
  - import
    - Changes the packages imported by the servlet that results from the JSP page
      - *Always* use packages for utility classes!
  - contentType
    - Specifies MIME type of result
    - Cannot be used conditionally (use <% response.setContentType(...) %> for that)
- **Used moderately**
  - isELIgnored, session, buffer
- **Used occasionally**
  - errorPage/isErrorpage
  - extends
- **Avoid like the plague**
  - isThreadSafe
    - Always use explicit synchronization instead

Questions?