WebCache

Contents

Lab 5 WebCache

In this lab we will import an existing web application called *DictionaryApp*, which uses servlet and Java Server Pages (JSP) with JDBC. This lab demonstrates the use of Model-View-Controller architecture in a web application, with the web browser displaying the view rendered via JSPs, Servlet as controllers, and plain old java objects used to access the data model stored in a relational database.

We will first get the application working and demonstrate the assistance that WDT will provide in configuring the server correctly for the imported application. Then we will review the code to see how everything fits together.

The final and optional portion of this lab demonstrates how to use web caching to improve the performance of your application.

Please refer to the following table for file and resource location references on different operating systems.

Location Ref.	OS	Absolute Path
{LAB_HOME}	Windows	`C:\WLP_<version>`
	Linux	`~/WLP_<version>`
	Mac OSX	

5.1 Prerequisites

The following preparation must be completed prior to beginning this lab:

1. Complete the Getting Started lab to set up the lab environment, and learn how to create a server using Eclipse with WebSphere Developer Tools (WDT).

2. Optional: complete the Simple Development lab if you need a refresher on how to use eclipse and WDT.

5.2 Installing Derby relational database

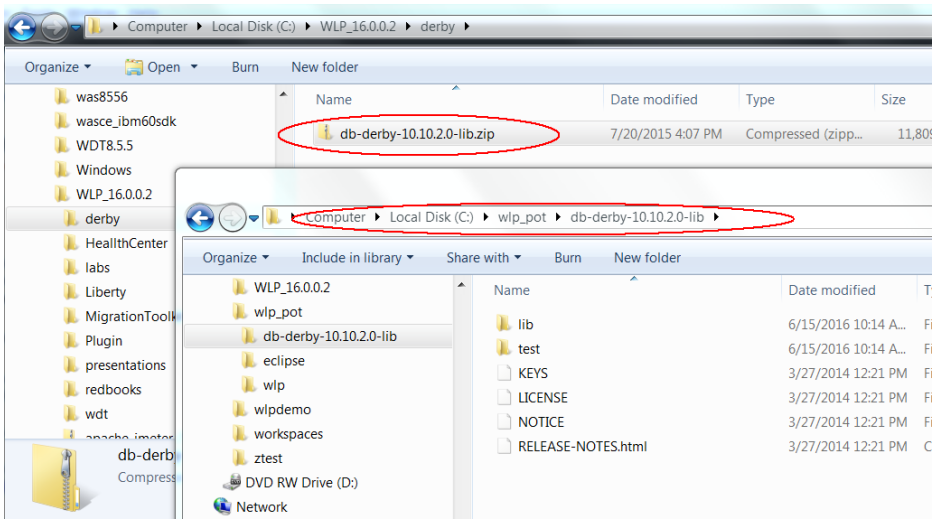
If you have not already installed Derby:

__1. Extract *{LAB_HOME}*\derby*<db-derby-lib-archive>* to *{LAB_HOME}*\db-derby-10.10.2.0-lib directory.

OS specific <db-derby-lib-archive> file name:

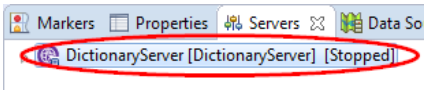
Windows: db-derby-10.10.2.0-lib.zip

Linux/Mac: db-derby-10.10.2.0-lib.tar.gz



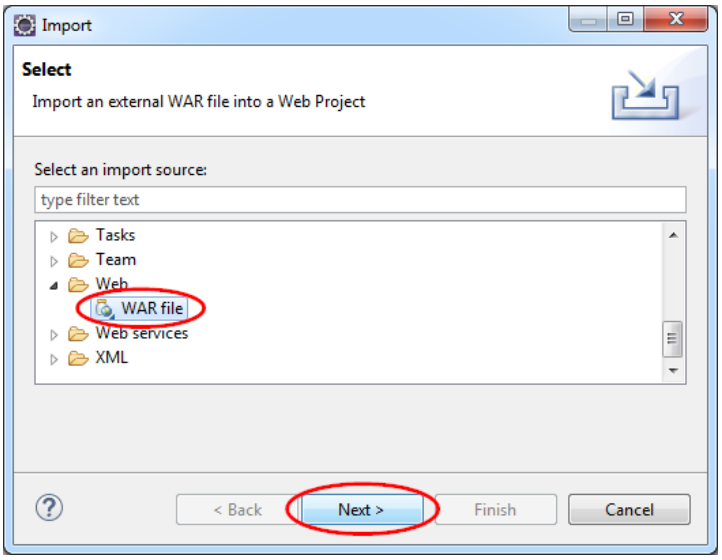
5.3 Create a new server

__1. Using the procedure learned in the Getting Started lab, create a new Liberty application server called **DictionaryServer**.



5.4 Import the Dictionary web application

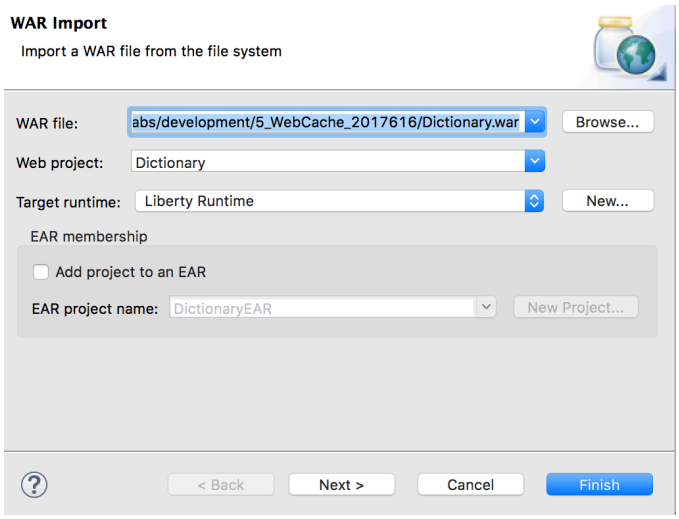
__1. Click **File > Import** from the menu. Expand **Web** and select **WAR file** on the Import window, then click **Next**.



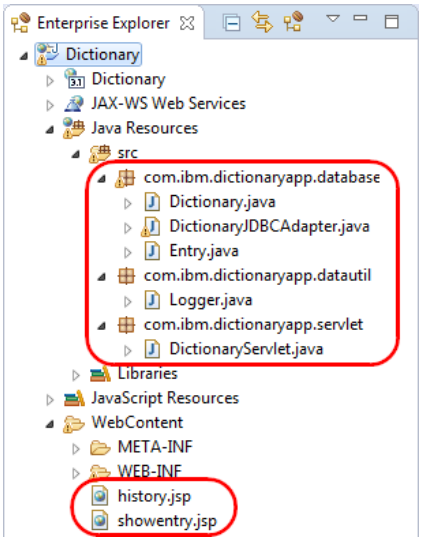
__2. Click **Browse** on the WAR Import view.

__3. Use the Open dialog to locate the `Dictionary.war` file and click **Open**.

__4. Clear the **Add project to an EAR** checkbox, and verify the **Target runtime** is set to **WebSphere Application Server Liberty**, and click **Finish**.



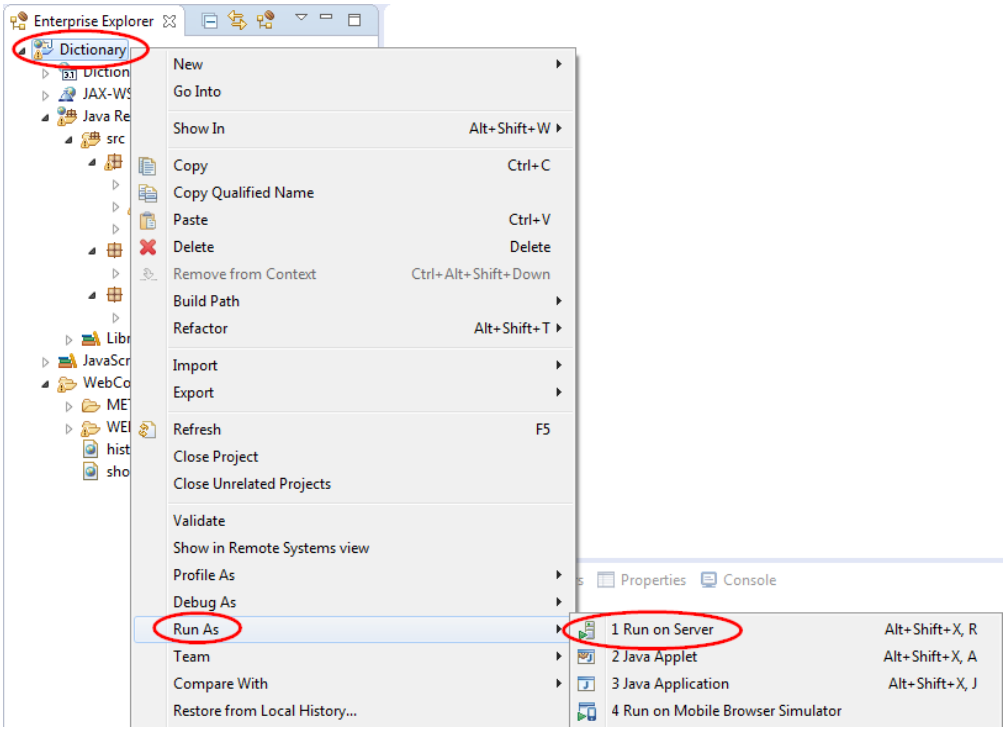
__5. In the Enterprise Explorer view, expand the **Dictionary** project and review its **Java Resources** and **Web Content** folders. You will see a servlet, 2 JSPs and some plain Java classes.



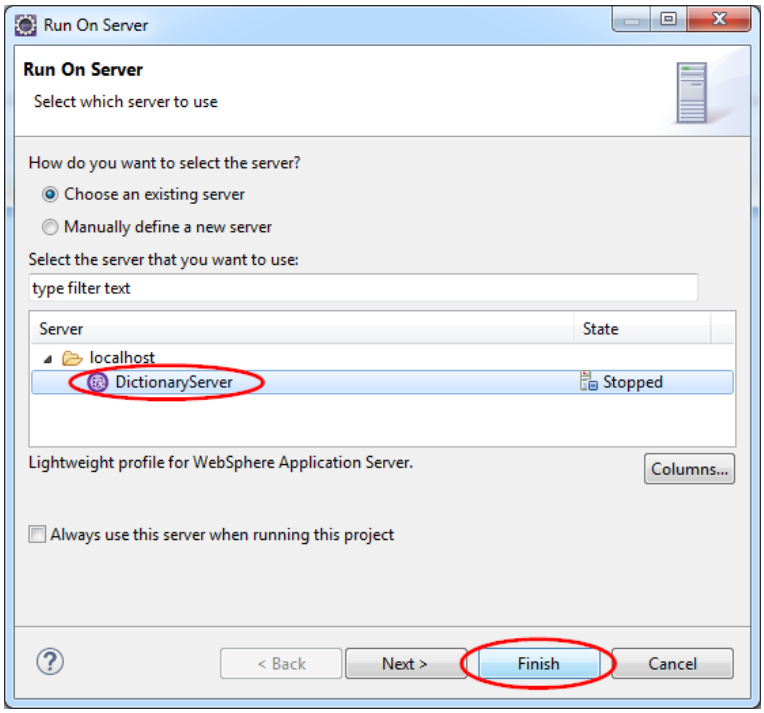
5.5 Install the application to the server

We haven't configured the server to run this application yet, so first let's see how much of that WDT can do for us. Look at your server configuration first and note which features are configured. Then add the imported application:

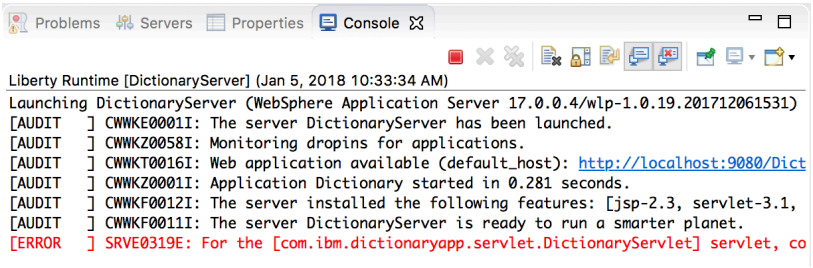
__1. In the Enterprise Explorer view, right click the **Dictionary** project, then click **Run As > Run on server**.



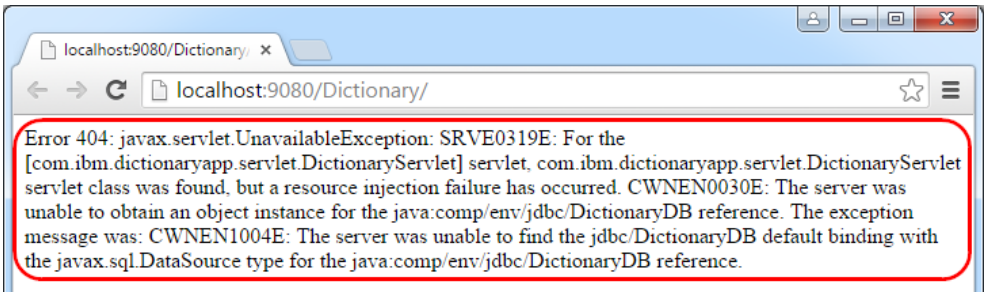
__2. On the Run On Server window, select **DictionaryServer** from the **Server** list, then click **Finish**.



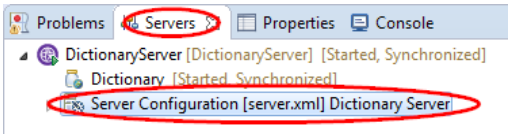
__3. You should see an error reported in the Console tab.



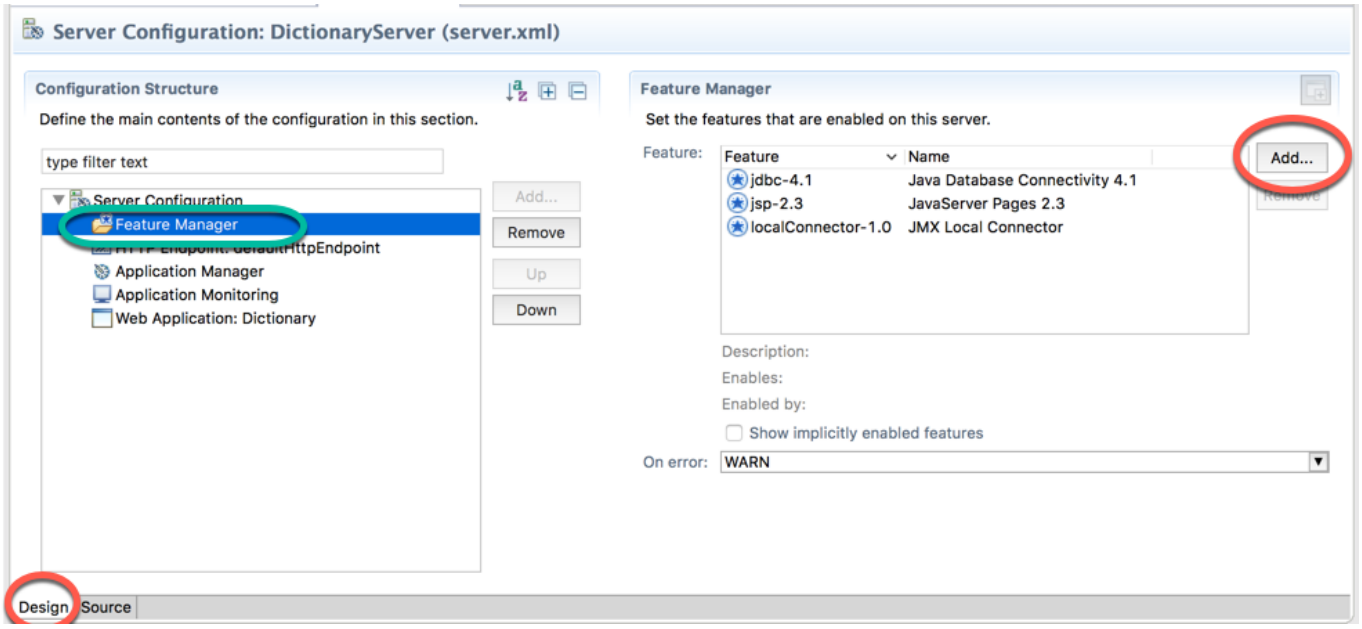
You may also see errors in the browser window.



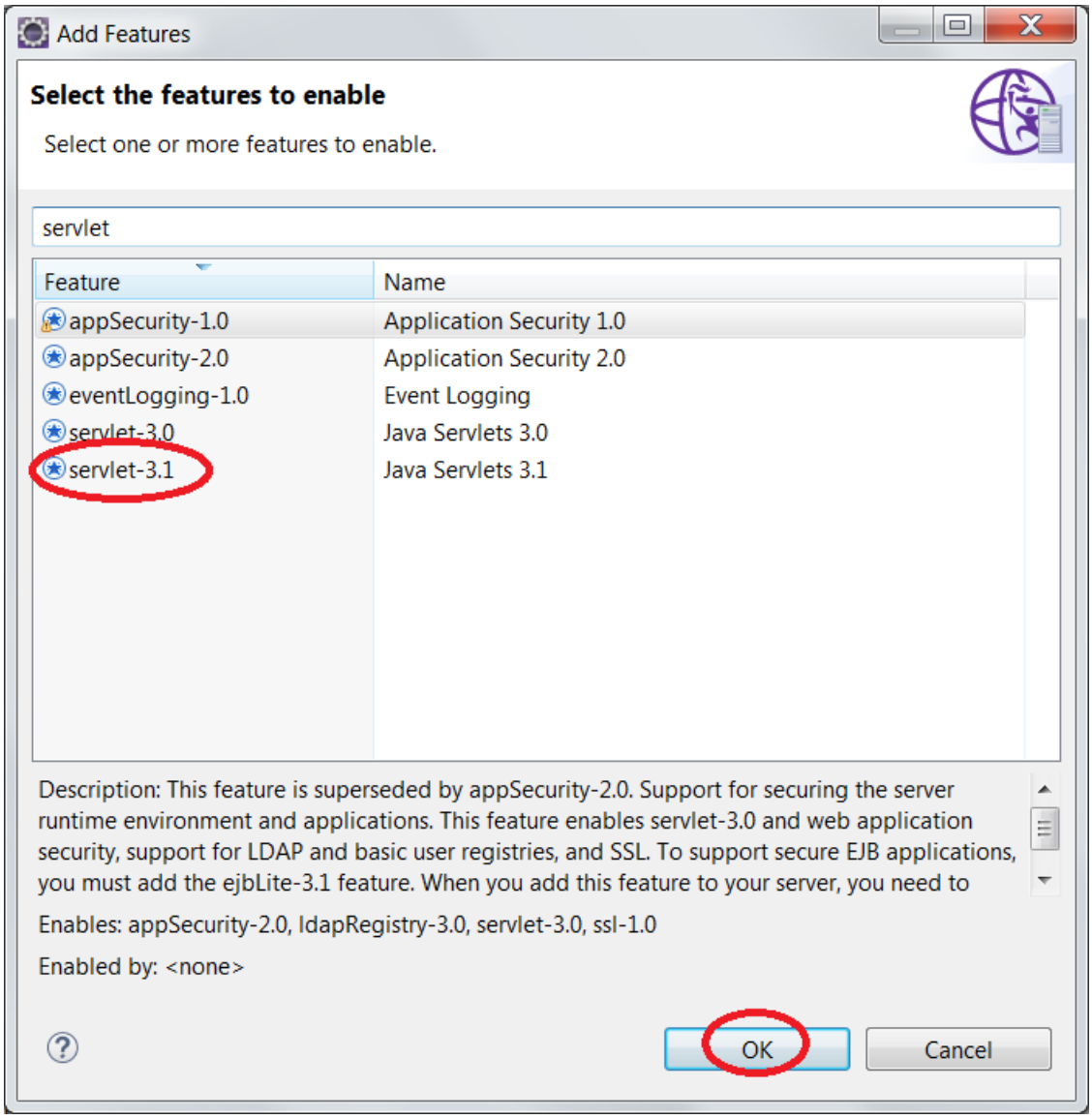
__4. The messages indicate that the error is related to the database. Bring up the server configuration of DictionaryServer by expanding **DictionaryServer** in the Server view and double clicking **Server Configuration**.



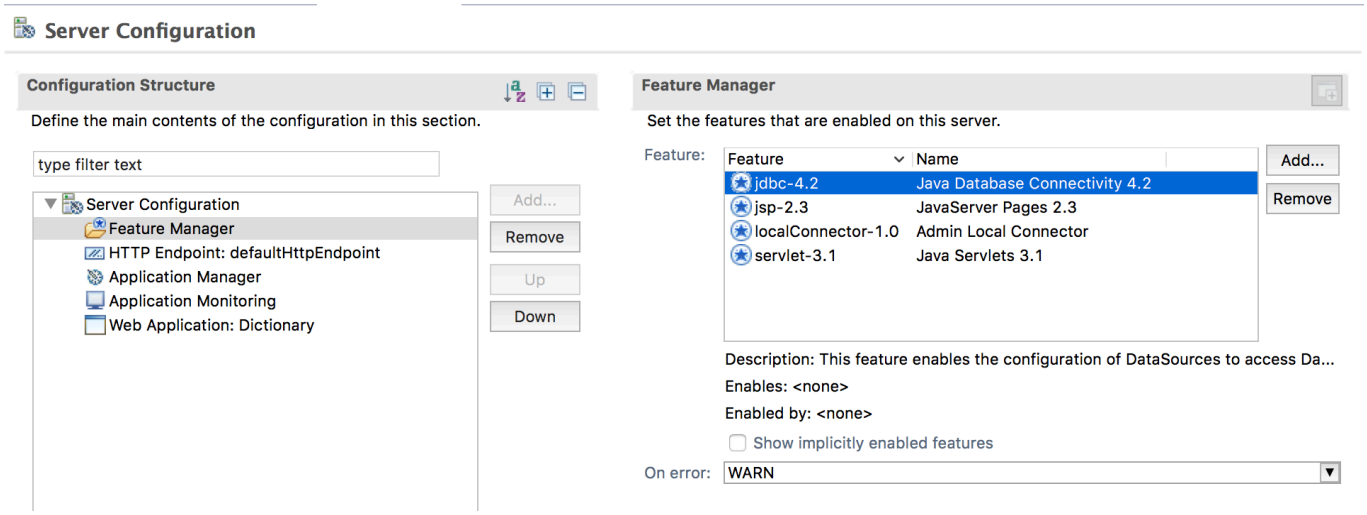
__5. Now, let's add the features we need. Switch to the **Design** view, making sure you have selected **Feature Manager** in the Configuration Structure view, then click **Add**.



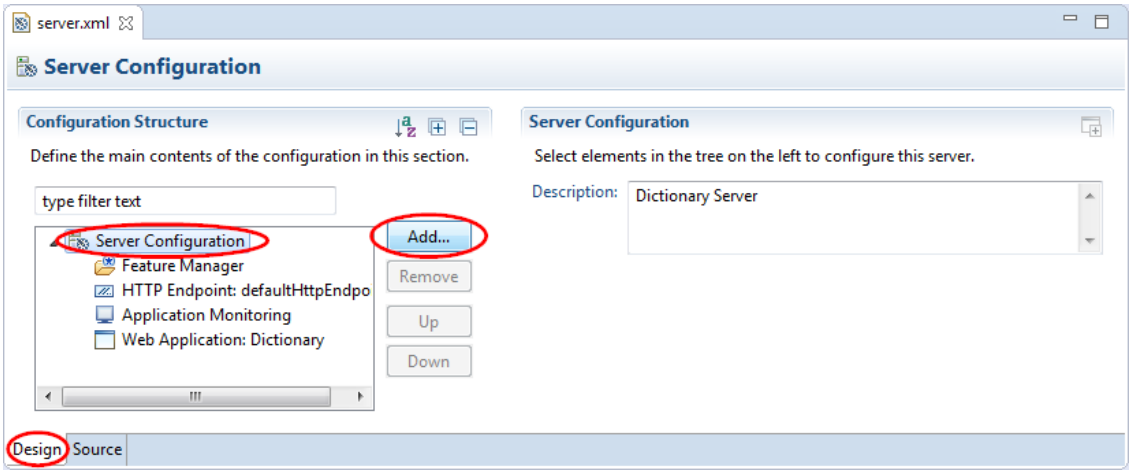
__6. In the **Add Element** window, enter `servlet` for the filter and select `servlet-3.1` from the element list, then click **OK**.



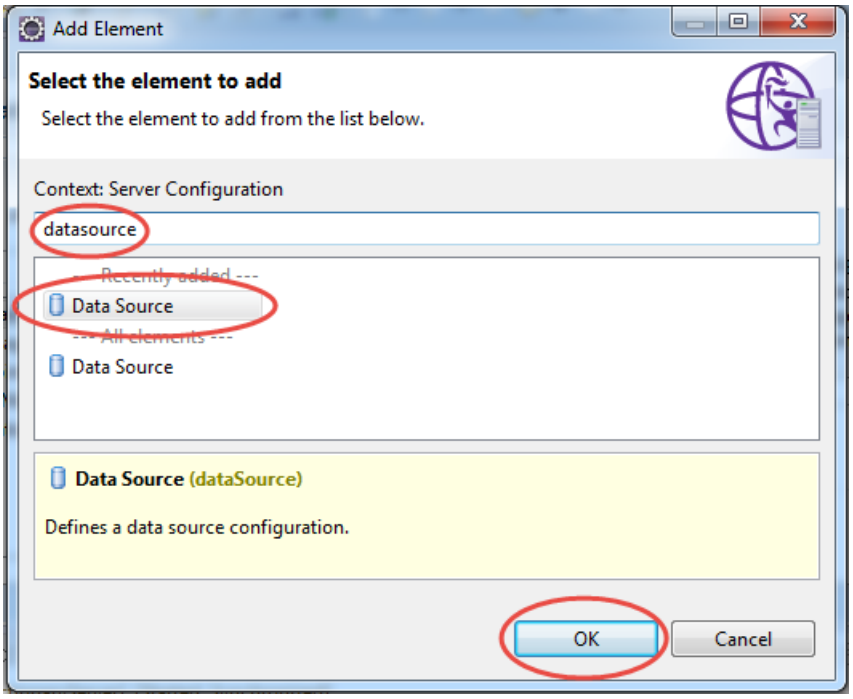
__7. Use the following screenshot as a reference for the end result. However, we still need to configure a data source to solve the initial problem.



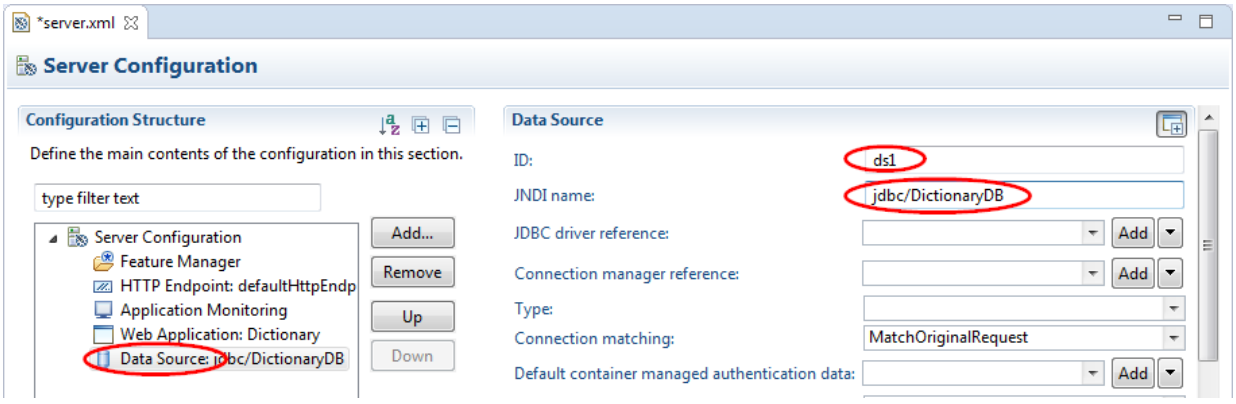
__8. In the same **Design** tab we have been working, click **Server Configuration** in the Configuration Structure view, then click **Add**.



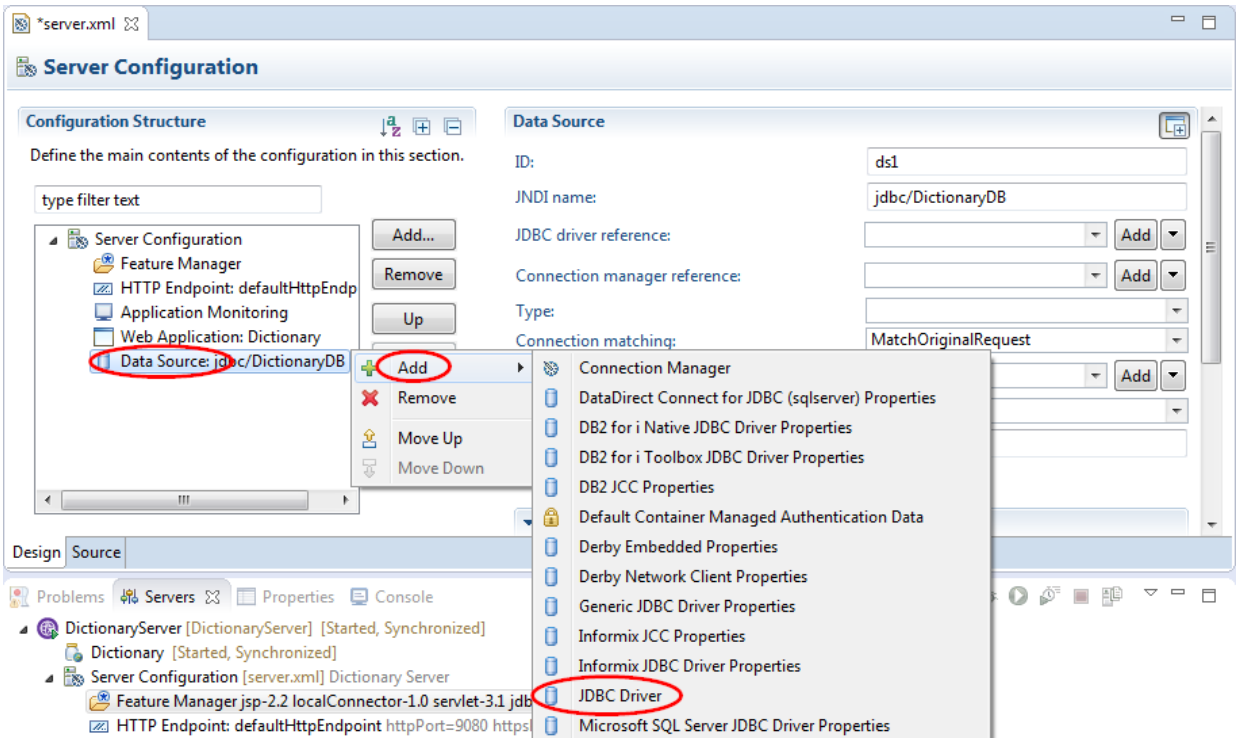
__9. In the Add Element window, enter `datasource` for the filter and select **Data Source** from the element list, then click **OK**.



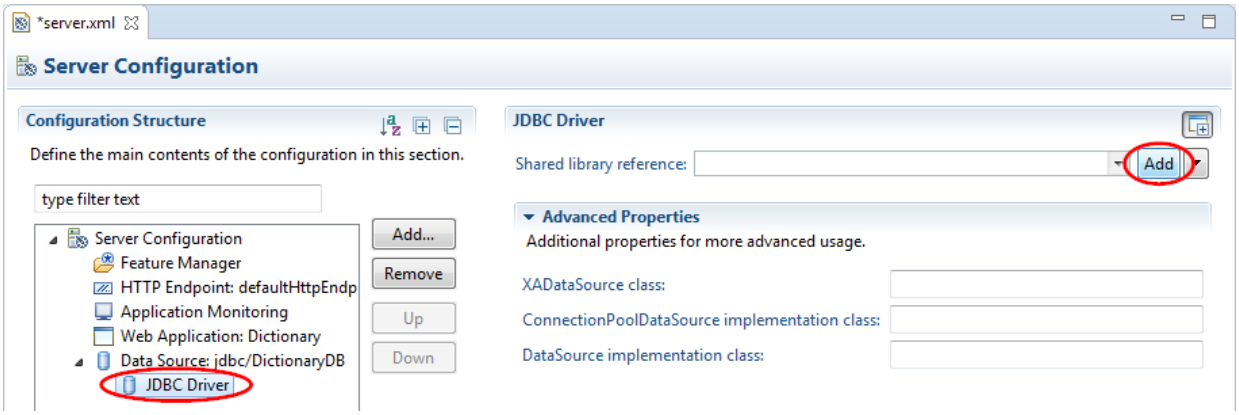
__10. With **Data Source** selected in the Configuration Structure view, enter `ds1` for **ID** and `jdbc/DictionaryDB` for **JNDI name** in the Data Source view.



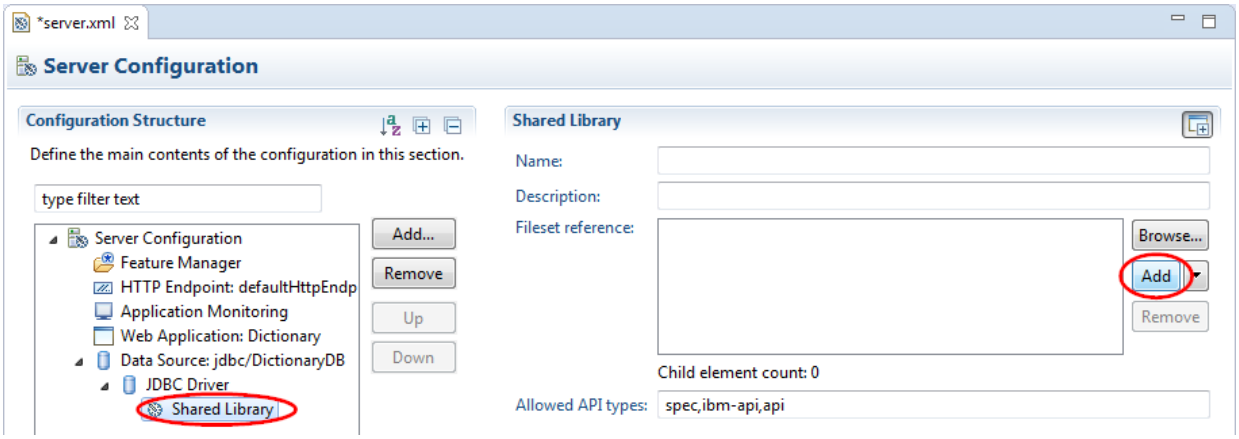
__11. In the Configuration Structure view, right click **Data Source**, then click **Add > JDBC Driver**.



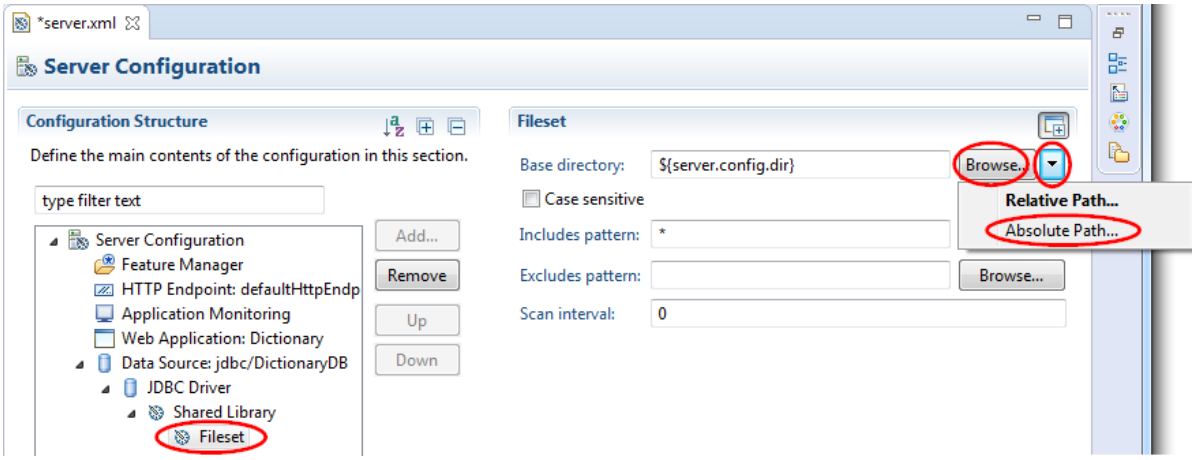
__12. With **JDBC Driver** selected in the Configuration Structure view, click the **Add** button in the JDBC Driver view to add a shared library reference.



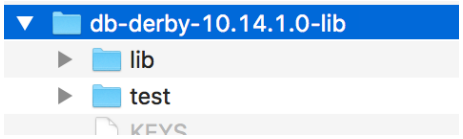
__13. In the Shared Library view, click the **Add** button next to the **Fileset reference** list.



__14. In the Fileset view, click the down arrow button ( ) next to the **Browse** button and click **Absolute Path**.



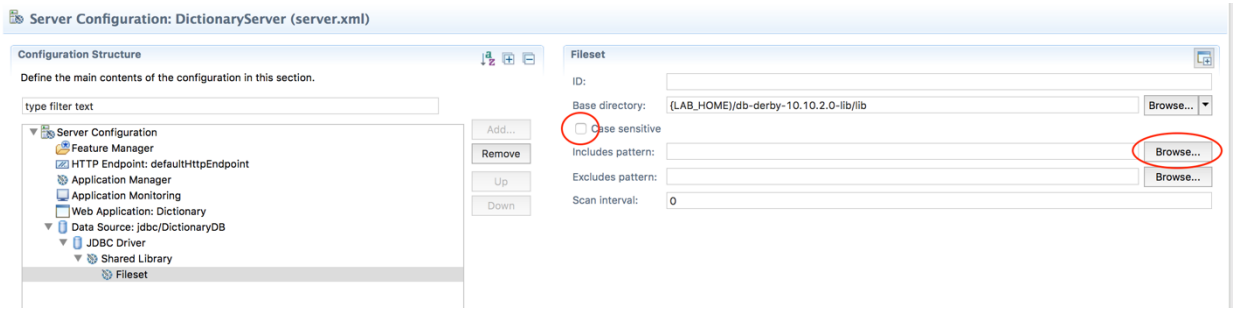
__15. Navigate to and select the `{LAB_HOME}\db-derby-10.14.1.0-lib\lib` directory in the Browse For Folder window, then click **OK**.



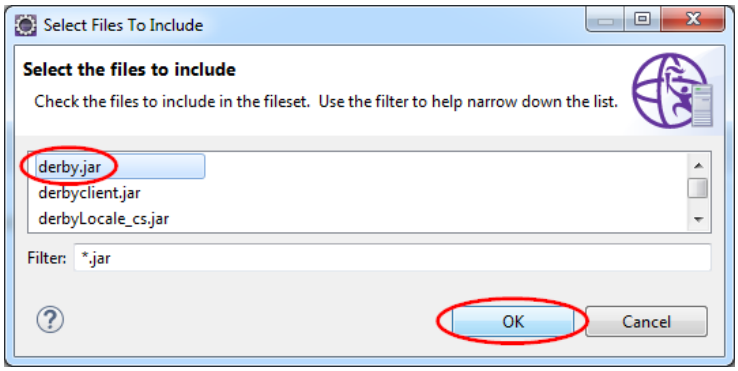
__16. Still in the Fileset view,

__a. Deselect the **Case sensitive** check box

__b. click the **Browse** button for **Includes pattern**.



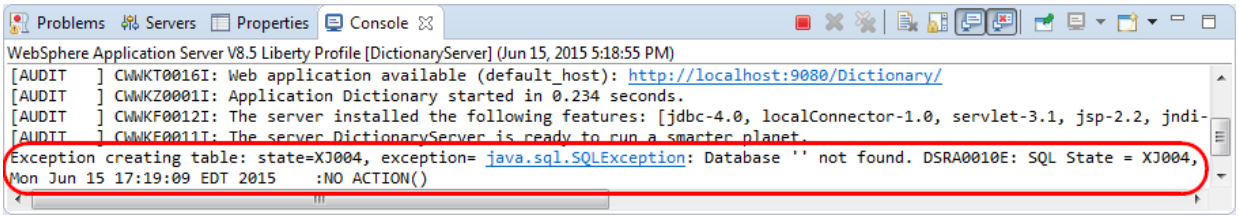
__17. Select `derby.jar` from the include file list, then click **OK**.



__18. Click on the **Source** tab and the `server.xml` entry for the data source should look similar to this:

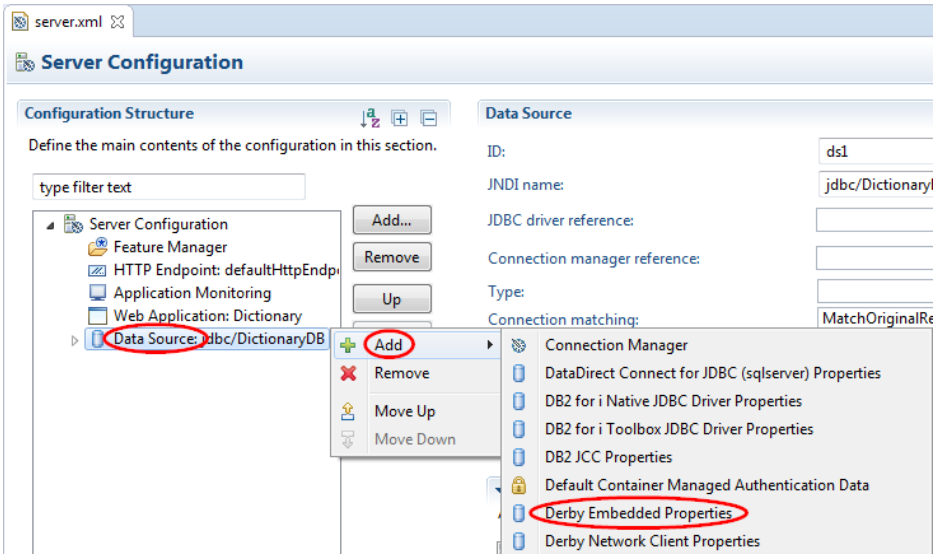
```
<dataSource id="ds" jndiName="jdbc/DictionaryDB">
      <jdbcDriver>
        <library>
          <fileset dir="{LAB_HOME)/db-derby-10.14.1.0-lib/lib" caseSensitive="false"></fileset>
        </library>
      </jdbcDriver>
  </dataSource>
```

__19. Save the server configuration. Point your browser to http://localhost:9080/Dictionary/, and refresh the page if needed. You should see an application error message in the Console about database not found.

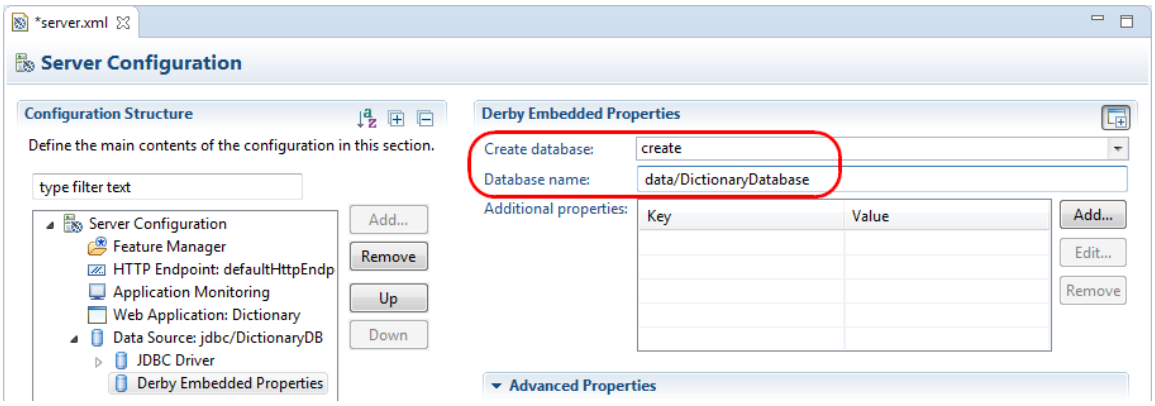


This is because the database does not exist. With most databases you have to create the database explicitly before they can be used, but with Derby you can set a property to indicate that the database should be created on first use. We will do that now.

__20. Open the `server.xml` again, if not already open, and click on the **Design** tab. Right click **Data Source** in the Configuration Structure view and click **Add > Derby Embedded Properties**.



__21. In the Derby Embedded Properties view, enter `create` for **Create database** and for **Database name**. This will create, on first use, a database called **DictionaryDatabase** under the server's directory.



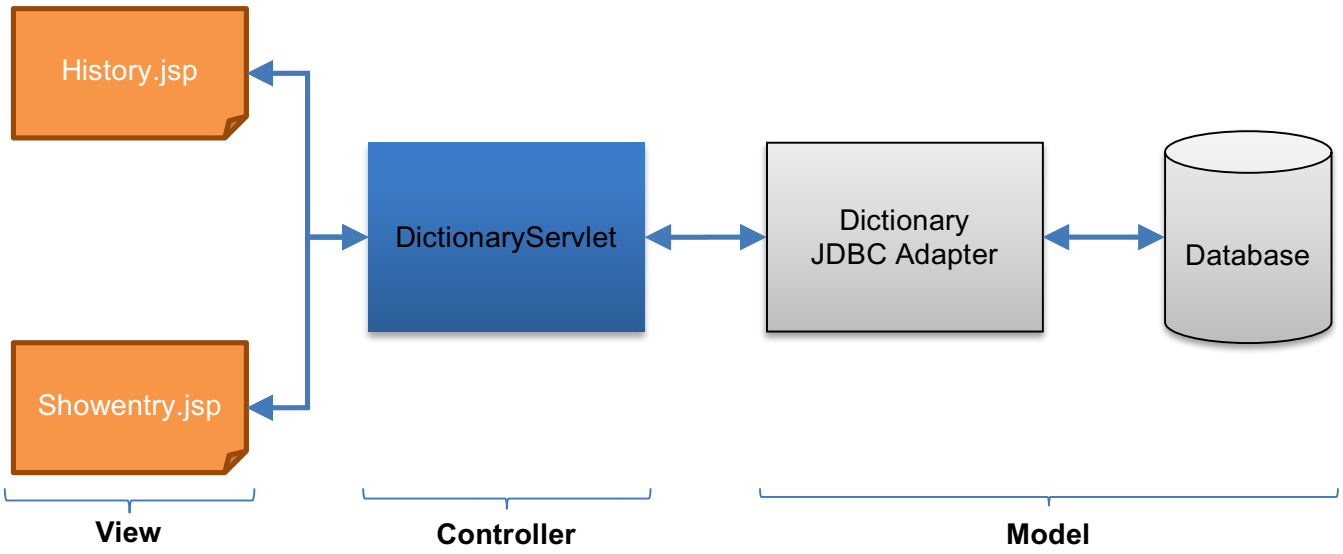
__22. In the Source view for `server.xml`, the new data source definition now looks like:

```
<dataSource id="ds1" jndiName="jdbc/DictionaryDB">
   <jdbcDriver>
      <library>
         <fileset caseSensitive="false" dir="{LAB_HOME}\db-derby-10.10.2.0-lib\lib"
            includes="derby.jar"></fileset>
      </library>
   </jdbcDriver>
   <properties.derby.embedded createDatabase="create"
      databaseName="data/DictionaryDatabase"/>
</dataSource>
```

__23. Save the `server.xml`. The application should now run successfully. Try to look up `IBM`, whose definition is pre-populated. Add some entries to the dictionary. Try looking them up. Then stop the server, restart it, and see if your entries can still be found. If they can, that is what we refer to as *persistence*, data that survives when the server process is stopped and restarted.

5.6 Code walk-through

The overall architecture of Dictionary application is shown below:



DictionaryApp uses the *Model View Controller (MVC)* architecture by implementing `DictionaryJDBCAdapter.java`, a database adapter, as the *model*, `showentry.jsp` and `history.jsp` as the *view*, and `DictionaryServlet.java` as the *controller*.

A user accesses DictionaryApp through the `DictionaryServlet` entry point. From there, `DictionaryServlet.java` will process any requests from the user by calling into the database adapter, `DictionaryJDBCAdapter.java`. After `DictionaryJDBCAdapter.java` has processed the data, `DictionaryServlet` generates a new view provided by `history.jsp` and `showentry.jsp` and the result is returned back to the user's browser as HTML.

The history of words recently entered by the user is generated by `history.jsp`, while the rest of the page that allows the user to enter or define a word are generated by `showentry.jsp`. You can request `history.jsp` by entering http://localhost:9080/Dictionary/history.jsp in the browser.

Browse the `.jsp` files. Note how JSPs are basically HTML with embedded Java code to make it easier to construct web pages. Note how `history.jsp` tracks the 5 most recent user entered words via the session state. *Session state* is information that the application server keeps track on behalf of each user's session. It is the mechanism commonly used to implement a shopping cart. Also note how `showentry.jsp` generates the **LOOKUP** and **DEFINE** buttons, and displays the words and definitions via the request parameters (passed from the servlet, which we will see later).

Browse the `DictionaryServlet` and note how it processes the request parameters from the incoming URL. Read the comments carefully and determine how it handles `LOOKUP` and `DEFINE` operations, and how it then generates the resulting view via `history` and `showentry` JSPs.

Browse the `DictionaryJDBCAdapter` and associated classes to see how it uses JDBC to call to the database to look up a word, or to define a word. Note how it creates a table in the database if one does not already exist, and pre-populates the table with the definition for "IBM".

5.7 Optional: Add dynamic caching

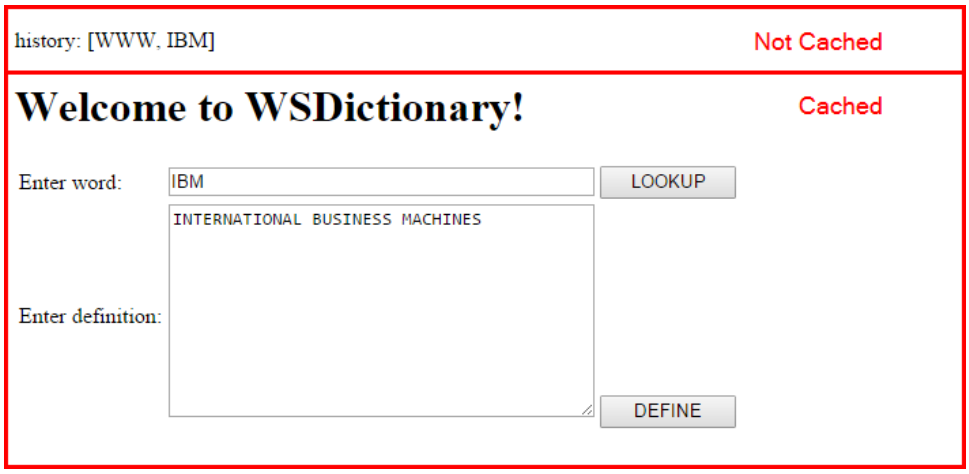
Dynamic caching can dramatically improve the performance of your application by caching the results of servlets and JSPs. Liberty contains a built-in per-server dynamic caching provider that you can use in production. In this section we will demonstrate how to use the built-in dynamic caching feature.

5.7.1 Caching design for Dictionary application

For the dictionary application, the requirements are:

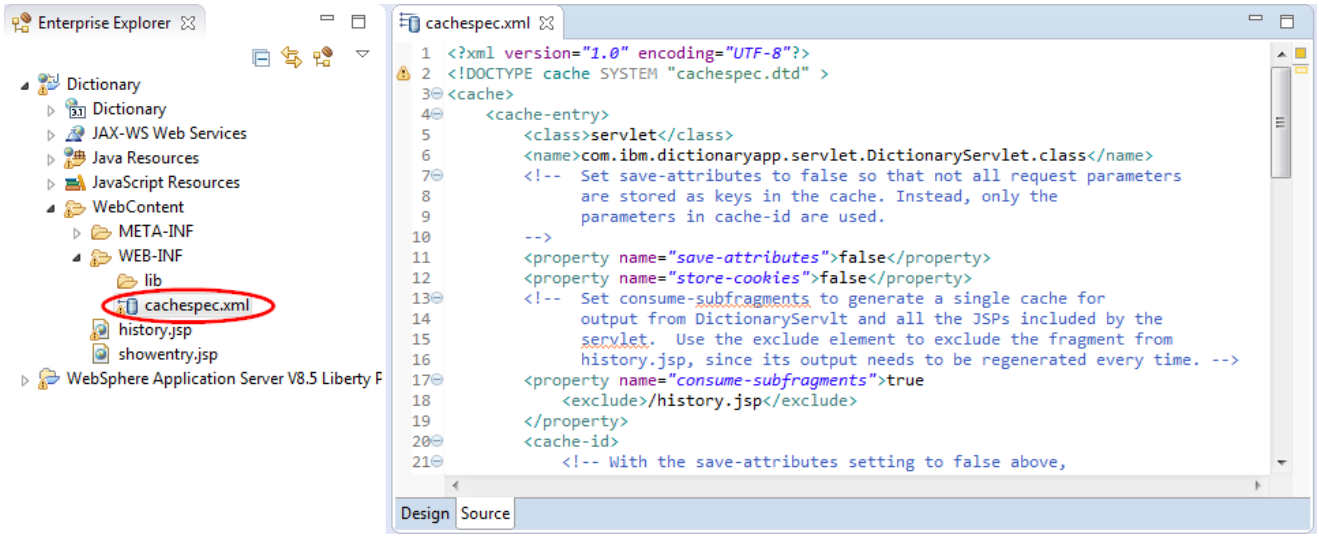
- The output line that contains the user's history is not cached, as it changes with each user interaction.
- The results of prior look ups, whether or not successful, are cached so that subsequent look ups of the same word are re-displayed without having to go to the database again. Previous words entered by the user are used as the keys to identify the cache.
- The cache associated with a prior look up of a word is invalidated if the user tries to define or redefine that word. This enable a new database operation to update the definition.

This is summarized pictorially as follows:



5.7.2 Caching policy

The `cachespec.xml` allows you to define the cache policy for your application. It is included with the sample application, and located at `WEB-INF\cachespec.xml`.



Browse `cachespec.xml` and carefully read the comments to understand how the rules implement the caching requirements from the previous section.

5.7.3 Installing Cache Monitor application

The cache monitor application is a sample application that is essential for understanding and debugging web caching. It is available on the WebSphere Liberty repository.

__1. Install the web cache monitor feature by running the command:

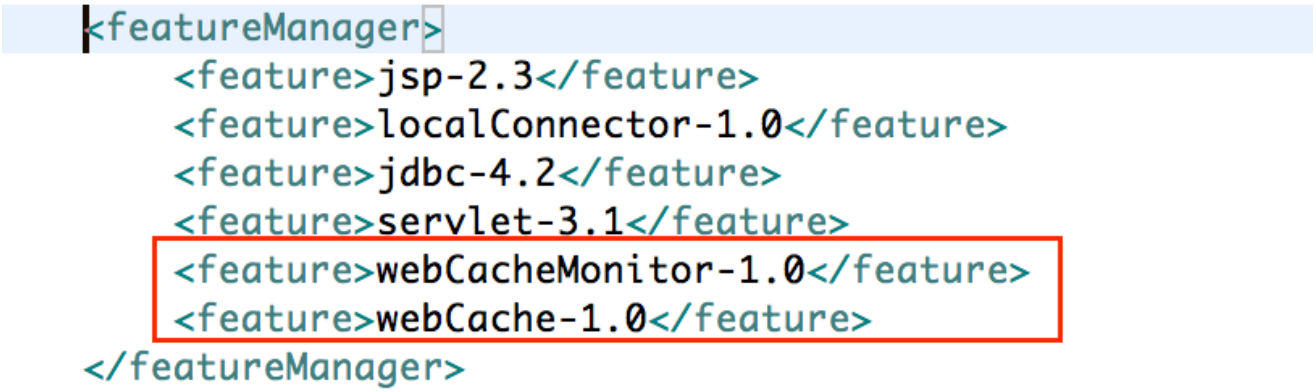
```
{LAB_HOME}\wlp\bin\installUtility install webCacheMonitor-1.0
```

__2. Restart Eclipse so WDT can pick up the new feature just installed.

5.7.4 Testing the application with Web Cache enabled

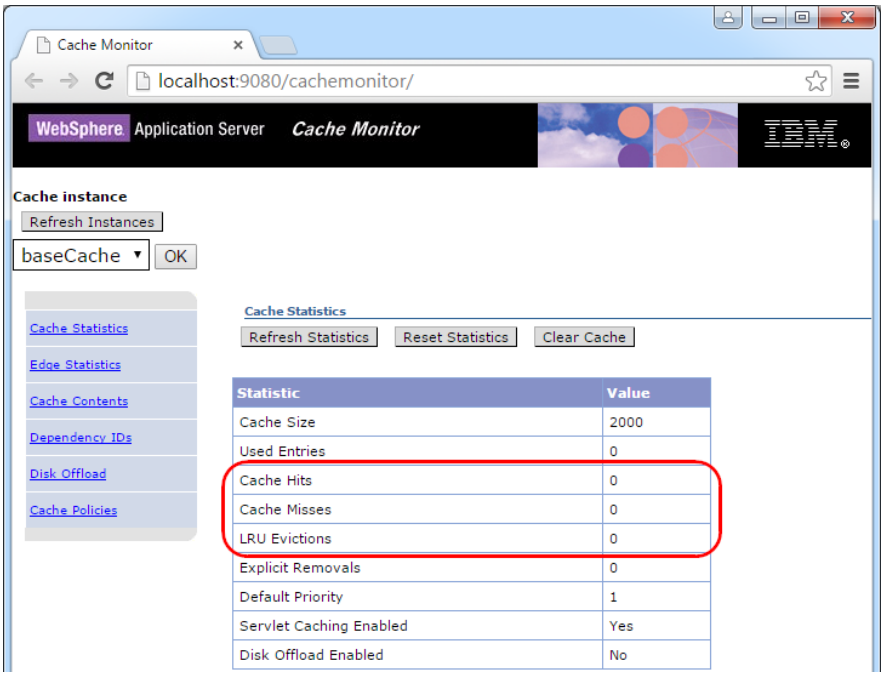
__1. Double click **DictionaryServer > Server Configuration** in the Server view to open the `server.xml` editor, then add the following features in the **Source** view.

```
<feature>webCache-1.0</feature>
<feature>webCacheMonitor-1.0</feature>
```

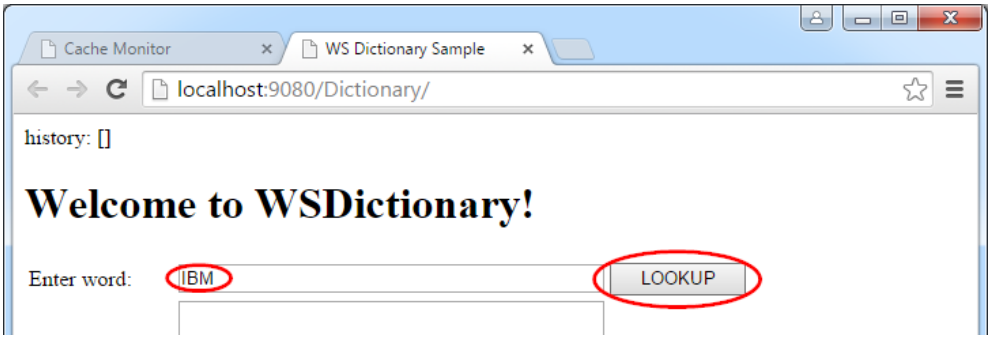


__2. Restart the server.

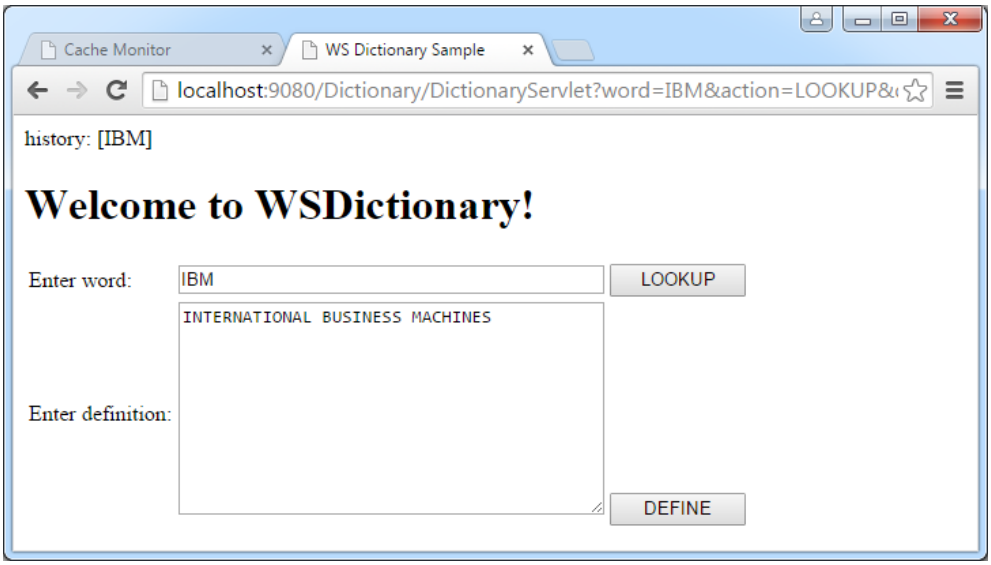
__3. Point your browser to the cache monitor at http://localhost:9080/cachemonitor and note the **Used Entries**, **Cache Hits**, and **Cache Misses** are all 0.



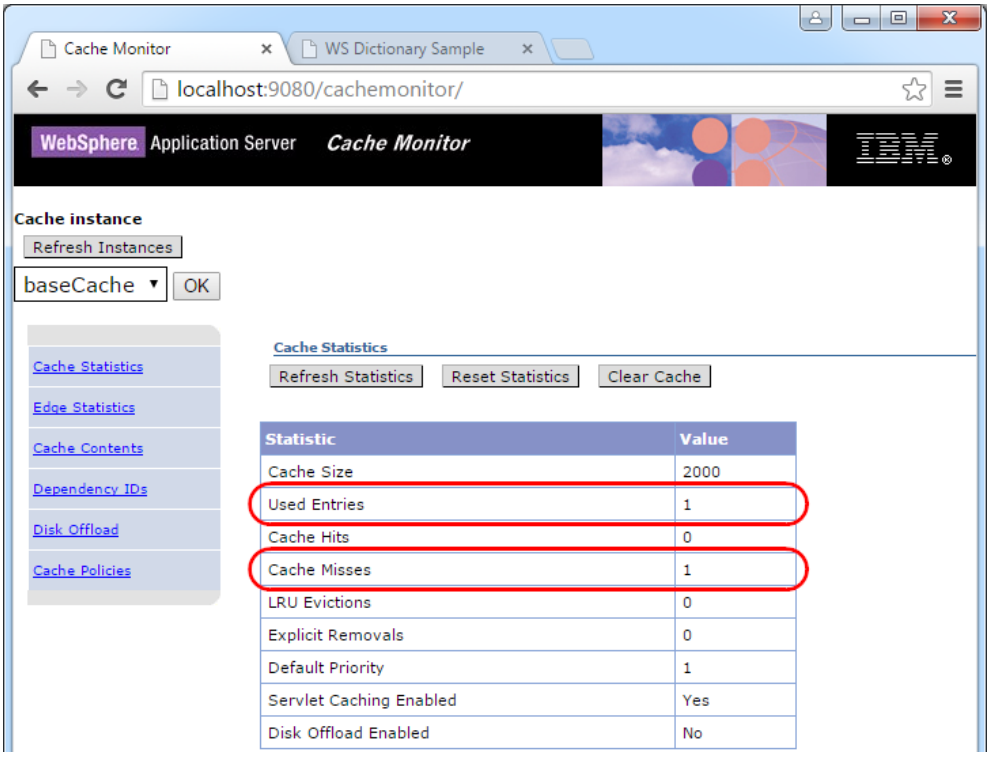
__4. Open another tab or windows in the browser, and point to the Dictionary servlet. Then lookup `IBM`.



__5. This should return the definition:



__6. Go back to the cache monitor tab, click **Refresh Statistics**. Since this is first lookup after server restart, the **Cache Misses** should show as 1. After this look up completed, a new entry is created in the cache, showing **Used Entries** count as 1.



__7. Click **Cache Contents** to examine the content of the cache. It will show that:

__a. The full **Cache ID** (or key) is:

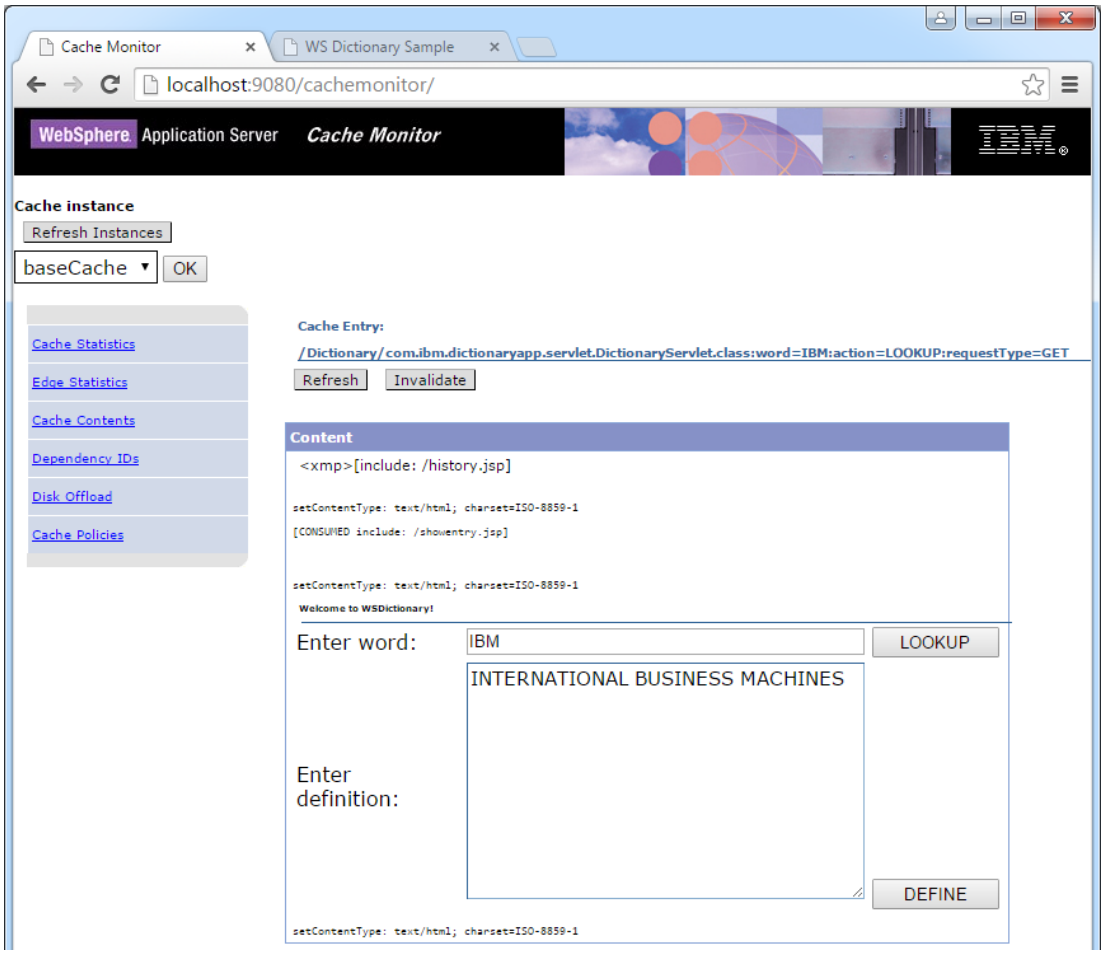
```
/DictionaryWeb/com.ibm.dictionaryapp.servlet.DictionaryServlet.cl
ass:word=IBM:action=LOOKUP:requestType=GET
```

__b. The Dependency ID is:

```
word:IBM
```

Cache ID	Timeout (seconds)	Dependency IDs
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=IBM:action=LOOKUP:requestType=GET	0	word:IBM

__8. Click on the Cache ID to see what is in the cache for that ID. Notice the fragment from `showentry.jsp` is part of the cache, while the fragment from `history.jsp` is not in the cache.



__9. Go back to the Dictionary servlet window and look up `WWW`. If `WWW` is not already defined, define it. The go back to the cache monitor window, and click on **Cache Contents** again. This should show two entries in the cache, with the new one for `WWW`.

Cache ID	Timeout (seconds)	Dependency IDs
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=IBM:action=LOOKUP:requestType=GET	0	word:IBM
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=WWW:action=LOOKUP:requestType=GET	0	word:WWW

__10. Verify look ups can be served from the cache. This is much faster comparing to having to go to the database each time:

__a. Click on **Cache Statistics** and check number of **Cache Hits**.

__b. Go back to the Dictionary servlet window and look up `IBM` again.

__c. Go back to the cache monitor window and click **Refresh Statistics**. Verify **Cache Hits** has increased.

Cache Statistics

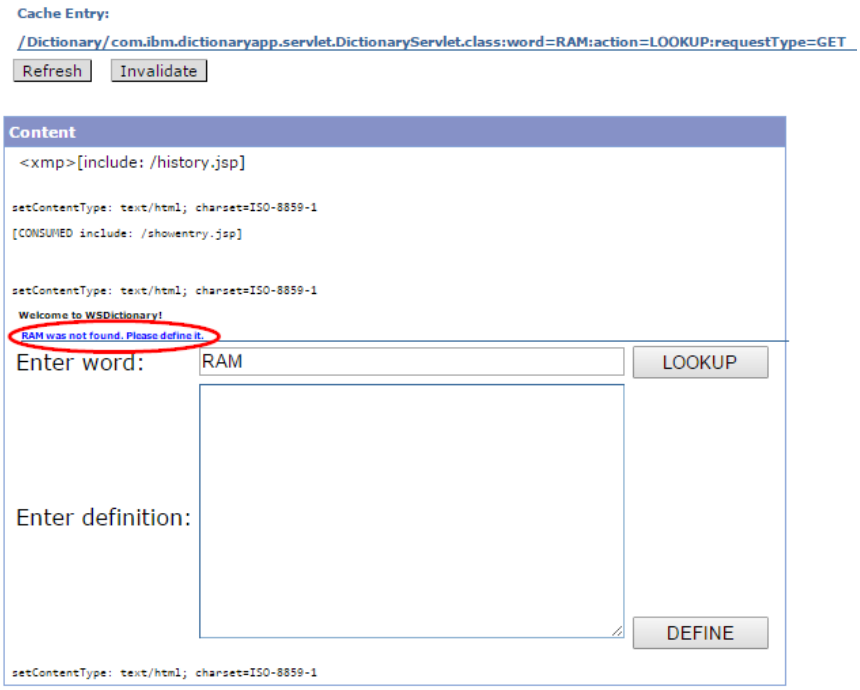
Refresh Statistics | Reset Statistics | Clear Cache

Statistic	Value
Cache Size	2000
Used Entries	2
Cache Hits	9
Cache Misses	3
LRU Evictions	0
Explicit Removals	1
Default Priority	1
Servlet Caching Enabled	Yes
Disk Offload Enabled	No

__11. Go back to the Dictionary servlet window and look up a word not in the dictionary: `RAM`. Go back to the **Cache Contents** and check that one more entry is added to the cache.

Cache ID	Timeout (seconds)	Dependency IDs
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=IBM:action=LOOKUP:requestType=GET	0	word:IBM
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=RAM:action=LOOKUP:requestType=GET	0	word:RAM
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=WWW:action=LOOKUP:requestType=GET	0	word:WWW

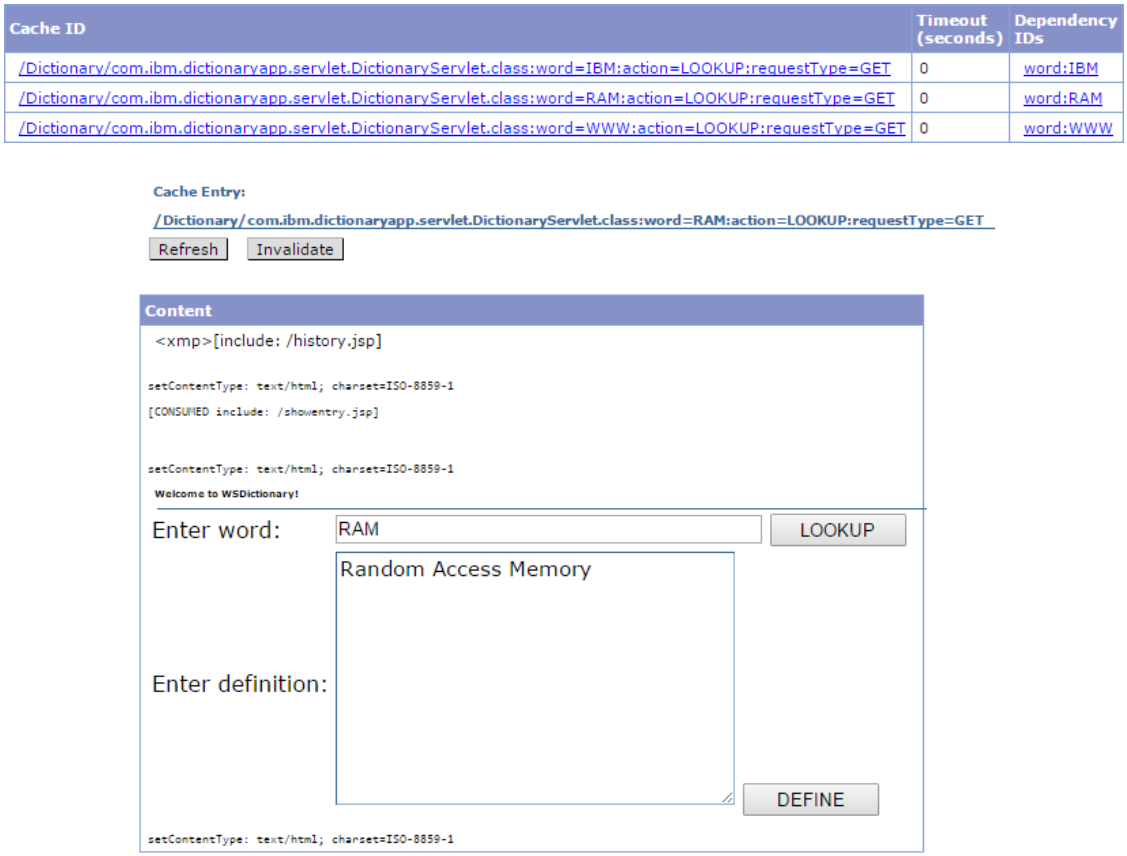
__12. Click on the **Cache ID** for the new entry and take note what has been cached. Next time you look up the word `RAM`, the same page asking the user to define `RAM` will be served from the cache again, with the exception of the `history.jsp` fragment, which will be regenerated.



__13. Go back to the Dictionary servlet windows and define `RAM` as *`Random Access Memory`*. Go back to the cache monitor and click on **Cache Contents** and note that the cache entry for the `word=RAM` entry has disappeared. This is due to the invalidation rule. The cache entry for the word `RAM` has a **Dependency ID** of `word=RAM`. When the word is defined, the invalidation rule in `cachespec.xml` specifies that any cache entry whose **Dependency ID** matches the **Invalidation ID** is invalidated.

Cache ID	Timeout (seconds)	Dependency IDs
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=IBM:action=LOOKUP:requestType=GET	0	word:IBM
/Dictionary/com.ibm.dictionaryapp.servlet.DictionaryServlet.class:word=WWW:action=LOOKUP:requestType=GET	0	word:WWW

__14. Go back to the Dictionary servlet window and look up `RAM` again. Since the cache entry was invalidated, the content is not served from the cache. Instead, the **DictionaryServlet** is ran and the results are fetched from the database. Go back to the cache monitor window and click on **Cache Contents** and verify that a new entry is created for the word `RAM`. Click on the **Cache ID** and ensure the cached page now contains the full definition.



__15. Experiment with different combinations of lookup and define and verify via cache monitor that the cache is updated as expected.

5.8 Clean up after lab

__1. Remove **Dictionary** application from the server by expanding the **DictionaryServer** in the Server view and right clicking **Dictionary** then click **Remove**.

__2. Stop the **DictionaryServer** by right clicking the **DictionaryServer** in the Server view then click **Stop**.

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