

## CNT 4714 – Programming Assignment #4 – Summer 2014

**Title:** “Program Assignment 4: Developing A Three-Tier Distributed Web-Based Application”

**Points:** 100 points (bonus problem potentially adds 15 points – see page 8.)

**Due Date:** **Friday July 11, 2014 by 11:59 pm (WebCourses time)**

**Objectives:** To incorporate many of the techniques you’ve learned so far this semester into a distributed three-tier web-based application which uses servlets running on a Tomcat server to access and maintain a persistent MySQL database using JDBC.

**Description:** In this assignment you will utilize a suppliers/parts/jobs/shipments database (creation/population script available on the course assignment page) as the back-end database. Front-end access to this database by the client will occur through a simple page displayed in the client’s web browser. The schema of this database consists of four tables with the following schemas for each table:

suppliers (snum, sname, status, city) //information about suppliers  
parts (pnum, pname, color, weight, city) //information about parts  
jobs (jnum, jname, numworkers, city) //information about jobs  
shipments (snum, pnum, jnum, quantity) //suppliers ship parts to jobs in specific quantities

The first-tier (client-level front-end) of your application will be a simple HTML page that allows the client to enter SQL commands into a window (i.e. a form) and submit them to the server application for processing. The front-end (and only the front-end) can utilize JSP technology if you wish. The client front-end will provide the user a simple form in which they will enter a SQL command (any DML, DDL, or DCL command could be entered by the user). The front-end will provide only two buttons for the user, and Execute button that will cause the execution of the SQL command they enter, and a Reset button that simply clears any content in the form input area. The client front-end will run on any web-based browser that you would like to use. You can elect to have a default query or not, it is entirely your decision.

The second-tier servlet, in addition to handling the SQL command interface will also implement the business/application logic. This logic will increment by 5, the status of a supplier anytime that supplier is involved in the insertion/update of a shipment record in which the quantity is greater than or equal to 100. Note that any update of quantity  $\geq 100$  will affect any supplier involved in a shipment with a quantity  $\geq 100$ . The example screen shots illustrate this case. An insert of a shipment tuple (S5, P6, J7, 400) will cause the status of every supplier who has a shipment with a quantity of 100 or greater to be increased by 5. In other words, even if a supplier’s shipment is not directly affected by the update, their status will be affected if they have any shipment with quantity  $\geq 100$ . **(See page 8 for a bonus problem that implements a modified version of this business rule.)** The business logic of the second tier will reside in the servlet on the Tomcat web-application server (server-side application). This means that the business logic is not to be implemented in the DBMS via a trigger.

The third-tier (back-end) is the persistent MySQL database described above and is under control of the MySQL DBMS server. All you need to do with the database is run the creation/population script. See the important note below concerning when/how to re-run this script for your final submission.

## References:

Notes: Lecture Notes for MySQL installation and use. Documentation for MySQL available at: <http://www.mysql.com>. More information on JDBC can be found at: <http://docs.oracle.com/javase/6/docs/technotes/guides/jdbc/>. More information on Tomcat can be found at <http://tomcat.apache.org>. Lecture Notes for Servlets. Lecture Notes for JSPs.

## Restrictions:

Your source file shall begin with comments containing the following information:

**/\* Name:**

**Course: CNT 4714 – Summer 2014 – Project Four**

**Assignment title: Developing A Three-Tier Distributed Web-Based Application**

**Date: July 11, 2014**

**\*/**

**Input Specification:** The suppliers/part/jobs/shipments database that is created/populated by the script `project4dbscript.sql`, is the back-end to this application. All other input comes from the front-end client submitted to the application server based servlet entered as either queries or updates to this database. The set of commands that you are to execute against this database are included in the `project5commands.sql` file available on the course homework page. I do not expect your front-end to execute the script. You'll need to execute the commands in this script one at a time in your application (copy and paste!). I've put them into a script file for convenience and so that you can run the script in the MySQL Workbench if you'd like to compare/see the result sets for each user command.

**Output Specification:** All output is generated by the servlet and should appear in the user's browser as a text/html page presented to the user. **IMPORTANT:** Be sure to re-run the `project4` database creation/population script before you begin creating your screen shots for submission. By doing so you will ensure that the database is in its initial state so that all update operations will produce the values we are expecting to see in your result outputs.

## Deliverables:

- (1) You should submit your entire `webapps` folder from Tomcat for this program. If you submit the entire folder, then all of the files necessary to execute your web application will be included with the directory structure intact. Submit this via WebCourses no later than **11:59pm Friday July 11, 2014**.
- (2) The following 11 screen shots must be submitted along with your `webapps` folder. (You can include the screenshots in the top-level of your `webapps` folder if you'd like, just be sure to include a note that you've done so.)
  - a. Command 1
  - b. Command 2
  - c. Command 3A
  - d. Command 3B – output may vary here
  - e. Command 3C
  - f. Command 4A – output may vary here
  - g. Command 4B
  - h. Command 4C – output may vary here
  - i. Command 4D
  - j. Command 5
  - k. Command 6

**Additional Information:**

Be very careful when setting up the directory structures required for the web applications running under your server (Tomcat 7.0.52 or later). See the course notes on servlets for the exact directory structure that must be developed.

**Important:** Please name your webapp: **Project4**. Let the Ana (the TA) know if you are doing the bonus problem by attaching a note to your WebCourses submission.

**Some screen shots illustrating the application.**

Main client screen (initial configuration using a default query string):

The screenshot shows a web browser window with the URL `localhost:8080/Project4/MySQLServlet`. The page title is "Welcome to the Project 4 Remote Database Management System". Below the title, there is a message: "You are connected to the Project4 database. Please enter any valid SQL query or update statement. If no query/update command is given the Execute button will display all supplier information in the database. All execution results will appear below." A yellow text input area contains the query `select * from suppliers`. Below the input area are two buttons: "Execute Command" and "Clear Form". Below the buttons is a section titled "Database Results:" containing a table with the following data:

snum	sname	status	city
S1	Michael Scuhmacher	1	Berlin
S10	David Coulthard	2	London
S11	Bernard Hinault	7	Paris

Annotations in the image include:

- "User input area." pointing to the yellow text box.
- "Two form buttons" pointing to the "Execute Command" and "Clear Form" buttons.
- "All results returned in this area." pointing to the "Database Results:" table.

Client simply clicks the “Execute Command” button and the SQL command in the form is executed:

The screenshot shows a web browser window with the URL localhost:8080/Project4/MySQLServlet. The page has a blue background and contains two buttons: "Execute Command" and "Clear Form". Below the buttons, the text "Database Results:" is displayed above a table. The table has four columns: snum, sname, status, and city. The data rows are as follows:

snum	sname	status	city
S1	Michael Scuhmacher	1	Berlin
S10	David Coulthard	2	London
S11	Bernard Hinault	7	Paris
S12	Eddy Merckx	1	Brussels
S17	Rubens Barichello	3	Sao Paulo
S2	Juan Pablo Montoya	4	Interlagos
S22	Jan Ullrich	5	Bonn
S3	Dietrich Thurau	1	Berlin
S32	Bernd Schnieder	2	Berlin
S4	Mark Webber	5	Melbourne
S5	Jenson Button	4	London
S6	Nicola Gianniberti	2	Milan
S7	Christian Albers	3	Orlando
S8	Giancarlo Fisichella	3	Milan
S9	Kimi Rikonnen	2	Helsinki

Results from running the query “select \* from suppliers” – to be used to illustrate an update operation explained on pages 6-8. Notice that the supplier S5’s status is currently 4.

Client makes a mistake typing a query:

The screenshot shows a web browser window with the following content:

- Browser tabs: CNT 4714 Remote Databas, Striped Table, /manager
- Address bar: localhost:8080/Project4/MySQLServlet
- Page title: Welcome to the Project 4 Remote Database Management System
- Text: You are connected to the Project4 database. Please enter any valid SQL query or update statement. If no query/update command is given the Execute button will display all supplier information in the database. All execution results will appear below.
- Text input field: `select something from suppliers`
- Buttons: Execute Command, Clear Form
- Section: Database Results:
- Error message: **Error executing the SQL statement:** Unknown column 'something' in 'field list'

There is no column named something in the shipments table.

**Error executing the SQL statement:**  
Unknown column 'something' in 'field list'

Error message is returned from MySQL indicating the problem with the operation.

Inserts and updates may cause changes to the supplier status field (business logic is triggered) as shown below:

Client issues the following insert command.

Alert message when an update to the quantity field in the shipments table has caused an update of a supplier's status in the supplier table. Note that in my application, I used this alert message any time the business logic was tested even if it did not trigger any updates. This means that this message would appear with different values even if no rows are updated.

After executing update command (the previous insert), client runs `select * from suppliers`.

Please enter any valid SQL query or update statement.  
If no query/update command is given the Execute button will display all supplier information in the database.  
All execution results will appear below.

```
select * from suppliers
```

**Execute Command** **Clear Form**

**Database Results:**

snum	sname	status	city
S1	Michael Scuhmacher	6	Berlin
S10	David Coulthard	2	London
S11	Bernard Hinault	7	Paris
S12	Eddy Merckx	1	Brussels
S17	Rubens Barichello	3	Sao Paulo
S2	Juan Pablo Montoya	9	Interlagos
S22	Jan Ullrich	10	Bonn
S3	Dietrich Thurau	6	Berlin
S32	Bernd Schnieder	2	Berlin
S4	Mark Webber	5	Melbourne
S5	Jenson Button	9	London
S6	Nicola Gianniberti	7	Milan
S7	Christian Albers	3	Orlando
S8	Giancarlo Fisichella	3	Milan
S9	Kimi Rikonnen	2	Milan

Notice on page 4 (in the original suppliers table) that supplier S5 had a status of 4. After this update, the business logic has increased supplier S5's status by 5, so it is now 9.

Notice too, that suppliers S1, S2, S6, S22, and S3) also had their status increased by 5, since they were involved with a shipment in which the quantity was  $\geq 100$  when the insert command was issued. See bonus problem below for a "fix".

## BONUS PROBLEM: 15 points

Instead of allowing any update/insert of a quantity  $\geq 100$  to affect any supplier with a shipment involving a quantity  $\geq 100$ , adjust the business logic portion of your application so that an insert/update of a quantity greater than 100, causes a change to the status of only those suppliers affected by the update. For example, using the case shown above, when inserting the row (S5, P6, J7, 400) into the shipments table, only the status of supplier S5 should be increased by 5 (see screen shot below). However, an update such as: UPDATE shipments SET quantity = quantity + 50 WHERE pnum = "P3", would increase by 5 the status of every supplier who ships part P3 in a quantity  $\geq 100$  after the update has been issued.

NOTE: If you elect to do the bonus problem, submit only this version of your application. Do not also submit the non-bonus problem version. Let Ana (the TA) know if you've elected to do the bonus problem or not.

The screenshot shows a database application interface with a blue background. At the top, it says "All execution results will appear below." Below this is a yellow text box containing the SQL command: `insert into shipments values ('S5', 'P6', 'J7', 400)`. Underneath the text box are two buttons: "Execute Command" and "Clear Form". A horizontal line separates the command area from the results area. The results area is titled "Database Results:" and contains a green box with the following text: "The statement executed successfully. 1 row(s) affected. Business Logic Detected! - Updating Supplier Status Business Logic updated 1 supplier status marks."



Immediately after issuing the update (insert above), the user reruns the select \* from suppliers query:

Please enter any valid SQL query or update statement.  
If no query/update command is given the Execute button will display all supplier information in the database.  
All execution results will appear below.

```
select * from suppliers
```

**Execute Command** **Clear Form**

**Database Results:**

snum	sname	status	city
S1	Michael Schumacher	1	Berlin
S10	David Coulthard	2	London
S11	Bernard Hinault	7	Paris
S12	Eddy Merckx	1	Brussels
S17	Rubens Barichello	3	Sao Paulo
S2	Juan Pablo Montoya	4	Interlagos
S22	Jan Ullrich	5	Bonn
S3	Dietrich Thureau	1	Berlin
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S4	Mark Webber	5	Melbourne
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S7	Christian Albers	3	Orlando
S8	Giancarlo Fisichella	3	Milan
S9	Kimi Rikonnen	2	Helsinki

Notice that this time, with the improved business logic that only the supplier directly affected by the insert has had their status updated, all other supplier status values remain unchanged.