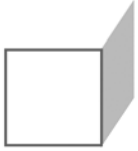




CHAPTER 2
THE CORE ACTIONS



OBJECTIVES

After completing “The Core Actions,” you will be able to:

- Describe the purpose and role of the JSTL core library in JSP coding.
- Use core actions to complement standard actions, custom actions, and JSP expressions for seamless, script-free page logic.
 - Produce dynamic output based on JSP expressions.
 - Find or instantiate objects at various scopes, and set their values.
 - Direct conditional processing of page content based on dynamic tests.
 - Direct iterative processing of page content by looping through ranges of numbers, over elements in a collection, or over tokens in a master string.
 - Import external resources by URL for processing, or redirect the JSP container to an external resource to handle the current request.

The JSTL Core Library

- The most basic of the four libraries in the JSTL, the **core** library includes actions to perform some very simple tasks:
 - **Produce output** to the response stream
 - **Export variables** (objects) at various scopes, and set their values to static content or JSP expressions
 - Direct processing flow through **conditionals and loops**
 - **Import external resources** for use in page processing
 - **Redirect** processing to another page or resource
- In a page that uses any of the core tags, be sure to include the **taglib** directive that makes the library visible.

```
<%@ taglib prefix="c"  
    uri="http://java.sun.com/jsp/jstl/core" %>
```

- Again, the choice of prefix is the developer's; we will be adhering to the conventional prefixes in this module, and so we use **c:** for core actions.

A New Tool

- The core actions fill in some critical gaps between other JSP programming techniques.
- JSP expressions are wonderfully simple and offer a way to include dynamic content in a page without a lot of coding.
 - They can only read values, not write them.
- Standard actions have the advantages of the XML-like JSP action syntax, and they offer a simple interface to JavaBeans.
 - They can only work with beans, however.
 - Also they have no way of referencing indexed properties.
- JSTL core actions offer a simple way to work with objects of all types.
 - JSTs can manage primitive types as well as JavaBeans; primitives are represented as “boxed” objects of types such as **Integer** or **Float**.
 - JSTs can work with and also with indexed properties and collections: list/vector/array structures as well as key/value maps.

Documenting Standard Tags

- In this module, we'll document each of the standard tags by a standard notation, for easy reference.

```
<prefix:action  
  attribute1 = "dynamic | static"  
  requiredAttribute = "dynamic | static"  
  ...  
  attributeN = "dynamic | static"  
>
```

- Each attribute is shown.
 - The value **"dynamic"** will indicate that the attribute value can include JSP expressions; **"static"** indicates that it cannot.
 - **Required attributes** are underlined.
 - Notes and discussion of the behavior of the action occupy the rest of the page.
 - Sometimes no one attribute is required, but there are more complex constraints that dictate that one of a set must be used. These sorts of constraints escape this notation, but can be stated in the notes and discussion.
- **The summary notation will also indicate whether the tag can or must have body content.**
 - The template shown above is for an empty element.
 - If body content is possible (or mandatory), a short description will be included as the body of the summary tag, and a separate end tag will be shown.

<c:out>

```
<c:out
  value = "dynamic"
  default = "dynamic"
  escapeXml = "dynamic"
>
  default value
</c:out>
```

- The `<c:out>` action produces output to the response stream.
 - The **value** attribute defines the desired output, whether static or JSP expression content.
 - If the value is an expression that evaluates to **null**, then the default value is produced instead.
 - If the tag has a body, it provides the default value.
- In a JSP 2.0 container, the value expression alone would accomplish just about the same thing as using `<c:out>`.
 - This tag is handy when a page might need to function in either a **JSP 1.x or JSP 2.0 container**.
 - It is also good practice to use `<c:out>` when producing values derived directly from user input.
 - `<c:out>` automatically performs **output escaping**, which means that it can't generate HTML markup.
 - This feature guards against **cross-site scripting (XSS)** attacks.

<c:set>

```
<c:set
  var = "static"
  value = "dynamic"
  target = "dynamic"
  property = "dynamic"
  scope = "static"
>
  value
</c:set>
```

- This action finds or instantiates an object and sets its value.
- There are two distinct ways of invoking this action:
 - Identifying an object to set with the **var** attribute.

```
<c:set var="found" value="${true}" />
```

- Identifying an object **target** on which to set a specific **property**.

```
<c:set target="${team}" property="goalie"
  value="Rejean Lemelin" />
```

- In either case, the **value** attribute (or the body content) provide the value to set.
- In either case, the **scope** attribute qualifies the assignment target: either **var** or **target** must be found or instantiated under this scope.

Setting Properties

- In the **target/property** usage, the two attributes are evaluated in a way similar to the evaluation of a JSP expression **target.property**:
 - If **target** is a map, then **property** is treated as a key value in that map, and the corresponding value is set to **value**.
 - If the key does not exist, a new pair is added to the map: key=**property**, value=**value**.
 - If the key exists but the provided **value** is null, then the key is removed from the map.
 - If the **target** is not a map, then it is treated as a JavaBean and a mutator for **property** is sought under Beans naming conventions
 - that is, the action behaves very much like `<jsp:setProperty>`.
- Note that scalar collections – lists, vectors, arrays, etc. – are left out of this usage entirely.
 - That is, **property** will not be evaluated as a numeric index for a scalar collection type. If it were, one could use this action to set the Nth element of a collection to a new value.
 - Generally speaking, non-map collections are not addressed effectively by JSTL. JSP expressions do read such collections easily, but modifying collections is not well supported by standard actions or by JSTL.

Gotchas

- Note that both of these attributes accept EL expressions.
- This is a good thing, but a bit counterintuitive in the case of **target**.
 - You must use an EL expression to indicate the target object.
 - Otherwise, the expression will resolve to a string! You must provide a value for **target** that resolves to an object reference.
 - This is in contrast to the **var** attribute; **var** creates an object, where **target** references something that already exists.
 - Thus the first expression below will work but the second will not:

```
<c:set var="myNumber" value="5" />  
<c:set target="myMap" property="five" value="5" />
```

- Correct is:

```
<c:set target="{myMap}" property="five"  
value="5" />
```

- There are various other examples of this throughout JSTL.
 - Each one makes sense when studied carefully, but does not make for intuitive usage.

<c:remove>

```
<c:remove
  var = "static"
  scope = "static"
/>
```

- This action removes a object at a given scope.
- Beyond good citizenship in cleaning up unneeded objects at session and application scopes, this action has a couple of common uses:
 - An object might indicate a state by its **absence or presence**. That is, instead of a separate boolean object such as “filteringEnabled”, one might rely on the presence of a “filter” object to indicate enabled and its absence to indicated a disabled state.
 - An object might be useful for some quick process but then be **hiding** a higher-scope object that needs to be used in a JSP expression. For instance, the output of the following code will be as desired only with the `<c:remove>` action as shown:

```
<c:set var="x" value="what we want"
      scope="session" />
<c:set var="x" >what we don't want</c:set>
<c:remove var="x" />
<c:out value="${x}" />
```

Flow Control Actions

- The core library offers two ways of conditionally processing JSP content:
 - The `<c:if>` action controls processing of its body content by a single **test** attribute. This is a “yes or no” evaluation; there is no “if/else” construct.
 - The `<c:choose>` action provides “if/else” and “switch/case” logic, by including one or more `<c:when>` blocks and a single `<c:otherwise>` that functions as the “else” or “default” choice.
- It also provides two actions for creating loops over JSP content:
 - `<c:forEach>` allows looping over a range of numeric values or over a collection object.
 - `<c:forTokens>` will iterate over every token in a master string based on provided delimiters. This would be a specialty function in most languages, but it’s a natural basic function in JSP, where string processing and tokenizing is such common stuff.

<c:if>

```

<c:if
  test = "dynamic"
  var = "static"
  scope = "static"
>
  body content to process if test is true
</c:if>

```

- This action processes the tag body if the **test** condition evaluates to a boolean **true**.
 - The optional **var** and **scope** attributes identify a boolean object whose value will be set to the value of the test expression.
 - Either the target **var** or the body content to process, or both, may be included.
- The **test** attribute is another tricky one, like **target** on **<c:set>**.
 - That is, since only JSP expressions as the value of the **test** attribute make any intuitive sense, it's easy to forget the **#{}** characters in the test expression.

```

<c:if test="param.choice = 'Retry'" >
  You chose to retry the connection.
</c:if>

```

- This will always fail, since the literal string doesn't convert to boolean **true**. The correct usage is:

```

<c:if test="{param.choice = 'Retry'}" > ...

```

Filtering

EXAMPLE

- In **Examples\LevelsBlind\Step1**, the code in **Tags\LevelsBlind\filter.tag** tests a given member against the query criteria:

```
<c:if test="{sex == param.sex &&
    age + 4 > param.age && age - 4 < param.age}">
    ...
</c:if>
```

- We'll see this code in action in a later example, as it combines with looping actions to complete the filtering action.

<c:choose> and Related Tags

```

<c:choose>
  <c:when test = "dynamic" > <!-- 1 Mandatory -->
    possible content
  </c:when>
  <c:when test = "dynamic" > <!-- 2-N Optional -->
    possible content
  </c:when>
  <c:otherwise>default content</c:otherwise>
  <!-- Optional -->
</c:choose>

```

- <c:choose> serves to organize invocations of two other actions, <c:when> and <c:otherwise>.
- <c:choose> may only contain these tags.
 - There must be a <c:when>; there may be more than one.
 - There may be a <c:otherwise>, but only one.
 - Neither of these two tags can be used legally except as the direct child of a <c:choose>.
- The handler will process the <c:when> actions in sequence, and will process the content of the first one whose test expression evaluates to **true**.
 - Successive <c:when> actions will be ignored after a hit.
 - If present, the <c:otherwise> content will be processed only if none of the <c:when> tests is successful.

Odd or Even

EXAMPLE

- In **Examples\OddEven\choose**, the JSP shown in the previous chapter has been rewritten slightly to use the `<c:choose>` construct instead of a pair of `<c:if>`s.

```

${param["number"]} is
<c:choose>
  <c:when test="${param['number'] % 2 == 0}">
    even.
    <c:set var="totalEven" scope="session"
      value="${totalEven + 1}" />
  </c:when>
  <c:otherwise>
    odd.
    <c:set var="totalOdd" scope="session"
      value="${totalOdd + 1}" />
  </c:otherwise>
</c:choose>

```

- In this case, the switch saves a certain amount of trouble in writing two mutually exclusive test expressions.
 - Another advantage of choose/when/otherwise over two unrelated tests is seen when there is a range of possible values, only one of which should produce a certain result.
 - A closely related case is when there are only two legal values, but the tested input has yet to be validated; the `<c:otherwise>` will catch unexpected values and assure that one of two possible behaviors always obtains.
- We'll defer testing of this JSP, too, since it includes other exemplary code that we'll see later in this chapter.

<c:forEach>

```
<c:forEach
  items = "dynamic"
  begin = "dynamic"
  end = "dynamic"
  step = "dynamic"
  var = "static"
  varStatus = "static"
>
  content to process zero-to-many times
</c:forEach>
```

- This action effects a loop based on some combination of criteria as provided by attribute values.
 - **begin**, **end**, and **step** attributes, if present, will control the number of times the loop content is processed. **varStatus** will be provided to body content to describe the loop status.
 - **items** identifies a collection over which the loop will iterate. **var** will be provided to body content and will hold the current element in the collection.
 - Both **var** and **varStatus** have nested scope.
 - Either of these usages is viable independent of the other; they can also be combined, with the **begin** and **end** attributes setting boundaries and put to use as indices to the collection.
 - Also note that **varStatus** is viable in the absence of the **begin** and **end** attributes.
- Note that **items** is another in that category of attributes whose value is obviously dynamic ... and therefore dangerous. Don't forget the `#{ }`!

Using `<c:forEach>`

- Thus there are many common usages of the `<c:forEach>` action:
 - A traditional “for loop” to process content some number of times in a row:

```
<c:forEach begin="1" end="10" >...
```

- A simple “for-each loop” to iterate over a list of objects:

```
<c:forEach var="element" items="{myList}" >...
```

- A bounded iteration over a collection – say, to process the third through fifth elements:

```
<c:forEach var="each" items="{list}"  
begin="2" end="4" >...
```

The LoopTagStatus Interface

- The **varStatus** attribute provides information about the status of a loop in progress.
- It is of type **LoopTagStatus**, which (like all JSTL support interfaces) is JavaBeans-compliant. Properties are:

```
current : Object
index   : int
count   : int
first   : boolean
last    : boolean
begin   : int
end     : int
step    : int
```

- Many of these attributes reflect values provided to the loop action: **begin**, **end**, and **step**.
- The **current** property is just the object that would be referenced by the **var** object, if it were defined.
- The remaining attributes are the most commonly used, typically to modify the behavior of the body logic at the beginning and/or ending of an iteration:

```
<c:forEach var="word" items="${list}"
  varStatus="status" >
  ${var}
  <c:if test="${!varStatus.last}" >, and</c:if>
</c:forEach>
```

Iterating Over Maps

- The `<c:forEach>` action can iterate over scalar collections and also over maps.
 - In the first case, the **var** object will be the element in the collection, referenced directly.
 - In the case of a map, there are two objects that must be available through **var**: the key and the value.
 - Thus for maps **var** is of type **Map.Entry**, which offers properties for each of the two:

```
key : Object  
value : Object
```

- Thus iterating over a map is slightly different:

```
<c:forEach var="pair" items="param" >  
  <li>${pair.key} = ${pair.value}</li>  
</c:forEach>
```

<c:forTokens>

```
<c:forTokens
  items = "dynamic"
  delims = "dynamic"
  begin = "dynamic"
  end = "dynamic"
  step = "dynamic"
  var = "static"
  varStatus = "static"
>
  content to process zero-to-many times
</c:forTokens>
```

- This action is dedicated to looping over tokens parsed from a master string.
 - Thus the **items** attribute is required here; there is no point in using this action to implement a “for loop” over a range of numbers, since **<c:forEach>** will do that just as well.
 - The **delims** attribute is also required: each character in the value of this attribute will be treated as a delimiter for string tokenizing.
 - As in **<c:forEach>**, the **var** attribute defines a nested-scope variable; here, however, it is always of type **String**.

Love Is Blind

EXAMPLE

- Let's take a closer look at the filtering logic in **Examples\LevelsBlind\Step1**.
 - We'll see several flow-control actions used in concert to test a given member against the stated query criteria.
 - The page will be seen to implement the following algorithm:

```
if sex = parameter "sex",
and age is within 3 years inclusive
of parameter "age", then:
{
loop over all words in the parameter "interests"
{
loop over all words in the member's interests
{
test for a match
}
}
if there was a match, then this member qualifies.
}
```

Love Is Blind

EXAMPLE

- This algorithm is implemented in `Tags\LoveIsBlind\filter.tag`:

```

<%@ taglib prefix="c"
      uri="http://java.sun.com/jsp/jstl/core" %>
<%@ taglib prefix="pres"
      tagdir="/WEB-INF/tags/LoveIsBlind/Table" %>

<c:if test="{sex == param.sex &&
  age + 4 > param.age && age - 4 < param.age}">
  <c:set var="match" value="false" />
  <c:forTokens var="ask" items="{param.interests}"
    delims=" " >
    <c:forTokens var="bid" items="{interests}"
      delims=" " >
      <c:if test="{ask == bid}">
        <c:set var="match" value="true" />
      </c:if>
    </c:forTokens>
  </c:forTokens>
  <c:if test="{match}" >
    <pres:member name="{name}"
      pseudonym="{pseudonym}" age="{age}"
      sex="{sex}" interests="{interests}" />
  </c:if>
</c:if>

```

Love Is Blind

EXAMPLE

- Test this example as follows:
 - Run the **update** script in the example directory. The **CC_MODULE** variable will be called into play now, as this script will copy **filter.tag** and other tag files to the module's **WEB-INF\tags** directory so that the server can find them.
 - Start a web browser and navigate to the following URL:

http://localhost:8080/JSTL/Examples/LoveIsBlind/Step1

Love Is Blind — Query

Please enter desired characteristics below, and then click the **Query** button.

Sex: Male Female

Age:

Interests:

- Enter query criteria as shown above and click **Query**.
- The filter logic picks just two of the six listed members of the service, and these are listed in the table in **Results.jsp**:

<u>Name</u>	<u>Nickname</u>	<u>Age</u>	<u>Sex</u>	<u>Interests</u>
Alicia Grundel	Alicia	27	Female	music, painting, and theatre
Roberta Doss	Roberta	30	Female	cooking, wine, and theatre

Error Handling

- JSP error handling relies primarily on the **page** directive to specify an error page.
 - This will be served in lieu of the requested page if an exception is thrown during page processing.
- **This mechanism is coarse-grained, and for many purposes too “willing to fail.”**
 - The general attitude toward web page service is that it should be as error-tolerant as possible, providing page content if it can be managed, even if pieces are missing or incorrect due to errors, unavailable resources, etc.
 - Error pages don't fit all that well with this approach.

<c:catch>

```
<c:catch var = "static" >  
  content including actions that throw exceptions  
</c:catch>
```

- The `<c:catch>` action offers a means of error handling that is
 - Fine-grained
 - Able to recover from so-called “secondary processing” errors – that is, errors that should not compromise service of the requested page, even if some content will be missing or incorrect.
- Enclose a passage of JSP code that might produce exceptions – but whose success is not absolutely critical to page service – in a `<c:catch>` action.
 - The action will catch any exceptions that are thrown, preventing them from propagating to the JSP container.
 - Page processing can continue from the end tag of the catch action.
 - There is no “catch block” or “finally block” in which the author can include contingent actions – the error is always quietly discarded.
 - An object **var** can be exported – this will reference the exception that was caught, or will be **null** on success.
 - Successive code in the page can reference this object, and report it to the user or take other actions.

Buffering with `<c:set>`

- `<c:catch>` will not recover any response output created before an exception was thrown.
- That is, it is not **transactional**, but merely a robust way to keep page processing rolling.
 - The following might produce an incomplete sentence:

```
<c:catch>
  The current enrollment is ${registrar.adults}
  adults and ${registrar.children}
  children.
</c:catch>
```

- A useful technique combines `<c:catch>` with `<c:set>`, using the latter as an **output buffer**.
 - The buffer can then be flushed on success:

```
<c:catch>
  <c:set var="buffer" >
    The current enrollment is ${registrar.adults}
    adults and ${registrar.children}
    children.
  </c:set>
  ${buffer}
</c:catch>
```

- If anything goes wrong, control will pass out of the `<c:catch>` action before the buffer is written to the response stream.

Malformed Numbers

EXAMPLE

- Now we'll test out **Examples\OddEven\choose**.
- Note that **OddEven.jsp** has logic as discussed on the previous page:
 - It catches any exceptions in testing the number, and buffers output during that process.
 - It also checks the exception itself, and reports it:

```

<c:catch var="ex" >
  <c:set var="buffer">
    <p>
      ${param["number"]} is
      <c:choose>
        <c:when test="${param['number'] % 2 == 0}">
          even.
          <c:set var="totalEven" scope="session"
            value="${totalEven + 1}" />
        </c:when>
        <c:otherwise>
          odd.
          <c:set var="totalOdd" scope="session"
            value="${totalOdd + 1}" />
        </c:otherwise>
      </c:choose>
    </p>
  </c:set>
  ${buffer}
</c:catch>
<span style="font-size: 10pt; color: red;">
  ${ex}</span>

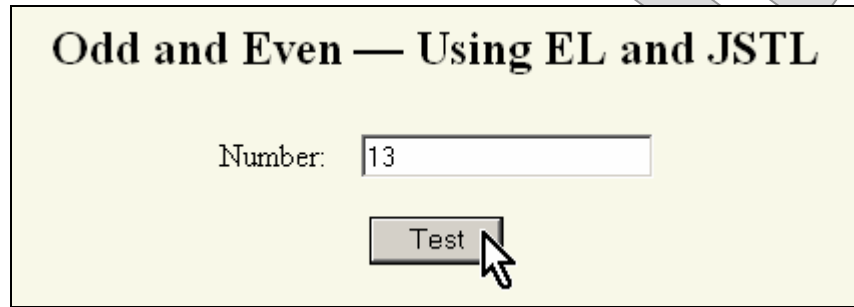
```

Malformed Numbers

EXAMPLE

- Try out this page starting at

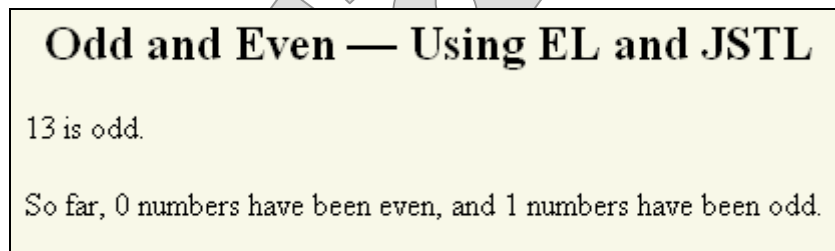
<http://localhost:8080/JSTL/Examples/OddEven/choose>



Odd and Even — Using EL and JSTL

Number:

- Enter a number and click **Test**.

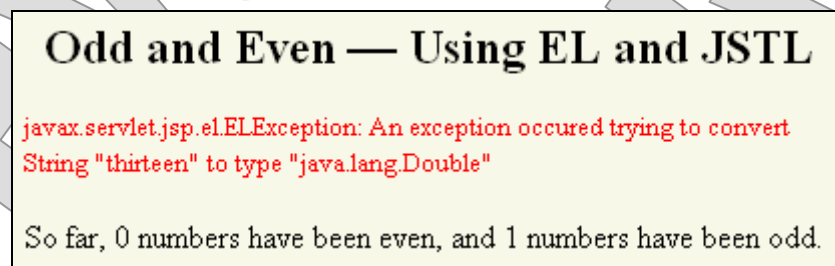


Odd and Even — Using EL and JSTL

13 is odd.

So far, 0 numbers have been even, and 1 numbers have been odd.

- This works fine; now go back and try entering something that can't be interpreted as a number.



Odd and Even — Using EL and JSTL

javax.servlet.jsp.el.ELEException: An exception occurred trying to convert String "thirteen" to type "java.lang.Double"

So far, 0 numbers have been even, and 1 numbers have been odd.

- The `<c:catch>` action handled the exception, and reported it, and the rest of the page appears normally, including the current session's count of odds and evens.

<c:url>

```
<c:url
  var = "static"
  scope = "static"
  value = "dynamic"
  context = "dynamic"
>
  optional <c:param>s
</c:url>
```

- This action helps to form a URL for use in page logic.
 - This can be as simple as providing a string **value**.
 - Parameters can be specified either in the **value** or using **<c:param>** subtags – see the following page.
- URLs can be absolute, context-relative or page-relative.
 - Absolute URLs begin with a **scheme prefix** such as “http:”.
 - Context-relative URLs begin with a forward slash. Successive tokens will be evaluated from the JSP application context root – or from some foreign context as declared using the **context** attribute.
 - Page-relative URLs begin with alphanumeric tokens: directories or file names.
- URL objects resolve to strings, so that they can be used in producing HTML links:

```
<c:url var="link"
      value="Next.jsp?value=${computed}" />
<a href="${link}" >Click Here!</a>
```

<c:param>

```
<c:param
  name = "dynamic"
  value = "dynamic"
>
  value
</c:param>
```

- This action is invoked only within other actions, and defines a URL parameter as a name/value pair.
 - It functions much the way <c:set> does, except that it assigns a value to a **name** instead of to an exported **var**.
 - The value can be provided by the **value** attribute or by body content.

```
<c:url var="link" value="Next.jsp" >
  <c:param name="value" value="{calculated}" />
</c:url>
```

<c:import>

```
<c:import
  url = "dynamic"
  var = "static"
  scope = "static"
  varReader = "static"
  context = "dynamic"
  charEncoding = "dynamic"
>
  <c:param>s, or actions that process a Reader
</c:import>
```

- This action brings in an external resource for use in successive page logic.
 - The **url** is a string, which can be any well-formed URL, absolute or relative.
 - It can be encoded directly as a string, derived from an existing **<c:url>**-exported object, or take advantage of its own **<c:param>** subtags.
 - The action can export either a **var** as a string representation of the resource, or a **varReader** as a **Reader** for further processing, or both.
 - The **varReader** usage involves body content including actions that can consume information from the **Reader**.
- Imported resources can be produced as part of the JSP output, or can be fed into other page logic.

```
<c:import var="fragment" url="Snippet.html" />
<p>Some HTML here.</p>
${fragment}
<p>Some more HTML here.</p>
```

<c:redirect>

```
<c:redirect
  var = "static"
  scope = "static"
  url = "dynamic"
  context = "dynamic"
>
  <c:param>s
</c:redirect>
```

- This action redirects the container to an external resource and asks that resource to handle the current request.

Occurrence Statistics

LAB 2

In this lab you will complete the implementation of a JSP that calculates statistics on word usage in a text document. This will involve several stages of development: tokenize the document and build a map of word counts; remove commonly-occurring short words from the map; and produce the top ten words by occurrence counts in an HTML table.

Detailed instructions are found at the end of the chapter.

Suggested time: 60 minutes.

Evaluated Only

SUMMARY

- **The core library is aptly named; it provides fundamental actions that form the basis of practically all page logic that is based on custom actions.**
- **It fills gaps left by other JSP authoring styles:**
 - It can write where JSP expressions can only read information.
 - It can manage non-Bean objects, which standard actions cannot.
 - It provides a means of developing complex page logic in reusable tag files, which scripting cannot.
- **This is the most “horizontal” of the JSTL libraries, and perhaps of all JSP custom tag libraries.**
 - Core JSTs will be a part of nearly all page logic of any complexity.
 - More specialized actions will take advantage of exported objects, conditionals, and loops established by these core actions.

Occurrence Statistics

LAB 2

Introduction

In this lab you will complete the implementation of a JSP that calculates statistics on word usage in a text document. This will involve several stages of development: tokenize the document and build a map of word counts; remove commonly-occurring short words from the map; and produce the top ten words by occurrence counts in an HTML table.

Intermediate answer steps are provided, so that a complete working version at each of these three stages is available. If you experience difficulty with any of these stages, you have the option of copying the intermediate answer for that stage and picking up with development from there.

Suggested Time: 60 minutes.

Directories:

- Labs\Lab2** (do your work here)
- Examples\Occurrence\Step1** (backup copy of starter files)
- Examples\Occurrence\Step2** (intermediate answer)
- Examples\Occurrence\Step3** (intermediate answer)
- Examples\Occurrence\Step4** (contains lab solution)

Files:

- Occurrence.jsp**
- Chapter1.txt** (source document for processing)
- Chapter2.txt** (source document for processing)
- Rhymes.txt** (source document for processing)
- ShortWords.txt**

Instructions

1. Open the starting version of **Occurrence.jsp** and review the contents: there are just a page heading and an empty HTML table.
2. Start by instantiating a **java.util.HashMap** called **words**, using `<jsp:useBean>`. This will be your primary data structure for the page.
3. Import the user's chosen document using `<c:import>` and export it in a variable **doc**.
4. Create a variable **delimiters** using `<c:set>`. Use the tag body to initialize the variable as follows: note that the embedded space and line break are intentional:

```
<c:set var="delimiters" > ,.!?;:~@#%*=-'"/\>< (
 )</c:set>
```

5. Create a `<c:forEachTokens>` loop over the **doc** variable, providing **delimiters** as the delimiter string and naming the iterator variable **word**.
6. In the loop, test to see if the word is in the map yet. That is, test the expression `"${words[word]} == null"`; this will determine if it is missing. If it is, add it to the map with a count of zero using `<c:set>`: **target** is the **words** map, **property** is the value of **word**, and **value** is 0. (Remember that **target** must be a JSP expression, and not a literal string.)
7. Now, inside the loop but after the `<c:if>` you just created, build another `<c:set>` to increment the count for this word. **target** and **property** are the same, and **value** is `"${words[word]} + 1"`.
8. Following this loop, write the JSP expression `${words}` directly to the page output – this will serve as a temporary test of your code, so you can see the full contents of the map after building it.

9. Test the page starting at the following URL. Enter “Chapter1.txt” for the filename and click **Sample**. You should get a long, dense list of words and word counts, something like what’s shown below. (This is the intermediate **Step2** answer.)

<http://localhost:8080/JSTL/Labs/Lab2>

Occurrence Statistics — Chapter1.txt

```
{before=4, counter=1, content=9, correctly=1, doing=1, little=2, the=220, here=3,
debugging=1, directory=1, vision=1, styles=1, a=130, behaviors=2, Object=3,
develop=1, after=1, namespace=5, function=1, now=1, differences=1, vice=1,
architecture=2, index=1, sets=1, The=44, can=46, necessary=5, achieving=1, we=8,
throws=1, Arithmetic=3, param[preferences=1, servlet=2, returns=1, A=14, items=2,
business=1, performed=2, promote=1, looping=1, After=1, formally=1,
development=4, Namespace=2, defining=2, dependence=1, Now=1, hierarchy=1,
problems=1, Hello=1, 1=7, it=40, identifies=1, steps=4, remainder=1, Scriptlets=1,
false=2, this=25, collection=10, tabular=1, derived=3, then=8, id=1, tags=1, four=5
```

10. Remove your temporary output expression. After this, there is an HTML table with column headers laid out, but no rows. You will add code after the headers – you can remove the placeholder JSP comment now, if you like. The task is to write rows to the table for the ten most frequently occurring words in the document.
11. Start by creating a `<c:forEach>` that iterates from 1 to 10. Reference the count in the variable **rank**. All the rest of your code will sit inside this loop.
12. You’ll perform an inner loop to find the word in the map with the highest occurrence count. `<c:set>` a variable **hits** and initialize it to zero.
13. Build the inner loop, a `<c:forEach>` that iterates over the **words** map. Remember that the value of the **items** attribute should be a JSP expression! Don’t just provide “words” as the value – that would be a literal string, not an object reference. Reference each entry in the map with a variable **word**.
14. Inside the inner loop, test **word.value** to see if it is greater than **hits**. If it is, set **hits** to this value, and set a new variable **topWord** to **word.key**.

15. When the inner loop completes, you'll have the most frequently occurring word in **topWord** and its occurrence count in **hits**. Produce the HTML table row, with three cells: the **rank**, the **topWord**, and the **hits**.
16. Test your page at this point. Things don't go exactly as we'd hope – have you guessed why?

Most-frequently-occurring words in the sample:

Rank	Word	Occurrences
1	JSP	59
2	JSP	59
3	JSP	59
4	JSP	59
5	JSP	59
6	JSP	59
7	JSP	59
8	JSP	59
9	JSP	59
10	JSP	59

17. The loops should be working as designed so far, and so you're getting the most frequently occurring word – over and over. Each time through the outer loop, the result will be the same – naturally, since, the contents of **words** don't change from one time to the next.
18. After writing the HTML table row, remove the entry for **topWord**, so that it will be out of the running the next time 'round. This should be done using `<c:set>`: to remove a key from a map, simply decline to provide a **value**:

```
<c:set target="{words}" property="{topWord}" />
```

19. Test again, and you should see correct results for **Chapter1.txt**. You can try out the other source files listed on the previous page, too. (This is the intermediate **Step3** answer.)

Occurrence Statistics — Chapter1.txt

Most-frequently-occurring words in the sample:

Rank	Word	Occurrences
1	the	220
2	a	130
3	to	121
4	of	115
5	and	108
6	is	97
7	in	89
8	be	68
9	JSP	59
10	c	56

20. Now, this is technically correct, but not as useful as it could be. Most statistics and search engines that work with prose documents routinely strip out commonly occurring and short words such as articles, prepositions, etc. Most users are not going to be interested in how many times 'the' appears in a document. A text file **ShortWords.txt** has been provided to simplify the task of stripping these words from the map.
21. Before the HTML table, import this document to a variable **shortWords**.
22. Create a tokenizing loop over the document, and for each word **shortWord** in the string, remove the corresponding entry in **words**.

23. Retest, and you should see a more useful output at this point:

Occurrence Statistics — Chapter1.txt

Most-frequently-occurring words in the sample:

Rank	Word	Occurrences
1	JSP	59
2	c	56
3	JSTL	42
4	scope	38
5	set	34
6	tag	33
7	value	32
8	EL	28
9	object	28
10	page	28

This is the final **Step4** answer. You might also try the **Chapter2.txt** at this point to see the different distribution of words there – probably not surprising that the pseudo-word “c” shows up quite a bit!