IBM RATIONAL APPLICATION DEVELOPER 6.0 – LAB EXERCISE

Profiling WebSphereBank

What this exercise is about

The objective of this lab is to provide you with an understanding …

Lab Requirements

List of system and software required for the student to complete the lab.

- IBM Rational Application Developer v6.0 with embedded WebSphere Application Server v6.0 Test Environment.
- Rational Agent Controller installed and configured
- Lab source files (Labfiles60.zip) must be extracted to the local system (preferably C:\)

What you should be able to do

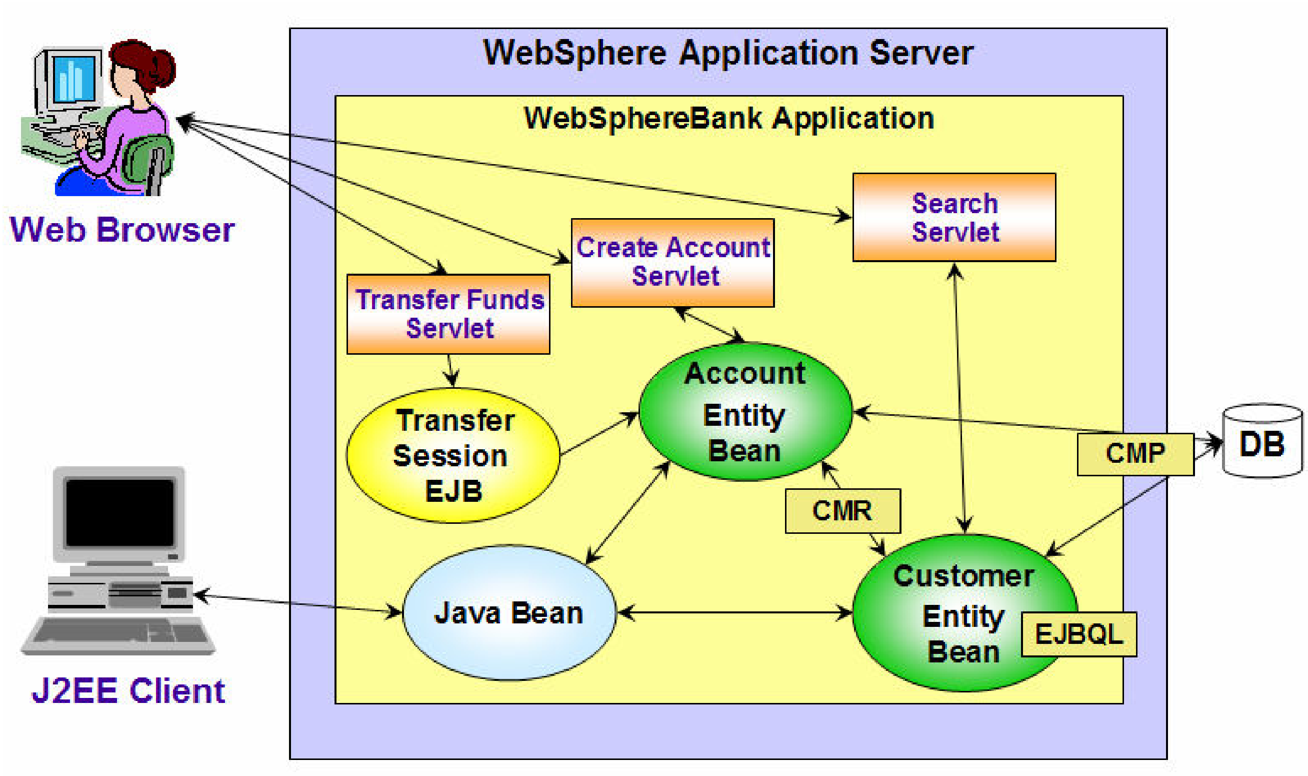
At the end of this lab you should be able to:

- Import an existing EAR file
- Start the WebSphere Application Server v6 test environment in profile mode
- Analyze memory usage profiling data
- Analyze Execution Time Analysis data

Introduction

The profiling capabilities included with IBM Rational Application Developer v6 are aimed at helping developers recognize and isolate a variety of performance problems before these issues become critical in a production environment. The types of problems IBM Rational Application Developer v6.0 can help identify are things such as memory leaks, performance bottlenecks, excessive object creation, and exceeding system resource limits. .

This exercise will highlight how to profile an application running on WebSphere Application Server v6 using the profiling capabilities in IBM Rational Application Developer v6. Specifically, you will use these features to profile the WebSphereBank enterprise application, and analyze this application for possible memory leaks and performance problems.



Exercise Instructions

Some instructions in this lab may be Windows operating-system specific. If you plan on running the lab on an operating-system other than Windows, you will need to execute the appropriate commands, and use appropriate files (.sh vs. .bat) for your operating system. The directory locations are specified in the lab instructions using symbolic references, as follows:

Reference Variable	Windows Location	AIX/UNIX Location
<WAS_HOME>	C:\WebSphere60\AppServer	/usr/WebSphere60/AppServer /opt/WebSphere60/AppServer
<IRAD_HOME>	C:\Program Files\IBM\Rational\SDP\6.0	
<LAB_FILES>	C:\Labfiles60	/tmp/Labfiles60
<TEMP>	C:\temp	/tmp
<LAB_NAME>	IRAD_Profiling	

Windows users please note: When directory locations are passed as parameters to a Java program such as EJBdeploy or wsadmin, it is necessary to replace the backslashes with forward slashes to follow the Java convention. For example, C:\LabFiles60\ would be replaced by C:/LabFiles60/

Part 1: Import the WebSphereBank EAR file

____ 1. Start IBM Rational Application Developer.

__ a. Select **Start > Programs > IBM Rational > Rational Software Development Platform**.

__ b. For the workspace, specify **<LAB_FILES>\IRAD_Profiling\workspace**.

____ 2. When IBM Rational Application Developer v6 opens, close the welcome page.

NOTE: If the Auto Launch Configuration Change Alert window appears click the **Yes** button to change the auto launch eclipse instance to use when opening IBM Rational Software Development Platform in the future.

____ 3. Import the WebSphereBank application into Rational Application Developer for testing.

__ a. Select **File > Import...**

__ b. Select **EAR file** and click **Next**.

__ c. Select **Browse...** and navigate to **<LAB_FILES>\IRAD_Profiling\WebSphereBankInitial.ear** and click **Open**.

__ d. Change the EAR project to **WebSphereBank**.

__ e. Click **Finish**.

Note: If you receive a Confirm Perspective Switch window, click on the **Yes** option to continue.

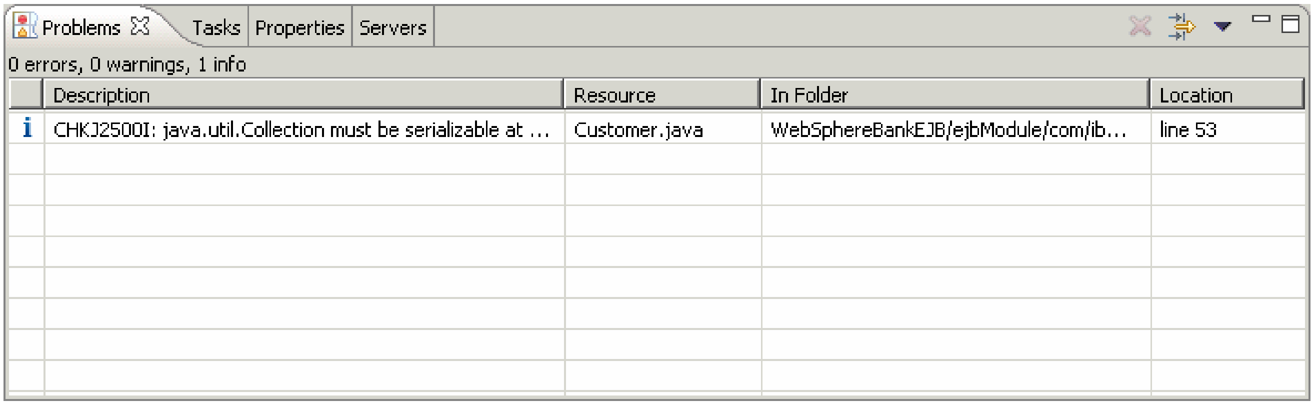
____ 4. When the import is complete, you will notice several errors in the Problems view. These errors arise because the WebSphereBankWeb Dynamic Web Project does not include the WebSphereBankEJB EJB project in the build path. Resolve these errors before you start working with the EJB Mediator support.

__ a. In the Project Explorer view, expand Dynamic Web Projects and right click on **WebSphereBankWeb**. From the context menu select **Properties**.

__ b. Select **Java Build Path** on the left, and click the **Projects** tab. Select the checkbox next to **WebSphereBankEJB**.

__ c. Click **OK**.

__ d. Verify that there are no errors in the Problems view. Your Problems view should look like the following screen capture:



0 errors, 0 warnings, 1 info

	Description	Resource	In Folder	Location
i	CHKJ2500I: java.util.Collection must be serializable at ...	Customer.java	WebSphereBankEJB/ejbModule/com/ib...	line 53

Part 2: Application and Cloudscape Setup

____ 1. Backup your server configuration. This will preserve your current server configuration. You will restore your server configuration at the end of the lab exercise.

__ a. Open a Windows **Command Prompt** and navigate to the following directory:

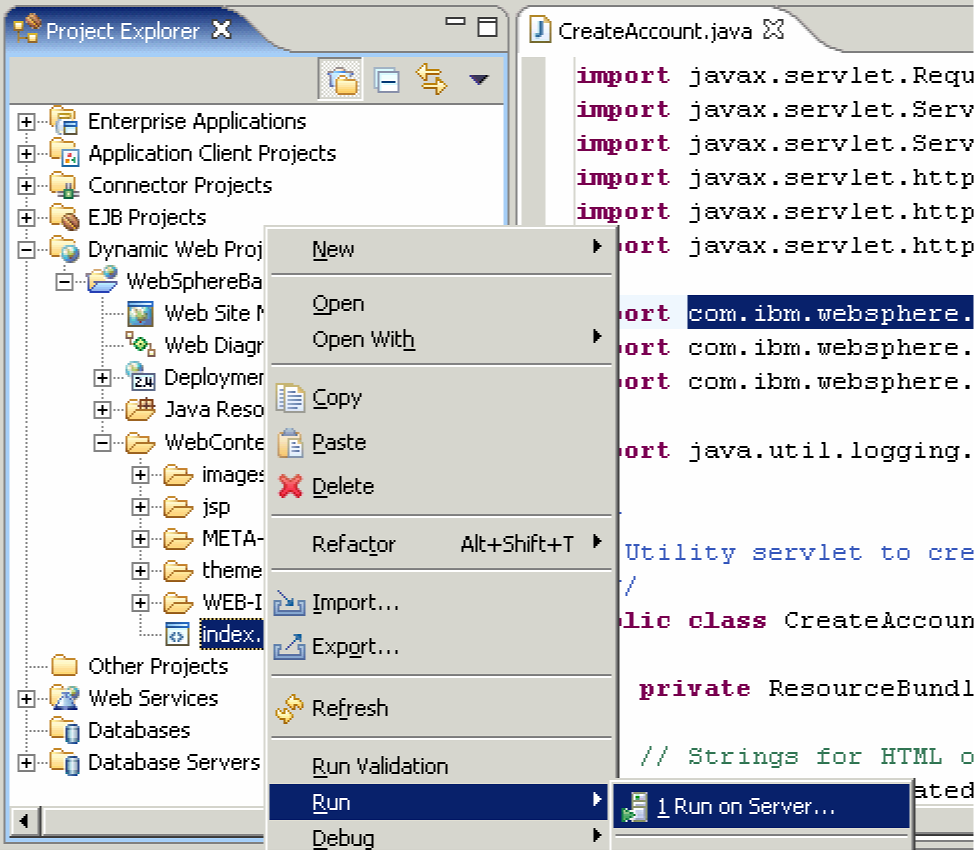
```
<RAD_HOME>\runtimes\base_v6\bin
```

__ b. Backup the server configuration by issuing the following command:

```
backupConfig <LAB_FILES>\<LAB_NAME>\backupconfig.zip
```

____ 2. Start the server with the WebSphereBank project while initializing the database and datasource.

__ a. In the Project Explorer view, navigate to **Dynamic Web Projects** > **WebSphereBankWeb** > **WebContent** and right click on index.html.

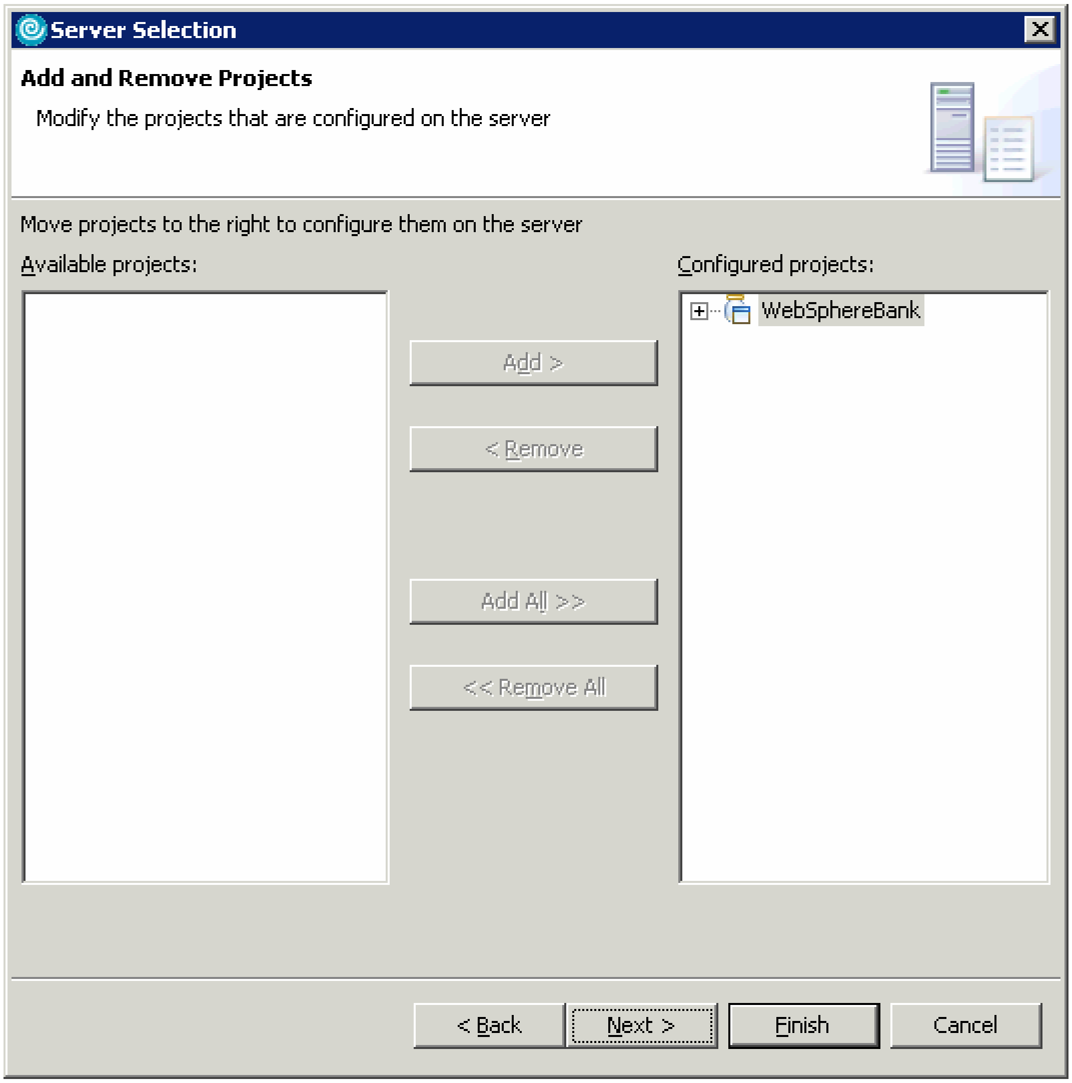


```
import javax.servlet.Requ
import javax.servlet.Serv
import javax.servlet.Serv
import javax.servlet.http
import javax.servlet.http
ort javax.servlet.http

ort com.ibm.websphere.
ort com.ibm.websphere.
ort com.ibm.websphere.

ort java.util.logging.

 Utility servlet to cre
/
lic class CreateAccoun

 private ResourceBundl

 // Strings for HTML o
                     ated
```

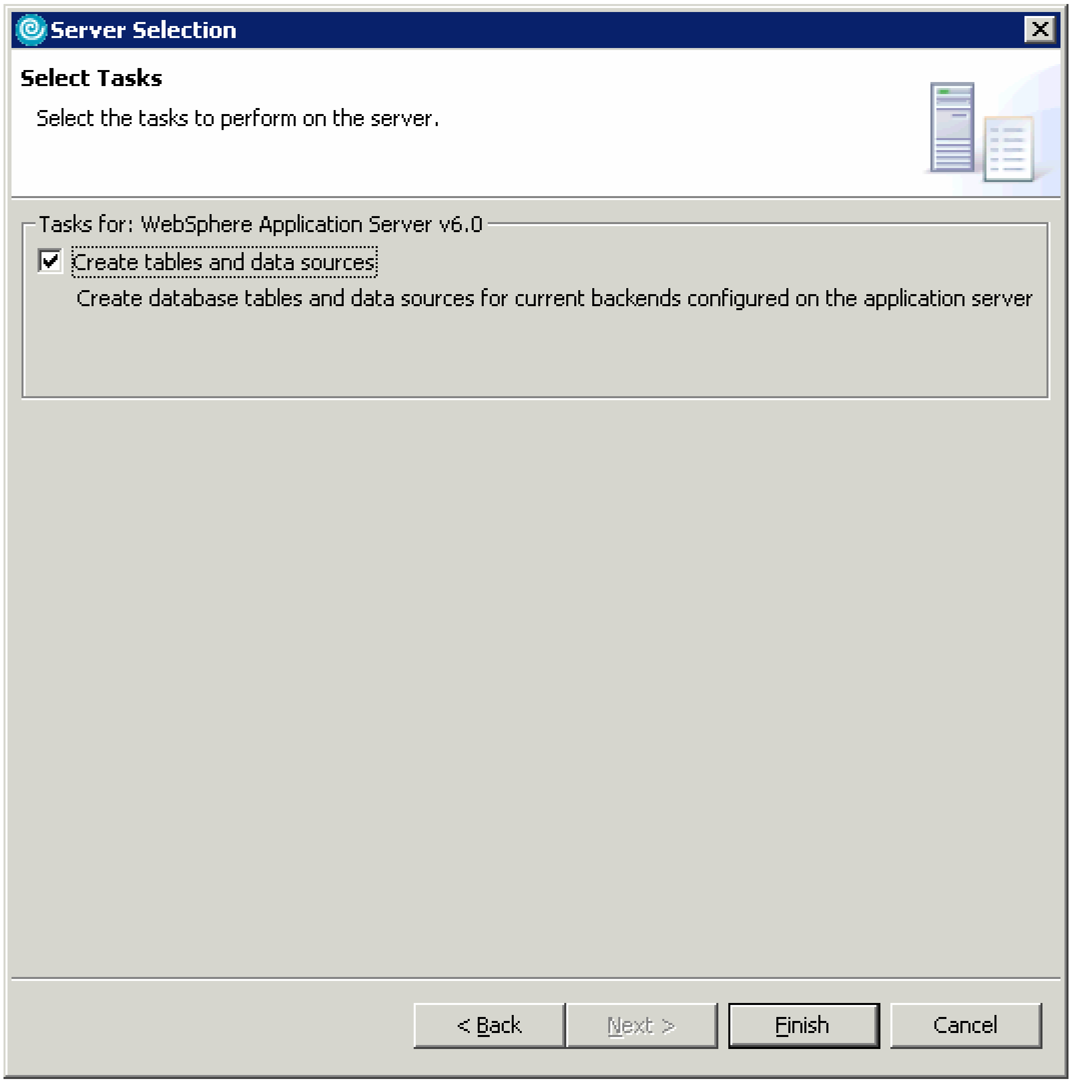
__ b. Select the **Run > Run on Server** option to open the Server Selection window.

__ c. On the Define a New Server page of the Server Selection window make sure the **Choose an existing server** option is selected as well as the server WebSphere Application Server v6.0. Then click on the **Next** button.

__ d. On the **Add and Remove Projects** page, make sure that WebSphereBank is added to the Configured projects list on the right side of the window. Then click on the **Next** button.



__ e. On the **Select Tasks** page, click on the Create tables and data sources checkbox. Then click the **Finish** button.



Select Tasks

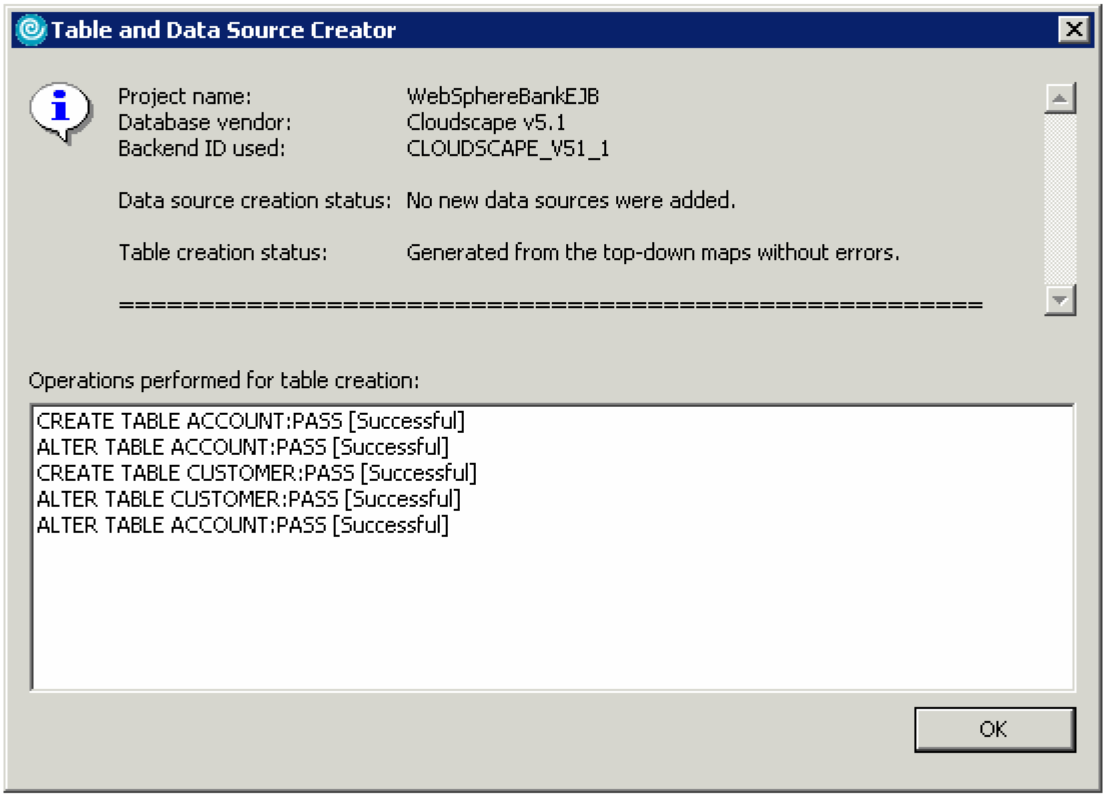
Select the tasks to perform on the server.

Tasks for: WebSphere Application Server v6.0

☑ Create tables and data sources

Create database tables and data sources for current backends configured on the application server

__ f. You should see a window like the one below if the database has been setup successfully.



```
Project name:                WebSphereBankEJB
Database vendor:             Cloudscape v5.1
Backend ID used:             CLOUDSCAPE_V51_1

Data source creation status: No new data sources were added.

Table creation status:       Generated from the top-down maps without errors.

======================================================
```

Operations performed for table creation:

```
CREATE TABLE ACCOUNT:PASS [Successful]
ALTER TABLE ACCOUNT:PASS [Successful]
CREATE TABLE CUSTOMER:PASS [Successful]
ALTER TABLE CUSTOMER:PASS [Successful]
ALTER TABLE ACCOUNT:PASS [Successful]
```

__ g. Click **OK**.

____ 3. Populate the WebSphereBank database with Customer and Account data. For your convenience, and Application Client Project called CreateAccounts has been included with the WebSphereBank EAR file you imported at the beginning of this lab exercise.

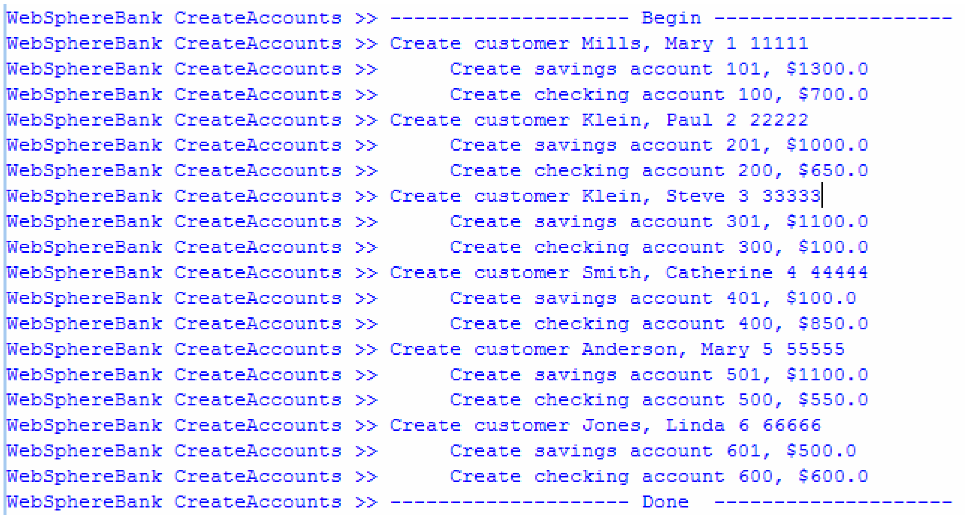
__ a. From the Project Explorer view, expand **Application Client Projects > CreateAccounts > com.ibm.websphere.samples.bank.client**.

__ b. Right click on CreateAccounts.java, and select Run > **Run** from the context menu.

__ c. In the Configurations list, select WebSphere v6.0 Application Client and click the **New** button at the bottom of the list.

__ d. Enter CreateAccounts for the Name and click **Run**.

__ e. When the process has completed you should see the following message in the Console view.



```
WebSphereBank CreateAccounts >> -------------------- Begin --------------------
WebSphereBank CreateAccounts >> Create customer Mills, Mary 1 11111
WebSphereBank CreateAccounts >>      Create savings account 101, $1300.0
WebSphereBank CreateAccounts >>      Create checking account 100, $700.0
WebSphereBank CreateAccounts >> Create customer Klein, Paul 2 22222
WebSphereBank CreateAccounts >>      Create savings account 201, $1000.0
WebSphereBank CreateAccounts >>      Create checking account 200, $650.0
WebSphereBank CreateAccounts >> Create customer Klein, Steve 3 33333
WebSphereBank CreateAccounts >>      Create savings account 301, $1100.0
WebSphereBank CreateAccounts >>      Create checking account 300, $100.0
WebSphereBank CreateAccounts >> Create customer Smith, Catherine 4 44444
WebSphereBank CreateAccounts >>      Create savings account 401, $100.0
WebSphereBank CreateAccounts >>      Create checking account 400, $850.0
WebSphereBank CreateAccounts >> Create customer Anderson, Mary 5 55555
WebSphereBank CreateAccounts >>      Create savings account 501, $1100.0
WebSphereBank CreateAccounts >>      Create checking account 500, $550.0
WebSphereBank CreateAccounts >> Create customer Jones, Linda 6 66666
WebSphereBank CreateAccounts >>      Create savings account 601, $500.0
WebSphereBank CreateAccounts >>      Create checking account 600, $600.0
WebSphereBank CreateAccounts >> -------------------- Done  --------------------
```

Part 3: Memory Leak Analysis

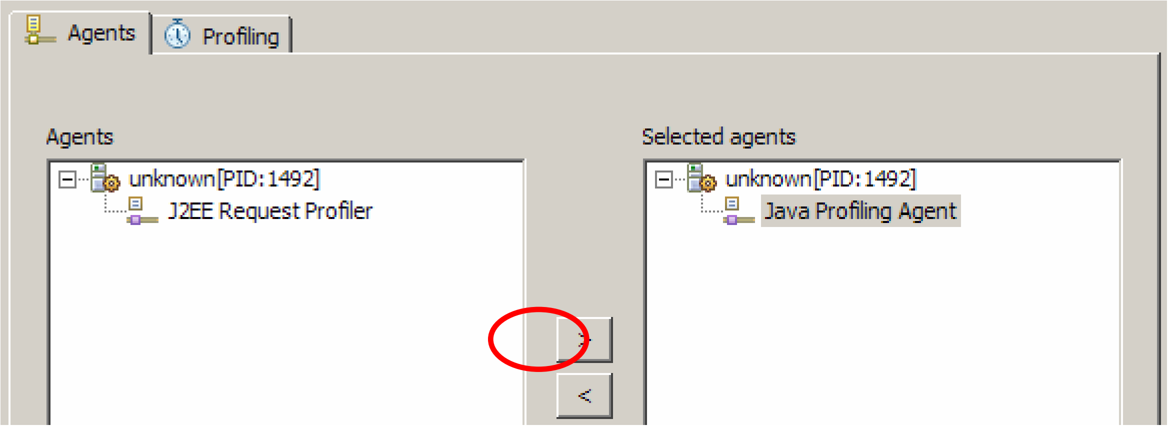
____ 1. Restart the Server in Profile mode.

__ a. From the Server view right click on WebSphere Application Server v6.0 and select **Restart > Profile** from the context menu.

NOTE: If your server status is indicated as "Stopped", right click on WebSphere Application Server v6.0 and select Profile from the context menu.

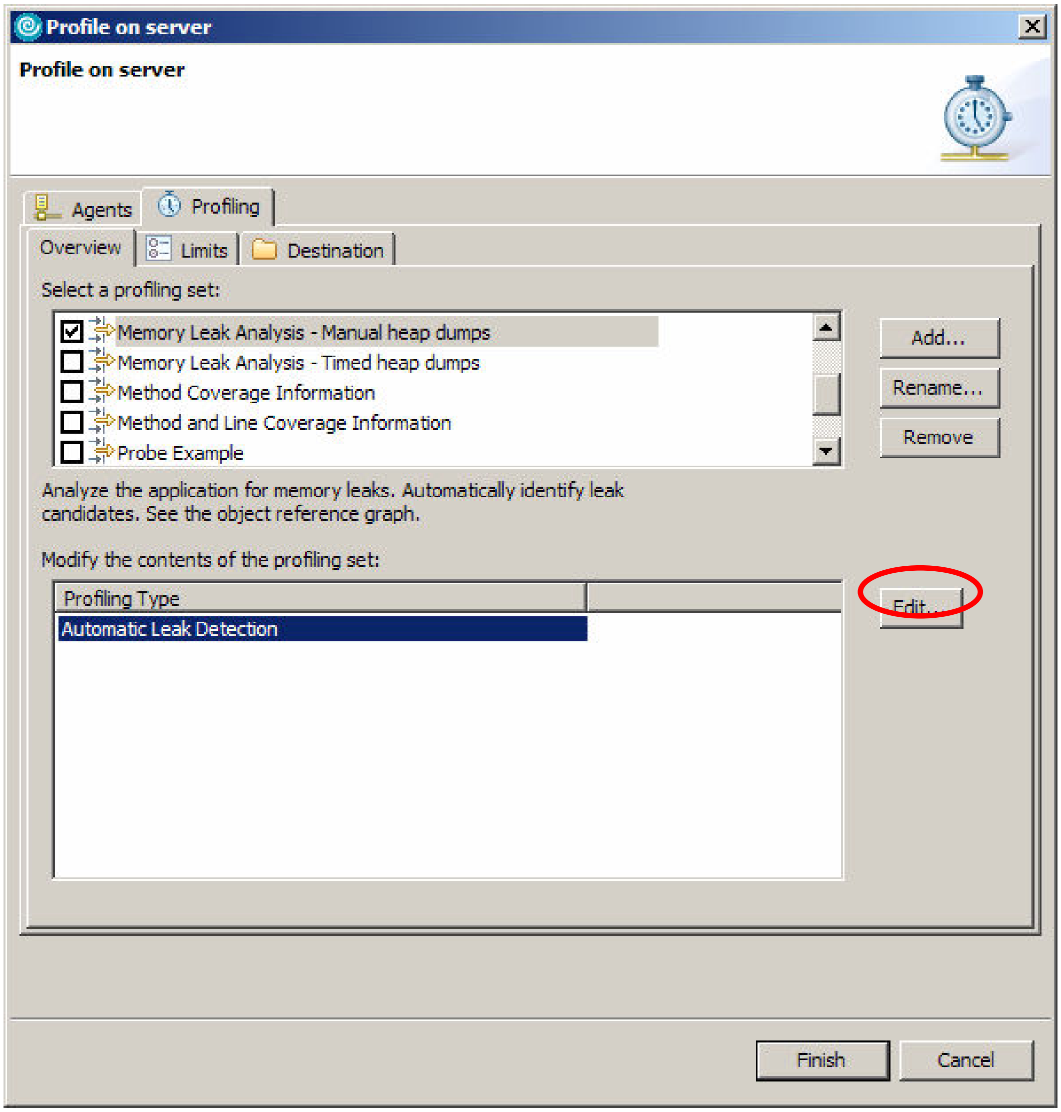
__ b. If a Confirm Enablement dialog appears to enable the Profiling and Logging capabilities, click **OK**.

__ c. You will see a Profile on server configuration window appear. The first step in the configuration process is to select the appropriate agent. From the Agents tab, expand the agent listed under unknown[PID:xxxxx]. Select the **Java Profiling Agent** and click the Add button, circled below, to add this agent to the selected agents list.



__ d. Click on the Profiling tab. On the Overview sub tab, check the box next to **Memory Leak Analysis – Manual heap dumps** from the list of profiling sets.

__ e. To modify the contents of the profiling set, select **Automatic Leak Detection** from the lower list under Profiling Type and click **Edit**.



Select a profiling set:

☑ Memory Leak Analysis - Manual heap dumps
☐ Memory Leak Analysis - Timed heap dumps
☐ Method Coverage Information
☐ Method and Line Coverage Information
☐ Probe Example

Analyze the application for memory leaks. Automatically identify leak candidates. See the object reference graph.

Modify the contents of the profiling set:

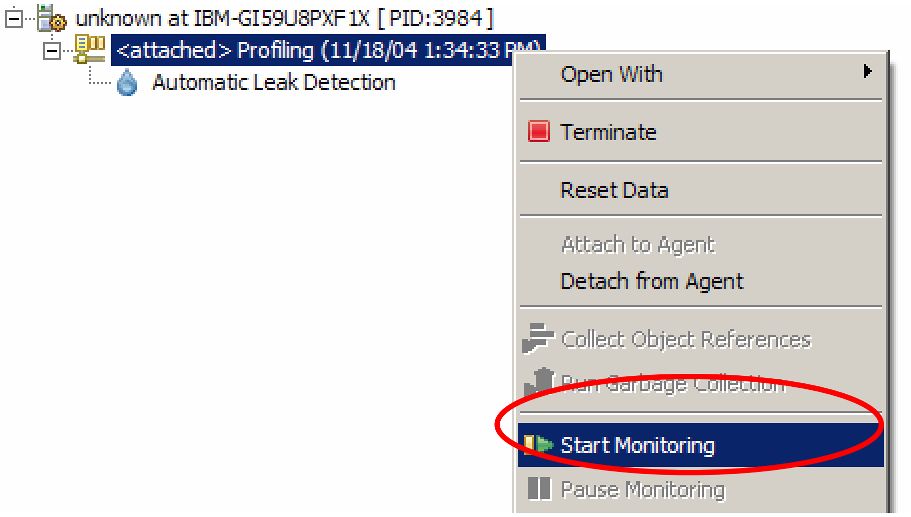
Profiling Type	
Automatic Leak Detection	

__ f. Highlight **Automatic leak detection** from the list of profile sets in the left. This item should already have a check mark next to it. Review the values specified for this profiling set. Verify that the threshold for leak candidates is set to 20. Accept the defaults and click **Finish**.

__ g. Click **Finish** on the Profile on server configuration dialog.

__ h. Notice that the Profiling and Logging perspective opens. A Dialog will appear reminding you to start Monitoring by selecting “Start Monitoring” from the pop-up menu of the agent in the Profiling Monitor view. Click **OK** for this message. You will perform this task in the next step.

__ i. From the Profiling Monitor view, right click on the agent and select **Start Monitoring** from the context menu.



____ 2. Access the WebSphereBank application and exercise the Get Balance function

__ a. Open a web browser and enter the following URL:

```
http://localhost:9080/WebSphereBankWeb/index.html
```

NOTE: You can add the web browser icon to the toolbar for any perspective by selecting Window > Customize Perspective from the menu. From the Customize Perspective window click on the Commands tab and scroll down in the Available command groups window and place a check box next to Web Browser. You should see the icon added to the toolbar. To open a web browser, click this icon on the toolbar.

__ b. From your web browser click on the Get Balance link listed on the left.

__ c. Enter 100 for the Account Number and click the Balance button.

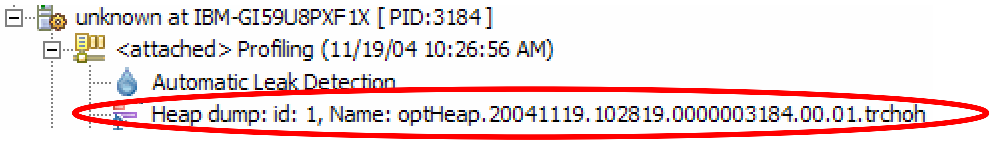
__ d. Repeat the above step and get the balance for accounts 101, 200, 201, 300, 301, 400, 401, 500, and 501. The purpose for this step is to exercise the GetBalanceServlet before collecting the first heap dump for our analysis.

____ 3. Manually collect the first Heap Dump

__ a. From the Leak Candidates view click the ( ) icon on the toolbar.

NOTE: If the Leak Candidates view did not automatically open for you when the Profiling and Logging perspective opened, you can open it by right clicking on the Automatic Leak Detection item underneath the appropriate agent in the Profiling Monitor view.

__ b. After collecting the initial heap dump, you should notice the heap dump listed underneath the appropriate agent in the Profiling Monitor view.

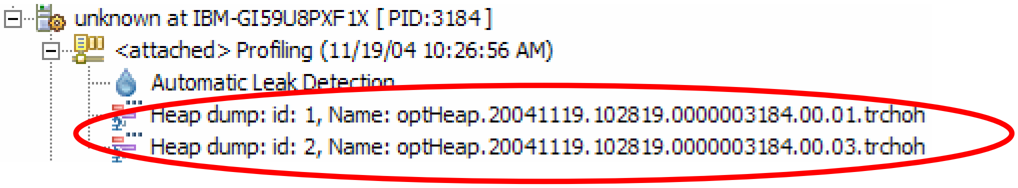

unknown at IBM-GI59U8PXF1X [PID:3184]
<attached> Profiling (11/19/04 10:26:56 AM)
Automatic Leak Detection
Heap dump: id: 1, Name: optHeap.20041119.102819.000003184.00.01.trchoh

____ 4. The memory leak analysis requires at least 2 heap dumps in order to perform an analysis. Access the WebSphereBank application once again and repeat step 2 above.

____ 5. Manually collect a second Heap Dump.

__ a. From the Leak Candidates view, click the icon on the toolbar.

__ b. After collecting the second heap dump you should notice a another heap dump list underneath the appropriate agent in the Profiling Monitor view.



```
unknown at IBM-GI59U8PXF1X [ PID:3184 ]
  <attached> Profiling (11/19/04 10:26:56 AM)
    Automatic Leak Detection
    Heap dump: id: 1, Name: optHeap.20041119.102819.0000003184.00.01.trchoh
    Heap dump: id: 2, Name: optHeap.20041119.102819.0000003184.00.03.trchoh
```

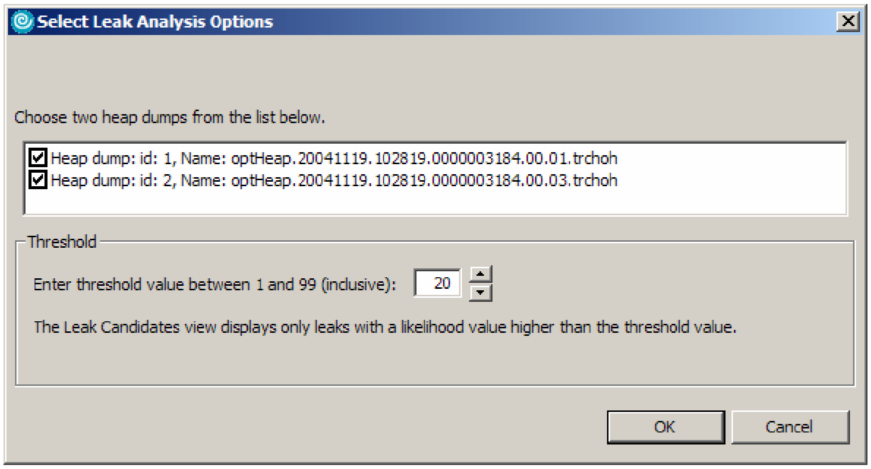
____ 6. Before doing the memory leak analysis, pause monitoring for the appropriate agent listed in the Profiling and Monitor view.

__ a. From the Profiling Monitor view, right click on the agent and select **Pause Monitoring** from the context menu.

____ 7. Analyze heap dumps to identify possible memory leaks.

__ a. From the Leak Candidates view, click on the icon on the toolbar.

__ b. From the Select Leak Analysis Options dialog select heap dump 1 and 2 from the list and accept the default threshold of 20. Click **OK**.



Select Leak Analysis Options

Choose two heap dumps from the list below.

☑ Heap dump: id: 1, Name: optHeap.20041119.102819.0000003184.00.01.trchoh
☑ Heap dump: id: 2, Name: optHeap.20041119.102819.0000003184.00.03.trchoh

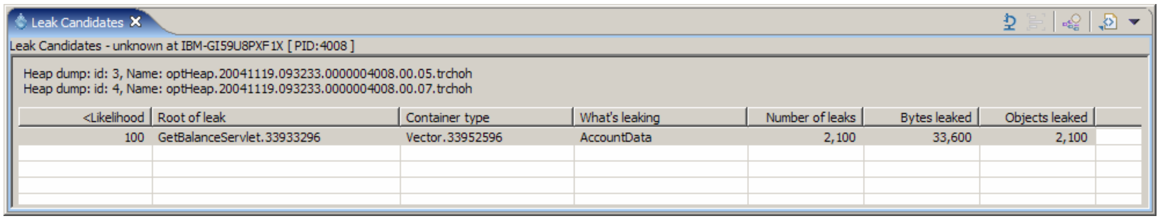
Threshold

Enter threshold value between 1 and 99 (inclusive): 20

The Leak Candidates view displays only leaks with a likelihood value higher than the threshold value.

__ c. It may take several minutes to complete the memory leak analysis. When the process completes you should see one item listed in the Leak Candidates view.

NOTE: If no candidates are found in the first try, turn monitoring back on and try again. The more attempts to get the balance that are made, the more likely the leak will be spotted.

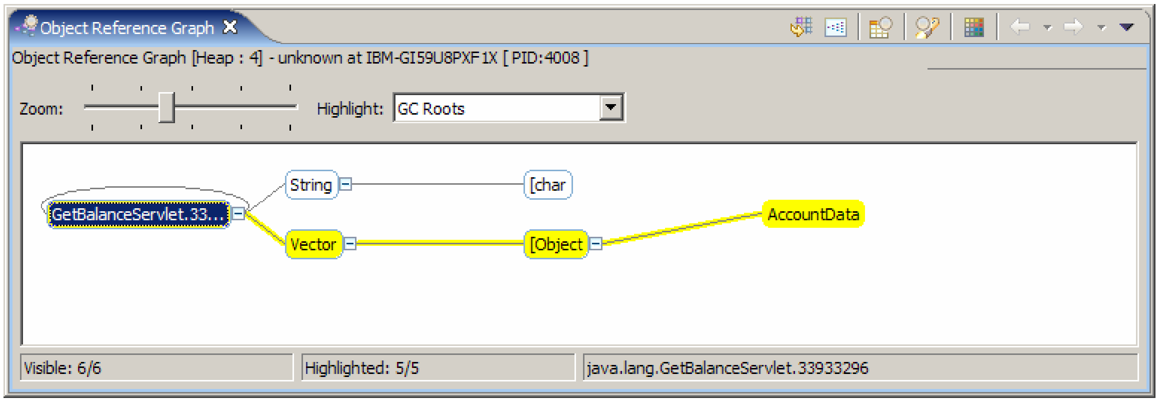


Leak Candidates - unknown at IBM-GI59U8PXF1X [PID:4008]

Heap dump: id: 3, Name: optHeap.20041119.093233.0000004008.00.05.trchoh
Heap dump: id: 4, Name: optHeap.20041119.093233.0000004008.00.07.trchoh

<Likelihood	Root of leak	Container type	What's leaking	Number of leaks	Bytes leaked	Objects leaked
100	GetBalanceServlet.33933296	Vector.33952596	AccountData	2,100	33,600	2,100

__ d. (OPTIONAL) Double click on the GetBalanceServlet item. You will see the Object Reference Graph and the Object Details views open. The Object Reference Graph should look like the following. Notice that this graph shows the allocation path for the object leak.



Object Reference Graph [Heap : 4] - unknown at IBM-GI59U8PXF1X [PID:4008]

Highlight: GC Roots

Visible: 6/6 | Highlighted: 5/5 | java.lang.GetBalanceServlet.33933296

NOTE: The previous step can take a very long time to complete. You can monitor the progress or cancel the process by opening the progress view. To open the Progress view select Window > Show View > Other from the menu bar. The Progress view can be found under the Basic category.

__ e. (OPTIONAL) Click on the Object node in the Object reference graph. Notice that the data displayed in the Object Details view is updated based upon the item selected in the Object Reference Graph. The Object Details view provides information about the size, referrers, and references associated with a particular object in the graph.

____ 8. From the leak analysis we have found that there is a potential object leak in the GetBalanceServlet. Specifically, there is a static Vector type data member in this class that gets AccountData objects added to it each time the GetBalanceServlet is invoked. Since this is a static member of the class, these objects are not garbage collected during the lifetime of the GetBalanceServlet class. To understand this problem, open the GetBalanceServlet and locate the code that creates this issue.

NOTE: You can find the GetBalanceServlet from the Project Explorer view (J2EE perspective) by expanding **Dynamic Web Projects > WebSphereBankWeb > Java Resources > JavaSource > com.ibm.websphere.samples.bank.web**.

What you did in this exercise

In this exercise you used the Profiling features available in IBM Rational Application Developer v6 to analyze the WebSphereBank application for memory leaks and performance problems. This exercise highlighted how to start the WebSphere Application Server v6 test environment in profiling mode, and configure profiling sets for memory analysis and execution time analysis.