# CNT 4714 – Project Three – Spring 2025

**Title:** "Project Three: A Two-Tier Client-Server Application Using MySQL and JDBC"
**Points:** 100 points
**Due Date: Friday March 14, 2025 by 11:59 pm (WebCourses Time)**

**Objectives:** To develop two-tier Java based client-server applications interacting with a MySQL database utilizing JDBC for the connectivity. This project is designed to give you some experience using the various features of JDBC and its interaction with a MySQL DB Server environment.

**Description:** In this project you will develop a Java-based GUI front-end (client-side) application that will connect to your MySQL server via JDBC. The application will let clients with various permissions execute SQL commands against different databases. You will also develop a more specialized GUI interface as a monitoring application.

**Detailed Description:** You will ultimately develop two different Java applications that will allow clients (the end-users) to execute SQL commands against a remote database. The first of these applications will allow general types of end-users (clients that you will create) to issue SQL commands against various databases. The second of these applications will be very closely based on the first application but is restricted to a specialized accountant client (more on this application below). For the first application, you will create a Java GUI-based front-end that will accept any MySQL DDL or DML command, pass this through a JDBC connection to the MySQL database server, execute the statement and return the results to the clients. Note that while technically your application must be able to handle any DDL or DML command, we won't actually use all of the commands available in these sublanguages. For one thing, it would be quite rare to allow a client to create a database or a table within a database. Note too, that the only DML command that uses the `executeQuery()` method of JDBC is the Select command, all other DML and DDL commands utilize `executeUpdate()`. Some screen shots of what your Java GUI front-end should look like are shown below. Basically, this GUI is an extension of the GUI that was developed in the lecture notes and is available on WebCourses as DisplayQueryResults.java. Your Java application must give the user the ability to execute any SQL DDL or DML command for which the user has the correct permissions. User information for connections will be maintained in properties files, but each user must supply their username and password (for their MySQL server account) via the GUI for verification purposes (more later). You will be able to start multiple instances of your Java application and allow different clients to connect simultaneously to the MySQL DB sever, since the default number of connections is set at 151 (See your Workbench options file under the networking tab). In addition to the client interactions with your application, a background (business logic) transaction logging operation will occur which keeps a running total of the number of queries and the number of updates that have occurred via each different user's interactions with your application (aggregate over all separate connections per user). This is a separate database (i.e., a completely different database than any to which a client user can connect), to which the application will connect, using special application-level privileges in a separate properties file. This separate properties file is not accessible by any end user. Each user operation will cause the application to make this connection and update the operational logging database table. More details on this aspect of the application are shown below and will be covered in the Q&A sessions. The second application that you develop will be essentially

a ”special-case” version of the first application, but will be restricted to an accountant-level client whose permissions are restricted to viewing (querying) this transaction logging database.

Once, you've created your main application, you will execute a sequence of DML and DDL commands and illustrate the output from each in your GUI for three different users. For this project you will create, in addition to the root user, two client users with limited permissions on the databases (see below), and an accountant-level users with limited permissions on the transaction logging database.. The root user is assumed to have all permissions on the databases, any command they issue will be executed. The client users will be far more restricted.

**Restrictions:**

1. Your source files for the main application should begin with comments containing the following information:

```
/*
        Name: <your name goes here>
        Course: CNT 4714 Spring 2025
        Assignment title: Project 3 – A Two-tier Client-Server Application
        Date:  March 14, 2025

        Class:  <name of class goes here>
*/
```

2. Your source files for the secondary application should begin with the comment containing the following information:

```
/*
        Name: <your name goes here>
        Course: CNT 4714 Spring 2025
        Assignment title: Project 3 – A Specialized Accountant Application
        Date:  March 14, 2025

        Class:  <name of class goes here>
*/
```

3. Your applications must provide a user interface, similar to the ones shown below, that will allow the proper category of user the ability to connect to selected databases via properties files. Your applications (both of them) **must** verify that the user credentials (username and password) entered via the interface match with the user credentials found in the properties file that was selected via the interface. If the credentials do no match, then no connection is established.
4. Non-query commands must display a message to the user regarding the status of the executed command (see below).
5. The project3app “client user” commands **must** be issued using the PreparedStatement interface. No exceptions.

**References for this assignment:**
Notes: Lecture Notes for MySQL and JDBC. Lecture and Q&A Session Videos.

**Input Specification:**

The **first step** in this assignment is to login to the MySQL Workbench as the **root user** and execute/run the scripts to create and populate the backend databases required for this project. (You can use the MySQL Workbench for this step, or the command line whichever you prefer.) You will also be using the **bikedb** from the notes. The script to create this database is already on Webcourses and if you have gone through the examples from the Module 3 notes (as you should have done), then you will have already created this database. If not, create it now. There are two scripts available on the project page to create these databases.

1. The first is named: `project3dbscript.sql`. This script creates a database named **project3**.
2. The second is named: `project3operationslog.sql`. This script creates a database named **operationslog**. This database will only be used and accessed by the project 3 application itself (project3app) and a special accountant-level user (theaccountant - see below), it is not intended to be accessed by normal end users.

The **second step** is to create client-level users. You will be creating four different "client-level" users for this project. These users will have the names: `client1, client2, project3app,` and `theaccountant`. The passwords for each of these client-level users will be the same as their username. These users will be created using the script named `clientCreationScriptProject3.sql`. Again, enter the MySQL Workbench as the root user and the execute this script. Your client-level users will all be created once the script executes. This script needs to executed only one time. Once the client-level users are created, they will be valid until they are explicitly removed from the system.

The **third step** is to assign the correct permissions to each of the users. By default your root user has all permissions on the **project3** and **bikedb** databases (any database actually). To assign the correct permissions to the various users, execute the `clientPermssionsScriptProject3.sql` script in the Workbench (or from the command line, whichever you prefer). This script will assign the following permissions to the users:

1. client1: select on **project3** and **bikedb**
2. client2: select, update on **project3** and **bikedb**
3. project3app: select, insert, update on **operationslog**
4. theaccountant: select on **operationslog**

Again, this script will only need to be executed one time.

**Output Specification:**
There are four parts for the output for this project.

1. Part 1 is to provide *screen shots from your application* which clearly show the complete query/command expression and results for each of the commands that appear in the script named: **`project3rootscript.sql`** available on Webcourses. There are ten different

commands in this script and some of the commands will have more than one output capture (see below).

2. Part 2 is to provide *screen shots from your application* which clearly show the complete query/command expression and results for each of the commands that appear in the script named: **`project3client1script.sql`** available on Webcourses. There are seven different commands in this script and some of the commands will have more than one output capture (see below).
3. Part 3 is to provide *screen shots from your application* which clearly show the complete query/command expression and results for each of the commands that appear in the script named: **`project3client2script.sql`** available on Webcourses. There are seven different commands in this script and some of the commands will have more than one output capture (see below).
4. Part 4 is to provide three screenshots. The *first two are taken from the perspective the accountant specific interface application* (see page 16 number 12 and page 18 number 13 for examples), that shows:
   (1) the results of the query –

```
"select num_queries
from operationscount
where login_username = "root@localhost";
```

   and, (2) `select * from operationscount;`

   The *final screenshot (3) is taken from the perspective of the Workbench* (see page 19 number 14). Login to the MySQL Workbench as the root user and execute the following query: `select * from operationscount;` **(Note that this is the ONLY screenshot that is taken from the perspective of the MySQL Workbench. All other screenshots are taken of your applications running the various commands in the script files.)**

**To produce your final output, first recreate all of the databases by rerunning their creation/population scripts, then run the root user commands followed by the client1 commands, followed by the client2 commands in script order within each script file. Then run the commands from part 4 above.**

**Deliverables:**

**NOTE: Be sure to label each screenshot. Use the convention: RootCommand1, RootCommand2A, RootCommand2B, and so on. Similarly for Client1Command1, Client1Command2A, and so on.**

1. All of the .java files associated with your project, along with any other necessary files. Put all of these files in a folder named: **Source Code**.
2. All 17 screenshots from the execution of the commands specified in the **`project3rootscript.sql`** script. All screenshots in this part are of your application executing the commands. Place all 17 of these screenshots in a folder named: **Root Commands Screenshots**.
3. All 11 screenshots from the execution of the commands specified in the **`project3client1script.sql`** script. All screenshots in this part are of your

application executing the commands. Place all 11 of these screenshots in a folder named: **Client1 Commands Screenshots**.

4. All 11 screenshots from the execution of the commands specified in the **`project3client2script.sql`** script. All screenshots in this part are from your application executing the commands. Place all 11 of these screenshots in a folder named: **Client2 Commands Screenshots**.
5. All 3 screenshots from item 4 above. Place all 3 of these screenshots in a folder named: **Accountant-OperationsLog Screenshots**.
6. A screenshot showing a mismatch between the user-entered credentials and the selected properties file resulting in no connection to the database being established. See page 15 in this document. Place this one screenshot in a folder named: **Credentials Mismatch Screenshot**.

**All of the above deliverables should be uploaded to WebCourses no later than 11:59pm Friday March 14. 2025. Zip everything into a single archive to upload. This .zip archive should contain the 6 folders, containing the contents described above, as well as being named as described above.**

**Additional Details:**

Beginning on page 7 are screen shots of the initial GUIs and subsequent uses of the UIs. Notice in the main application, that there are drop-down lists for selecting the various properties file that will be used to make the user connection. There will be properties files that maintain database driver and URL information as well as properties files that maintain user details for the connections. The driver and database URL will be maintained in properties files using the naming convention databasename.properties. The user credentials will be maintained in properties files using the naming convention username.properties. user credentials along with the JDBC driver and database URL will be specified in these files. The client must enter only their user credentials (username and password) through the GUI. Your application must verify that the user-entered credentials match those in the specified properties file before making a connection to the database. If the user entered credentials do not match those in the specified properties file, a message will be displayed to the user and no connection to the database will be established. Note that the properties file associated with the theaccountant user is not split into two properties files…all properties are contained in one file for this application only.

You must provide buttons for the user to clear the command window as well as the result window. You must provide buttons for establishing a connection as well as terminating a connection. The status of the connection should be returned to the GUI and displayed in the connection area. You must also provide buttons for clearing the command input area as well as the results area

The output of all SQL commands should be returned to the SQL Execution Result window. Please note that only single SQL commands can be executed via this application (we will not execute scripts of commands). We will also not go to the effort of making the application display the results of MySQL-specific commands. (When a MySQL-specific command is executed, the SQL Execution Result window does not need to display any results, if you wanted to you could display the line "MySQL command executed" in the results window, but this is not required.)

As each command in the various user scripts is executed (only successful commands – some of the commands in the various scripts will not be successful) the **operationscount** table in the **operationslog** database must be updated by your application. Note that the **operationscount** table is initially empty as defined in the creation script. Each user's queries and updates will be logged (counted) separately. Your application must obtain a connection to the **operationslog** database and perform the updates with project3app user credentials. Only successful operations will be logged – any transaction that errors will not increment any counter. These operations are invisible to the end user (regardless of who the user is, including root users). The application must connect to the **operationslog** database (as the project3app user) using a properties file which contains all necessary connection information. Note that any commands executed by theaccountant user will not be logged into this database.

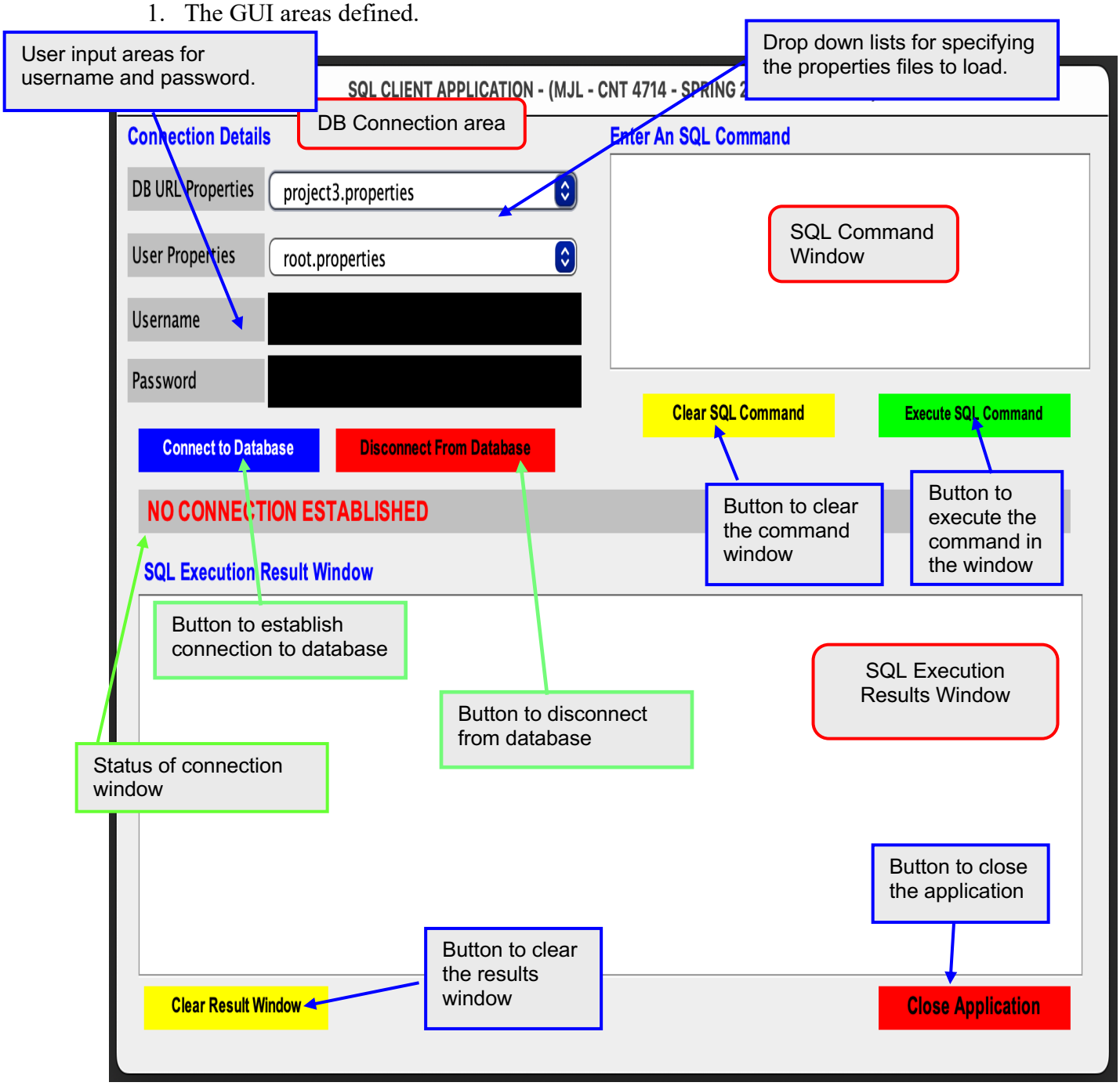
Note that for non-query DML and DDL commands, before and after screen shots must be taken to illustrate the basic effect of the command. See pages 12-14 for an illustration of this.

The remainder of the document illustrates the application at various phases during execution.

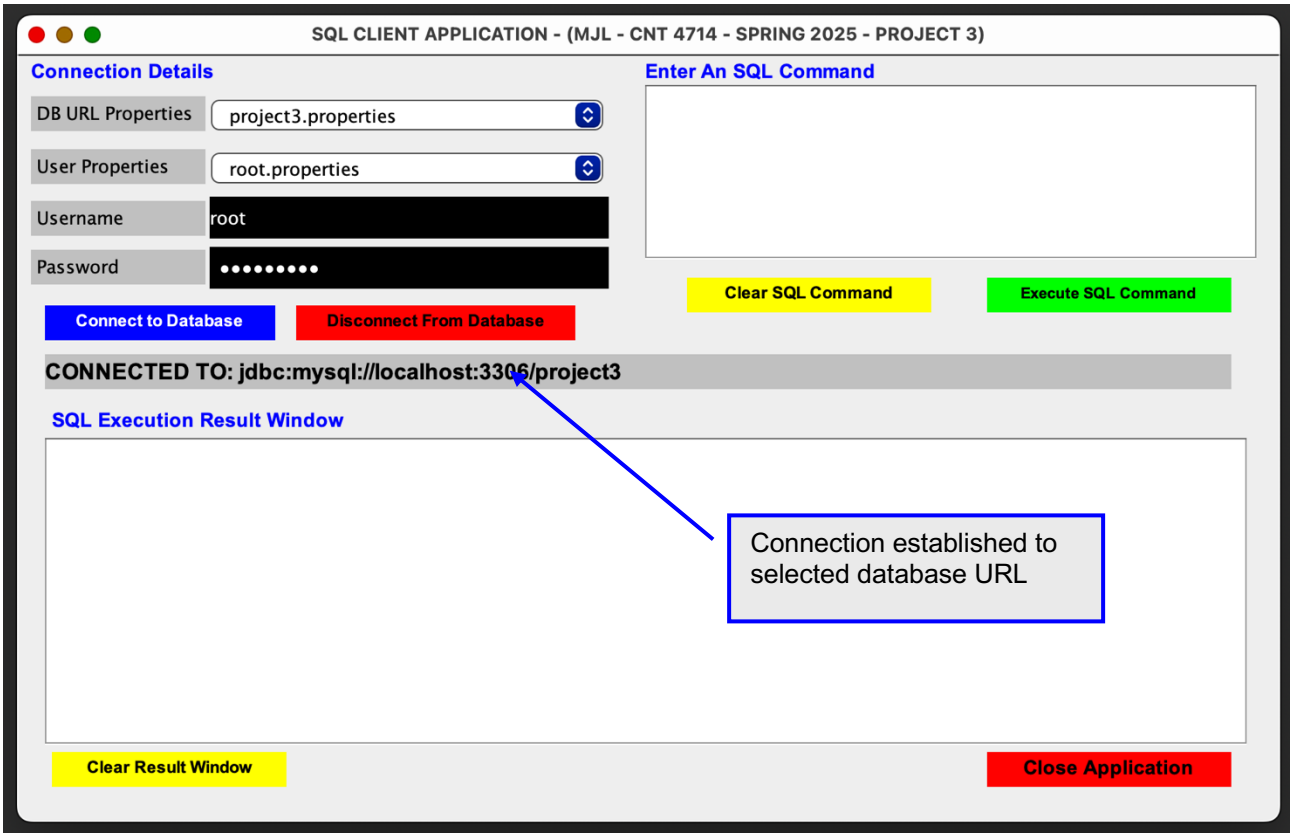
Many features and nuances of this project will be discussed in detail in the upcoming Q&A sessions. This document does **NOT** reflect every detail of this project, so pay attention to the Q&A session videos for the discussion of the various implementation details.

Your user interfaces (GUIs) should look reasonably similar to the ones shown below. Layout can be slightly altered, but should basically have the same overall look and feel (your colors may vary, but strive for good design and color contrast (readability)). Functionality must be identical to that described in this document. Button functionality is important. User should be able to disconnect from one connection and reconnect on another without needing to close the application. When the user click the Close Application button, the application must exit properly and not just abort. Open connections should be closed to allow the program to terminate gracefully.

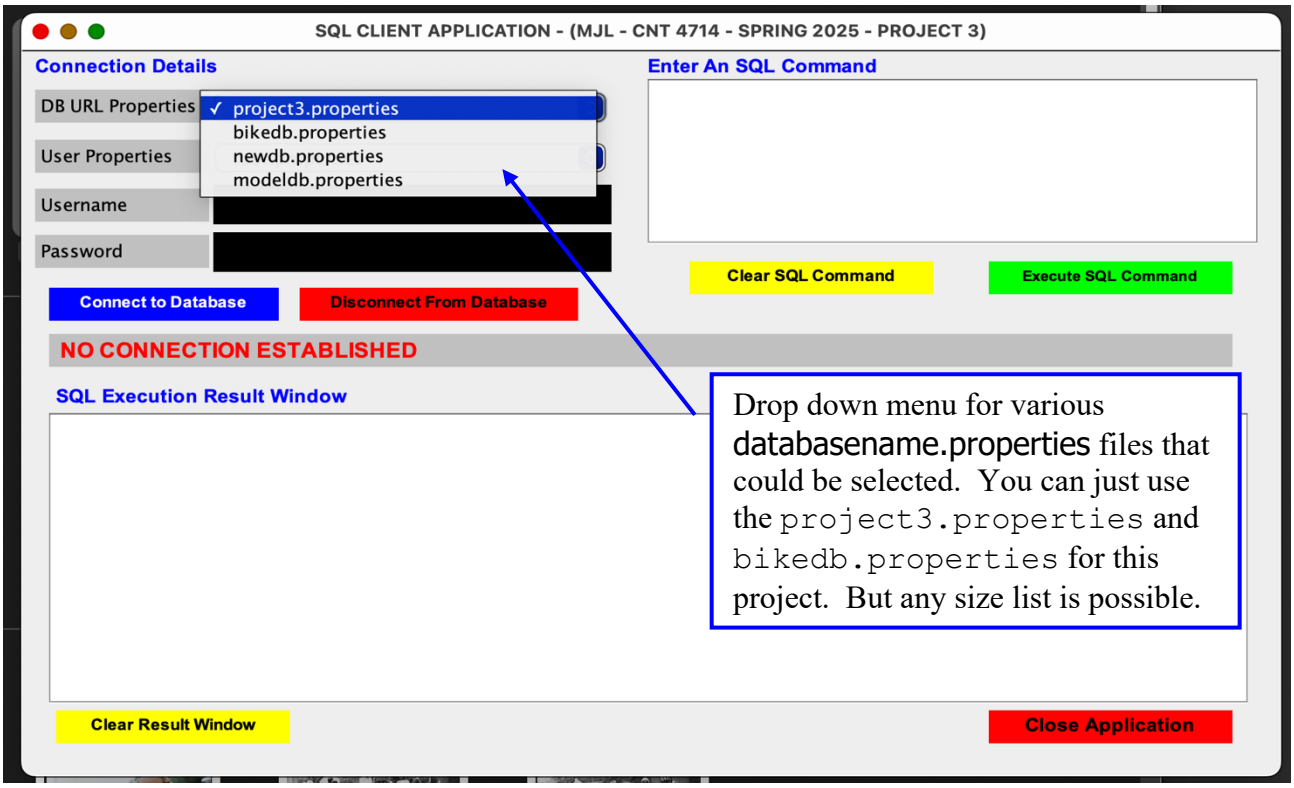
1. The GUI areas defined.



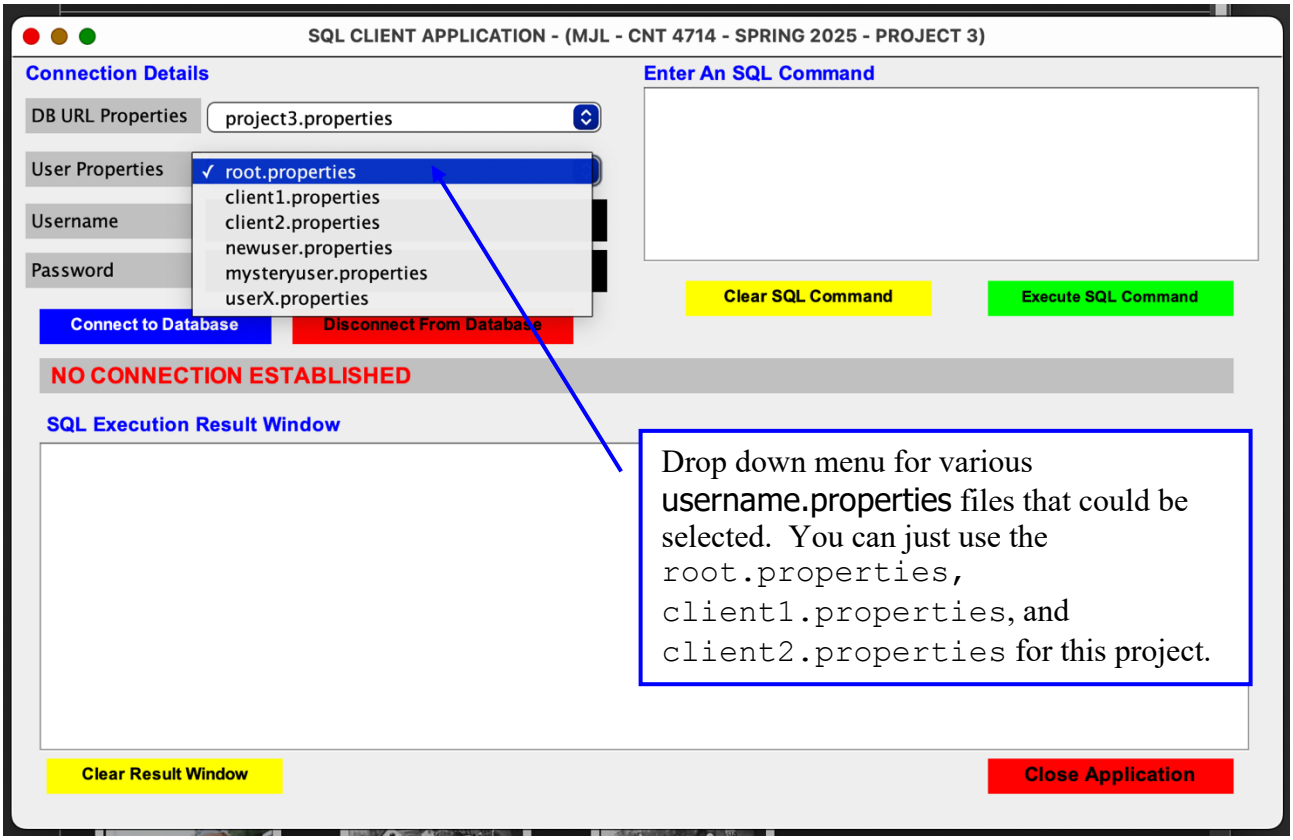
2. Screen shot illustrating an initial connection.



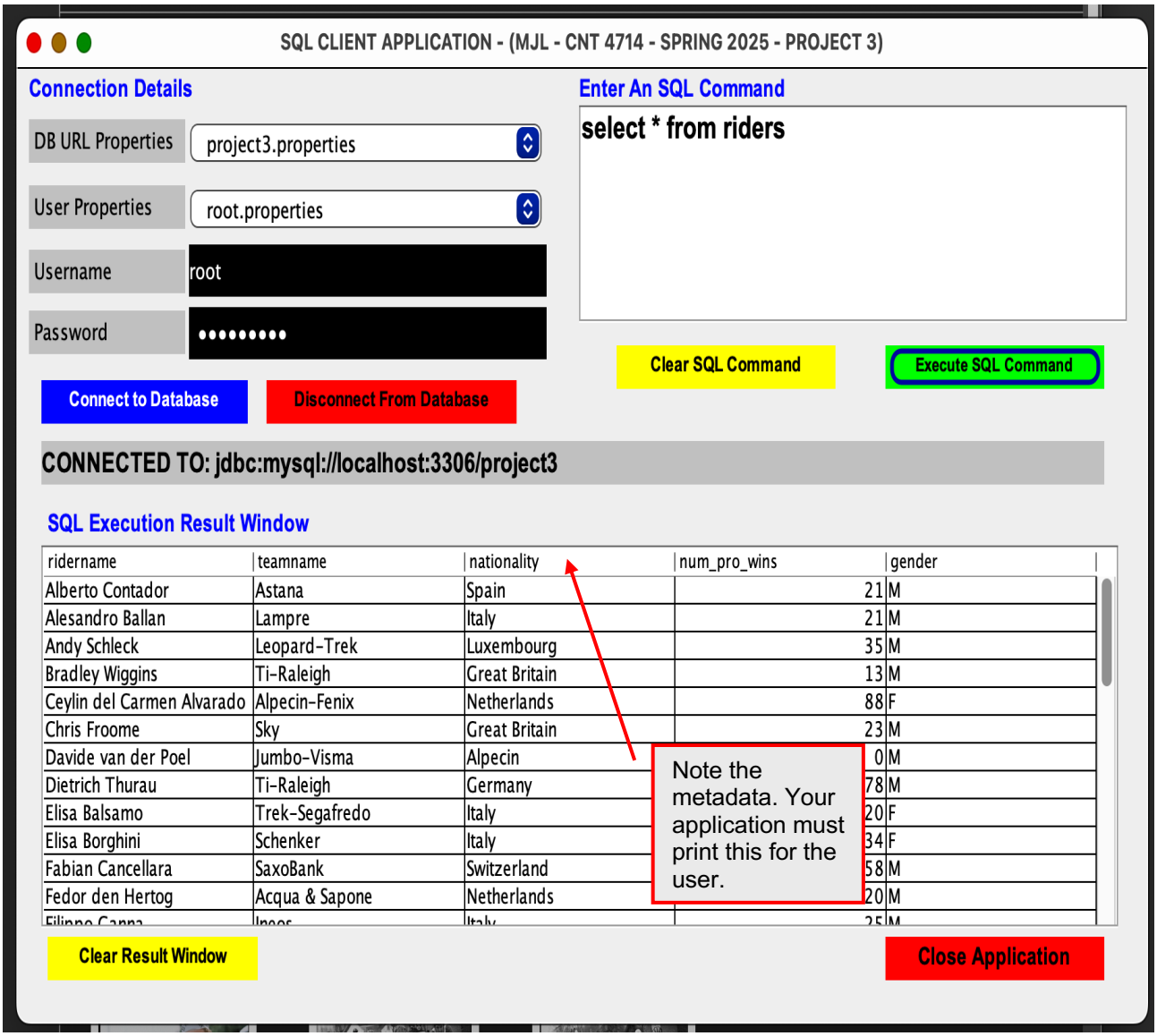

3. Illustrating the drop-down list of possible databasename.properties files that could be selected.



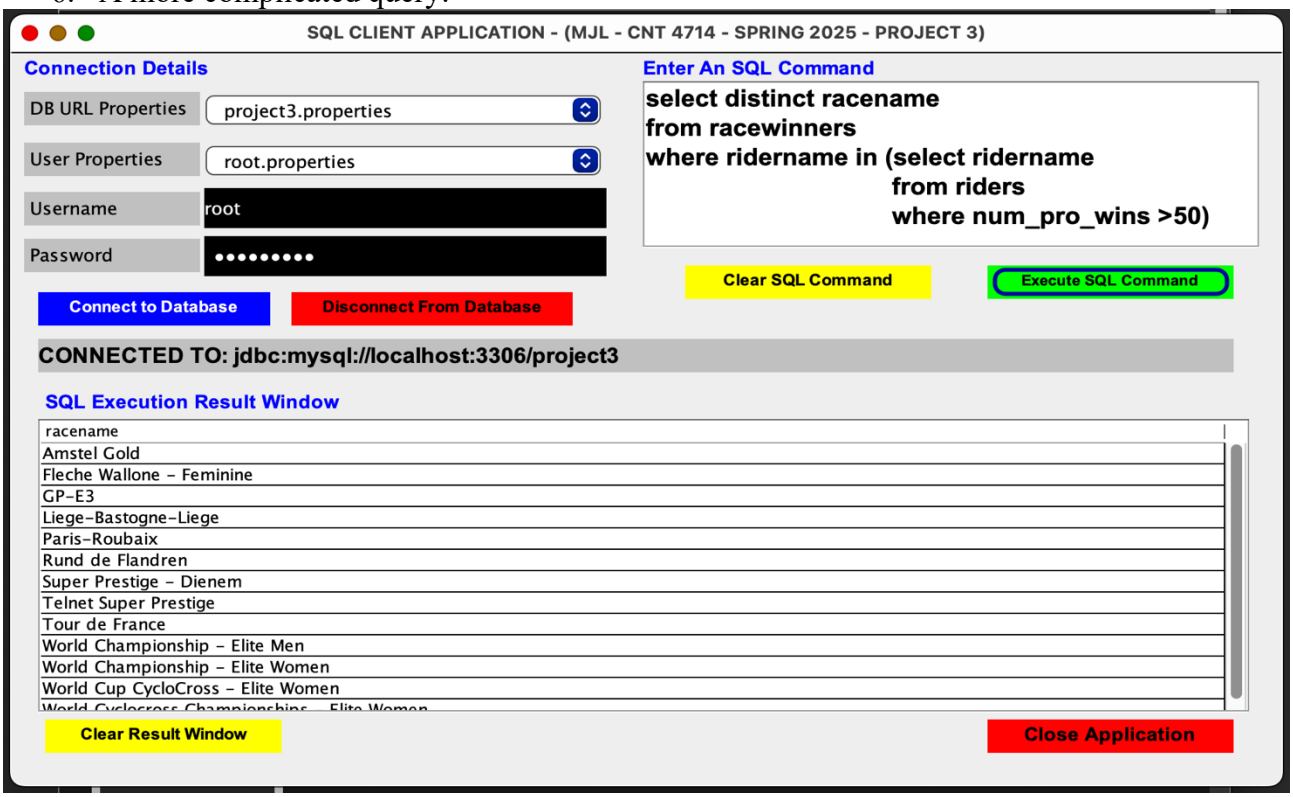
4. Illustrating the drop-down list of possible username.properties files that could be selected.



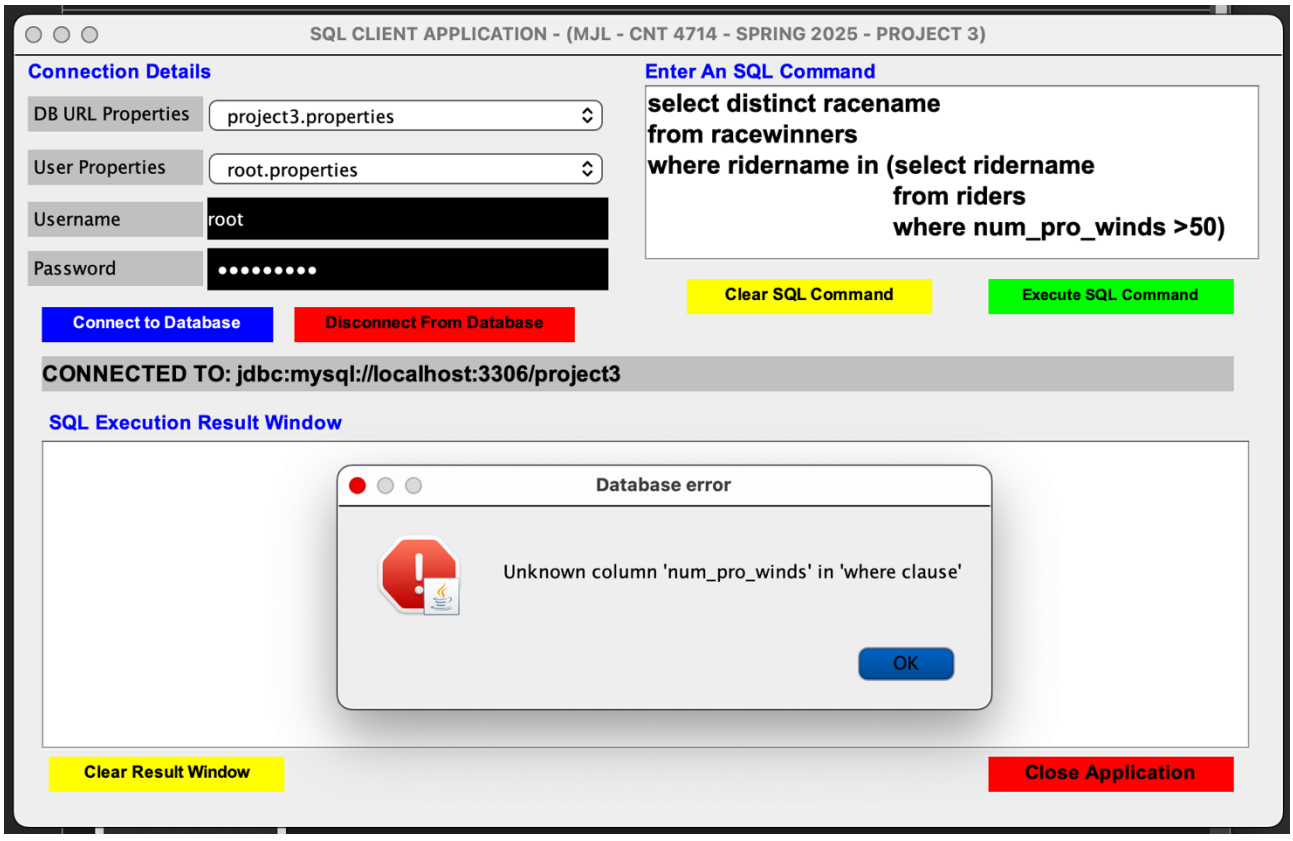
5. The root user has connected to the project3 database and issued a select command. Results are displayed in the SQL Execution Result Window.



6. A more complicated query:

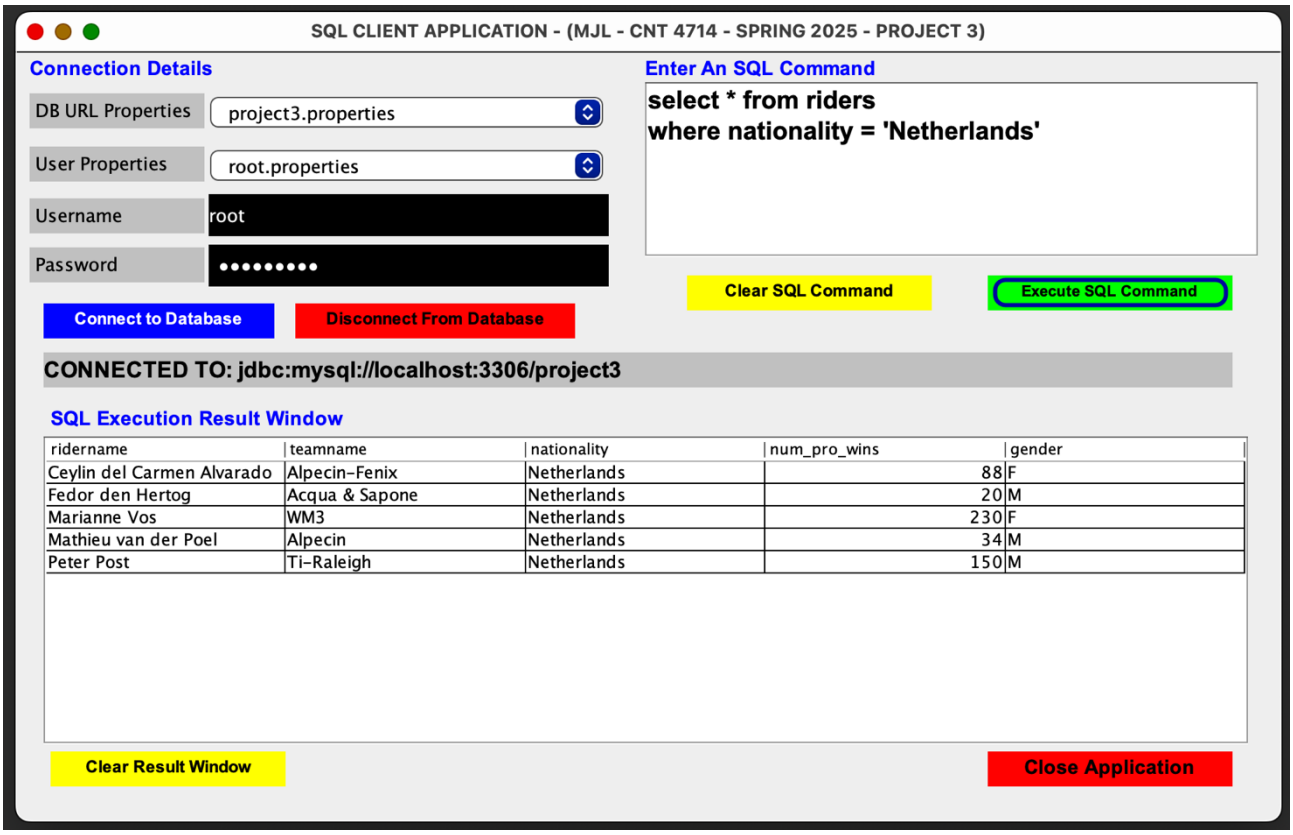



7. When the user makes a mistake entering a SQL command:

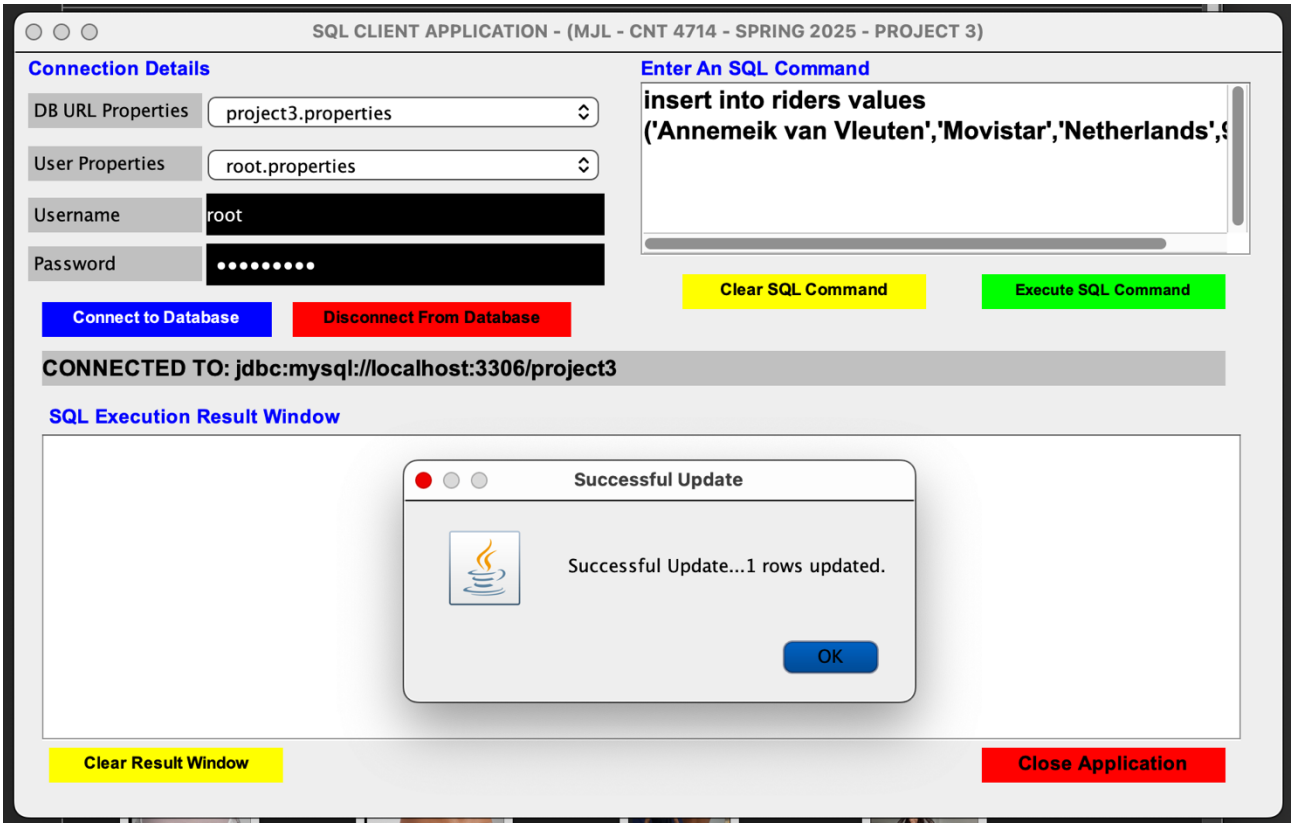


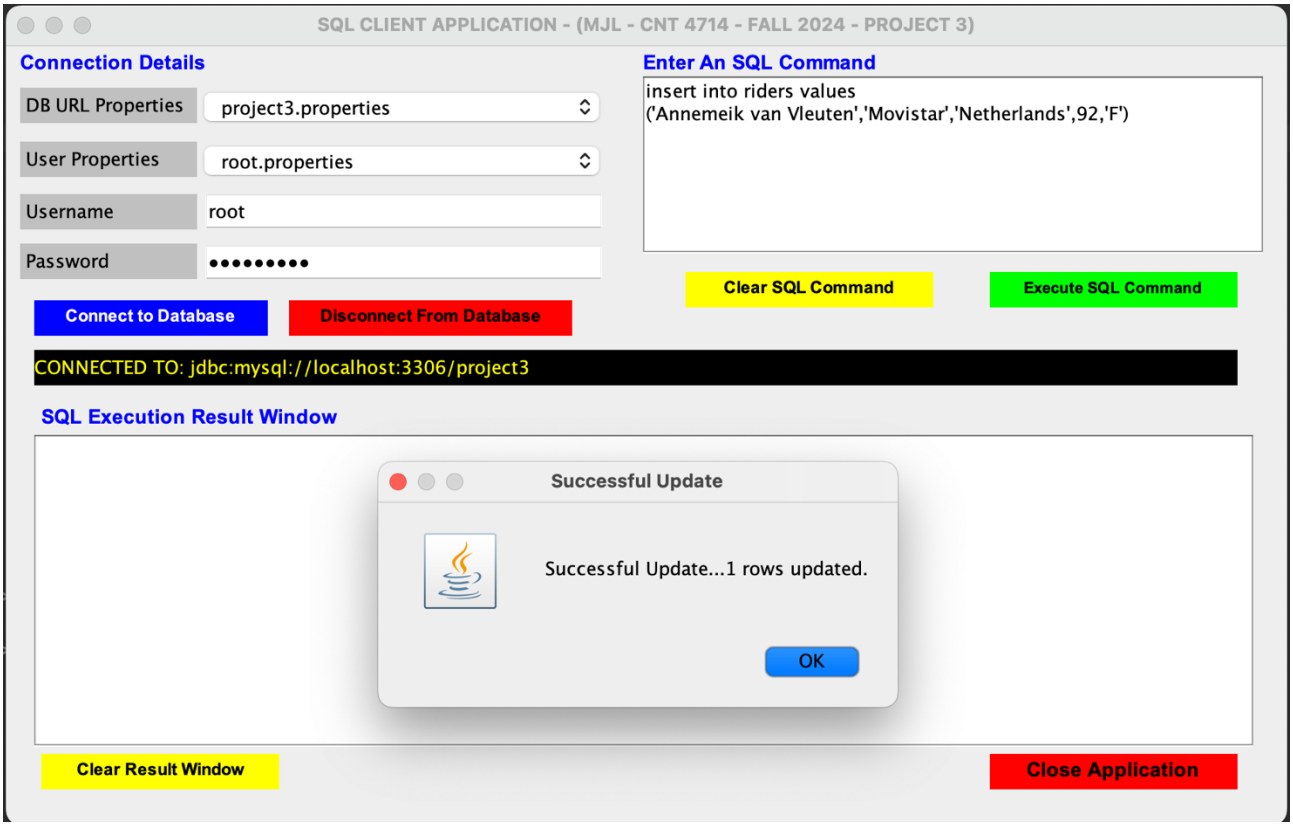
8. The following three screen shots illustrate that your application should be able to handle non-query commands from the users.

**Before screen shot** of a subset of the riders relation:

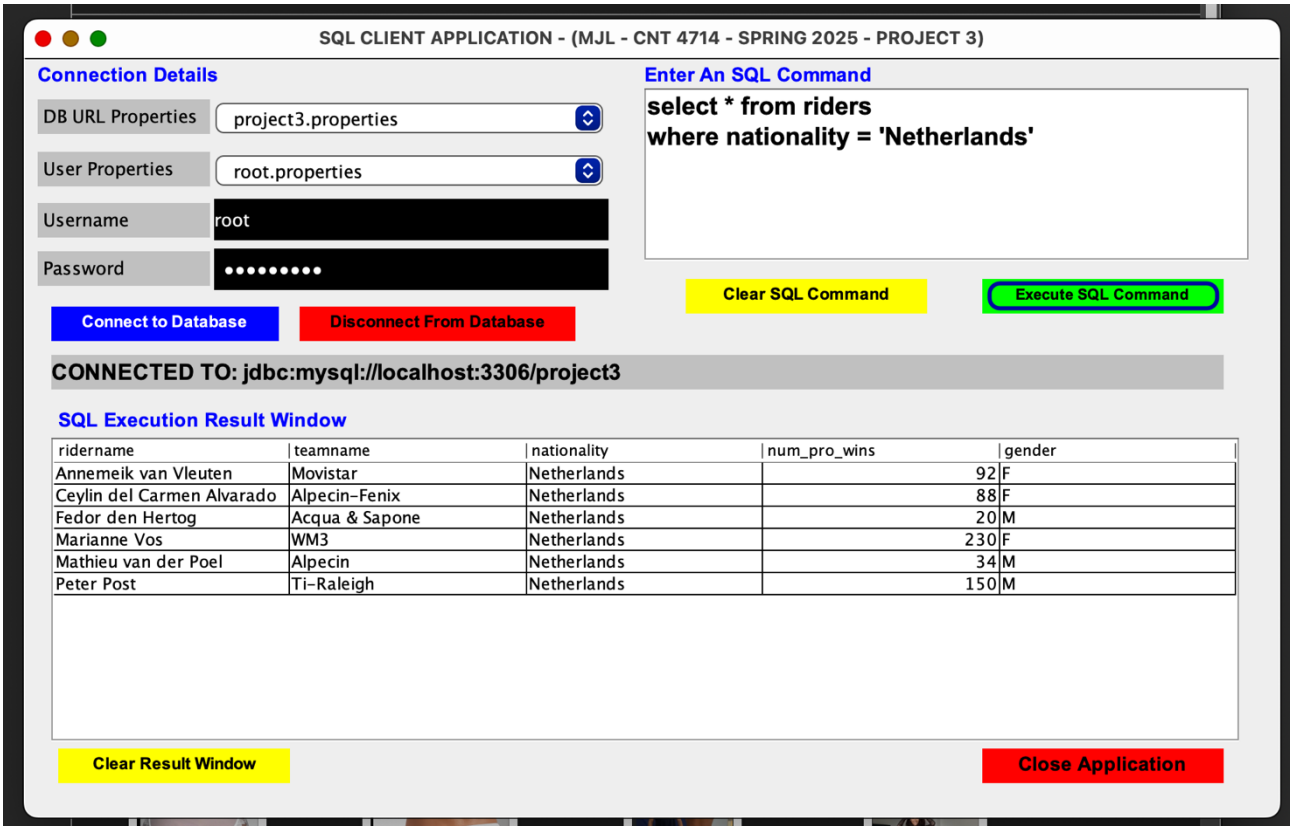


**Insert command issued:**

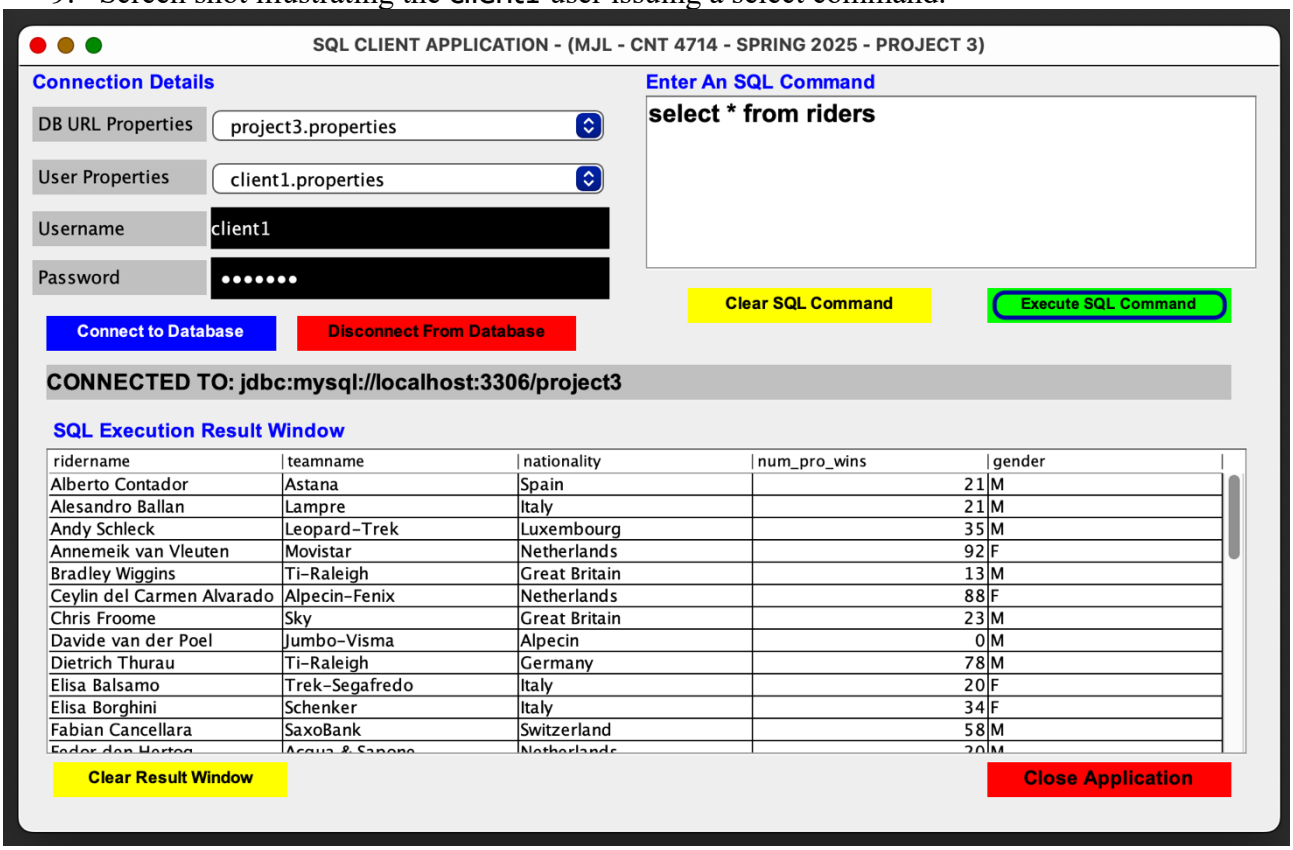




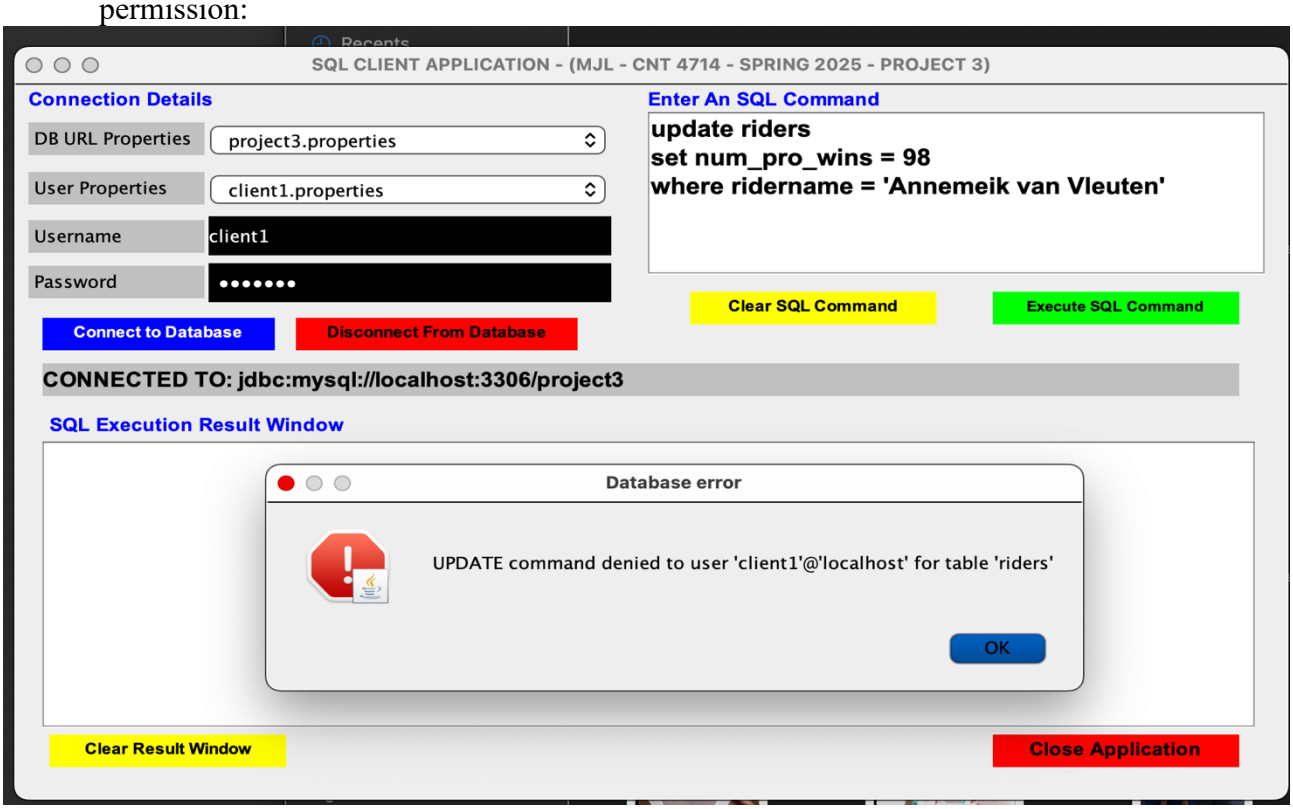

**After screen shot** of subset of riders relation after insert command was issued:



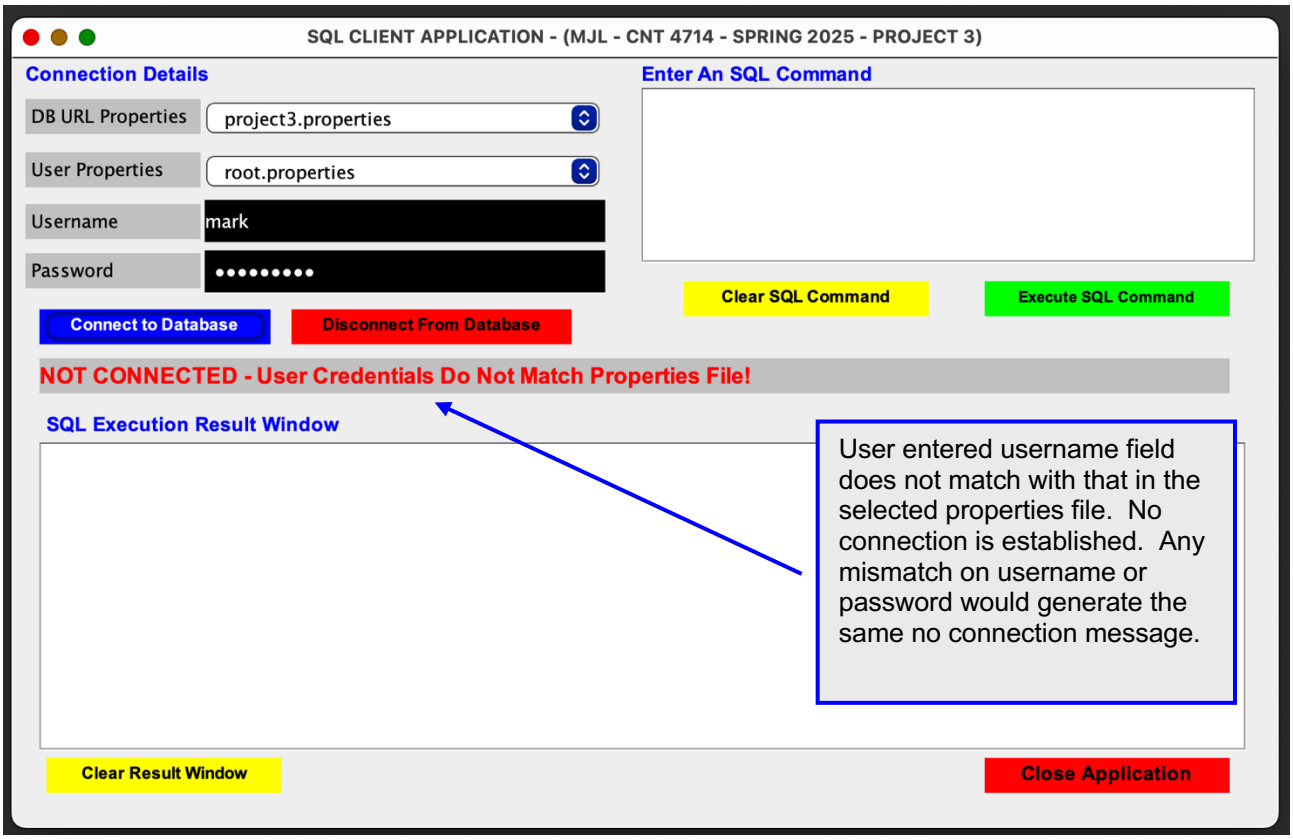
9. Screen shot illustrating the client1 user issuing a select command.



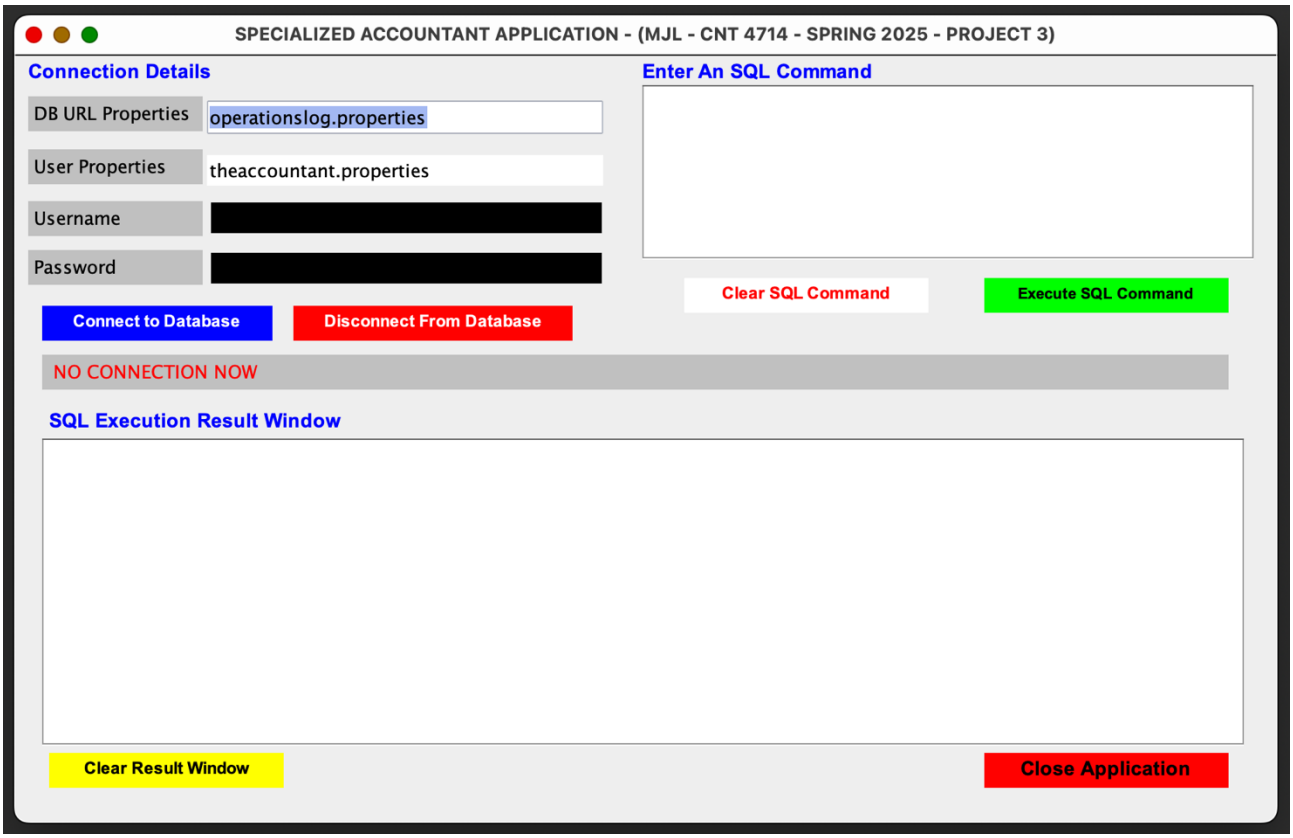

10. Screen shot illustrating the client user issuing a command for which they do not have permission:



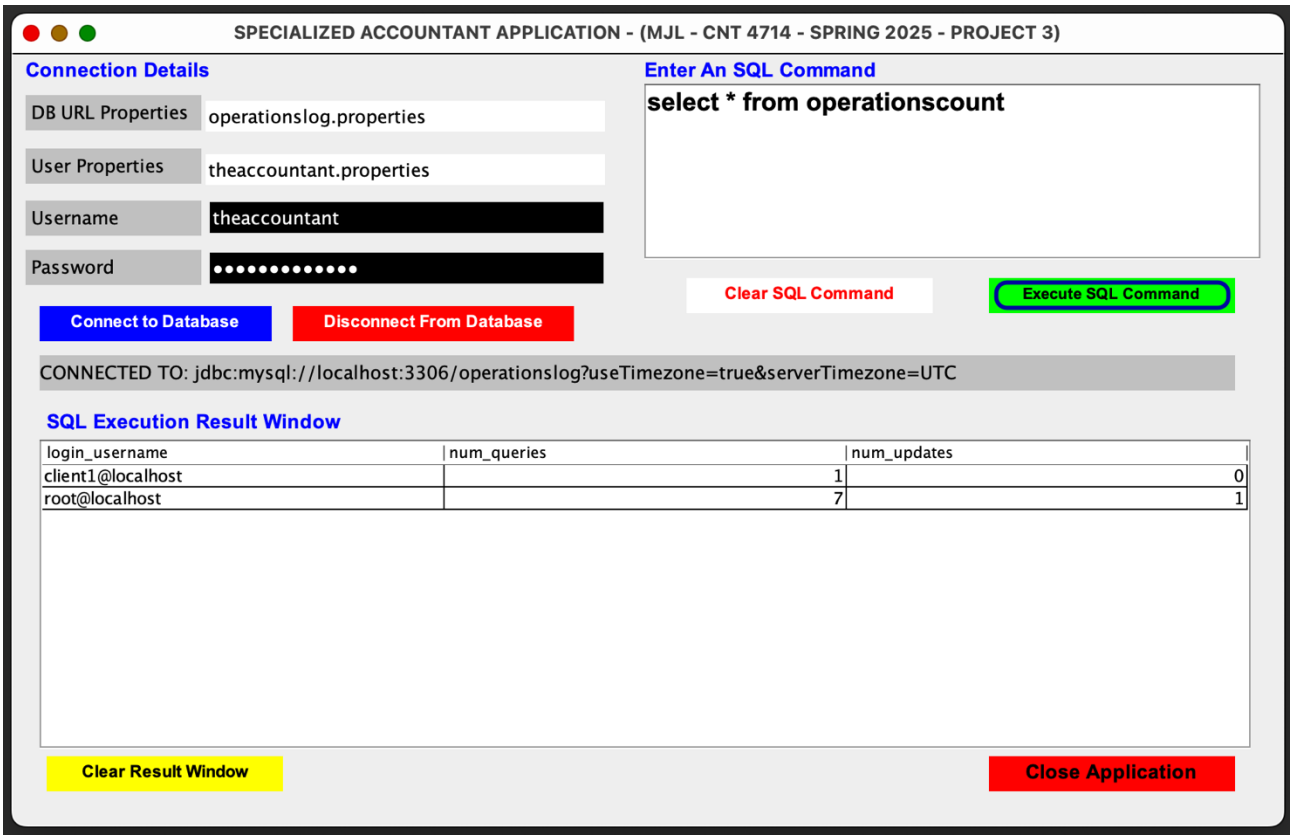
11. The following screenshot illustrates how the user-entered credentials must match those in the selected properties file in order to establish a connection to the database specified in the properties file.



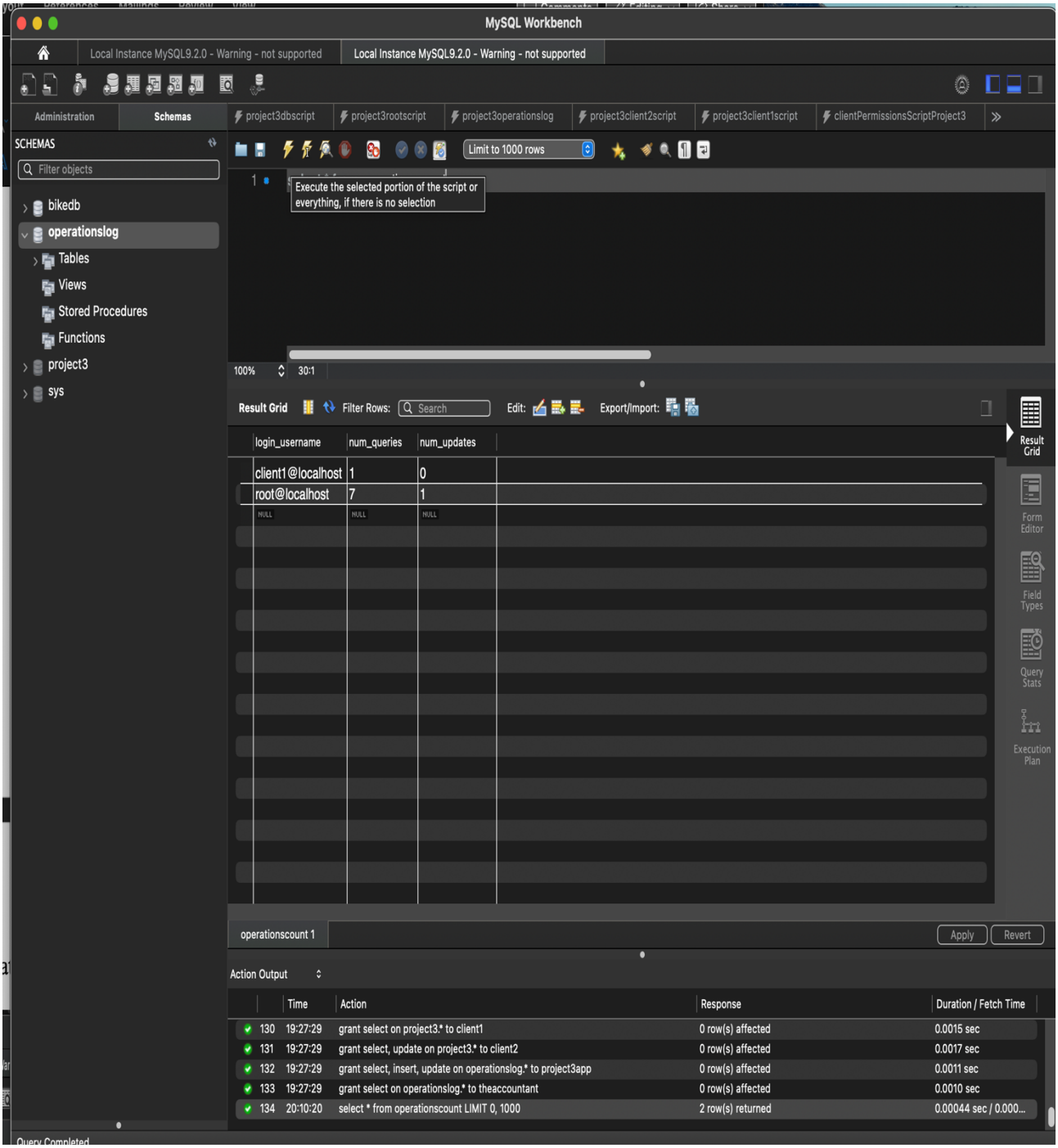
12. The specialized interface for theaccountant user is just a slightly modified version of the primary interface that has been illustrated in all of the previous images. This GUI does not allow the user to select either of the properties files that will be read. In this case, those values are hardcoded into the app and the user will only enter their login credentials for verification purposes. The same procedure will happen in that the user's credentials will be verified for a match with what is read from **theaccountant.properties** file. As before, if the credentials do not match, then no connection is established. Assuming the credentials match, then a connection to the **operationslog** database is established and theaccountant user can issue queries against this database. Only selection privilege is granted to theaccountant.



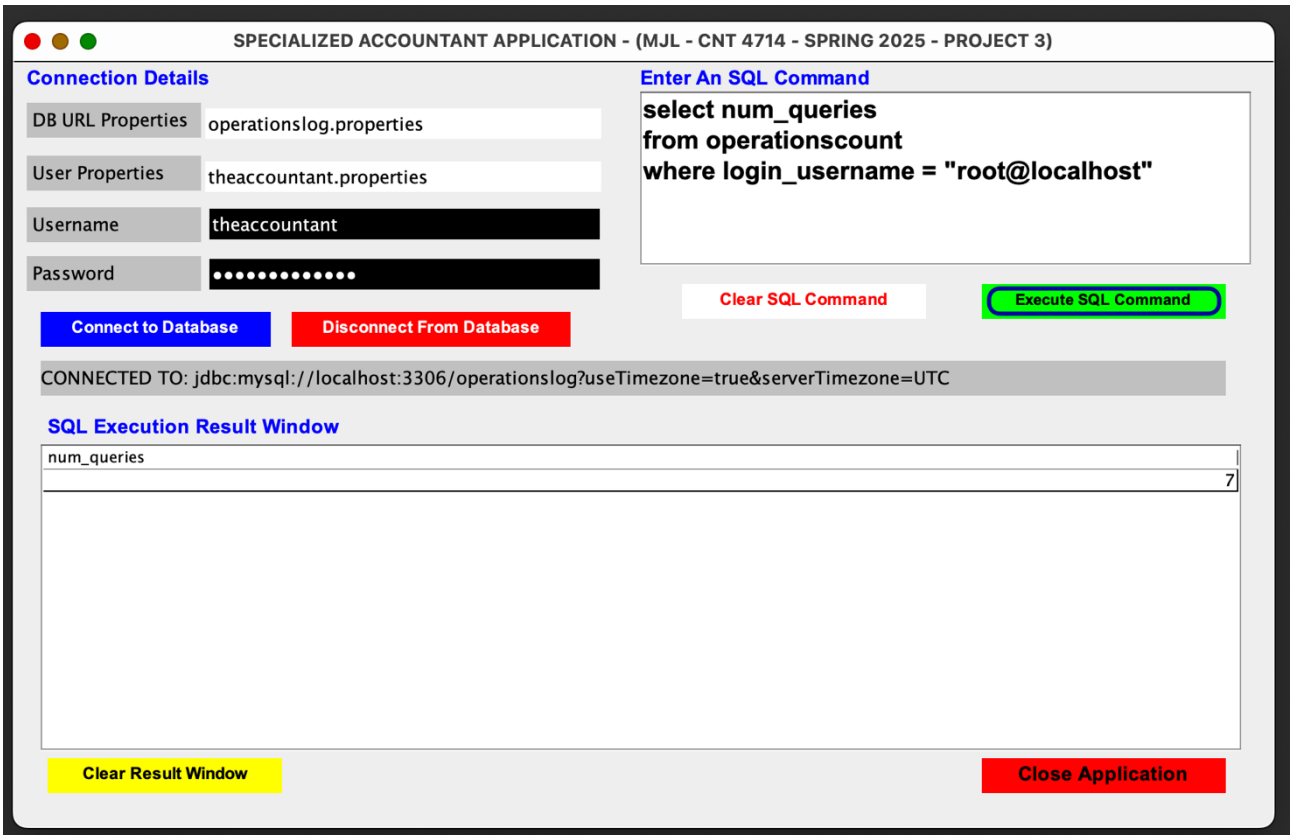
13. The following screenshot illustrates the **operationscount** table values after various operations have been completed. This screenshot is taken from the theaccountant user in the specialized interface created for the accountant user. We will discuss this interface in more detail in the Q&A sessions. You can see the similarity of this interface to that of your main application UI.



14. The same data in the **operationscount** table but viewed from the MySQL Workbench.



15. This example shows a different query issued by theaccountant user.




16. Below is a high-level time line for the project:

| Step | Action |
|---|---|
| 1 | Make sure your MySQL server is correctly installed, configured, and operational before attempting any part of this project. Test root user connections by running some of the examples from the JDBC notes. |
| 2 | Create the three databases used in this project by executing their creation/population scripts from the Workbench. |
| 3 | Create the different user accounts on the MySQL server by executing the `clientCreationScriptProject3.sql`. |
| 4 | Execute the `clientPermissionsScriptProject3.sql` script to set the specific user permissions. |
| 4 | Make sure you understand completely how the DisplayQueryResults application and the helper class ResultSetTableModel work. These two classes can be used to develop your applications. Use and modify these classes as needed. |
| 5 | Start developing the main application. Construct the GUI and work on connection details first. Once connection issues are handled, then move on to executing commands on the DB server and getting results back and displayed. Use the root user for development purposes since they have all permissions and any correct command will execute. |
| 6 | Once main application is done, build the specialized app for theaccountant user. |
| 7 | Modify the application to handle logging of user commands. |
| 8 | Finish early – you have a lot of screenshots to take and label. |