Chapter 9:

Database Connectivity to MySQL

Informatics Practices

Class XII

By- Deepak Bhinde

PGT Comp. Sc.

Introduction

A real life application needs to manipulate data stored in a Database.

A database is a collection of related data in the form of Tables. Most of the database uses SQL (Structured Query Language) to Insert, Delete, Update or retrieve stored data.

In order to connect a Java application to a database designed in MySQL, Oracle, Sybase, MS SQL Server etc, you need a Bridge/Interface Driver Program.

Java Provides JDBC (Java Database Connection) and JDBC-ODBC interface/ Driver to connect a database. JDBC is commonly used to connect MySQL database.

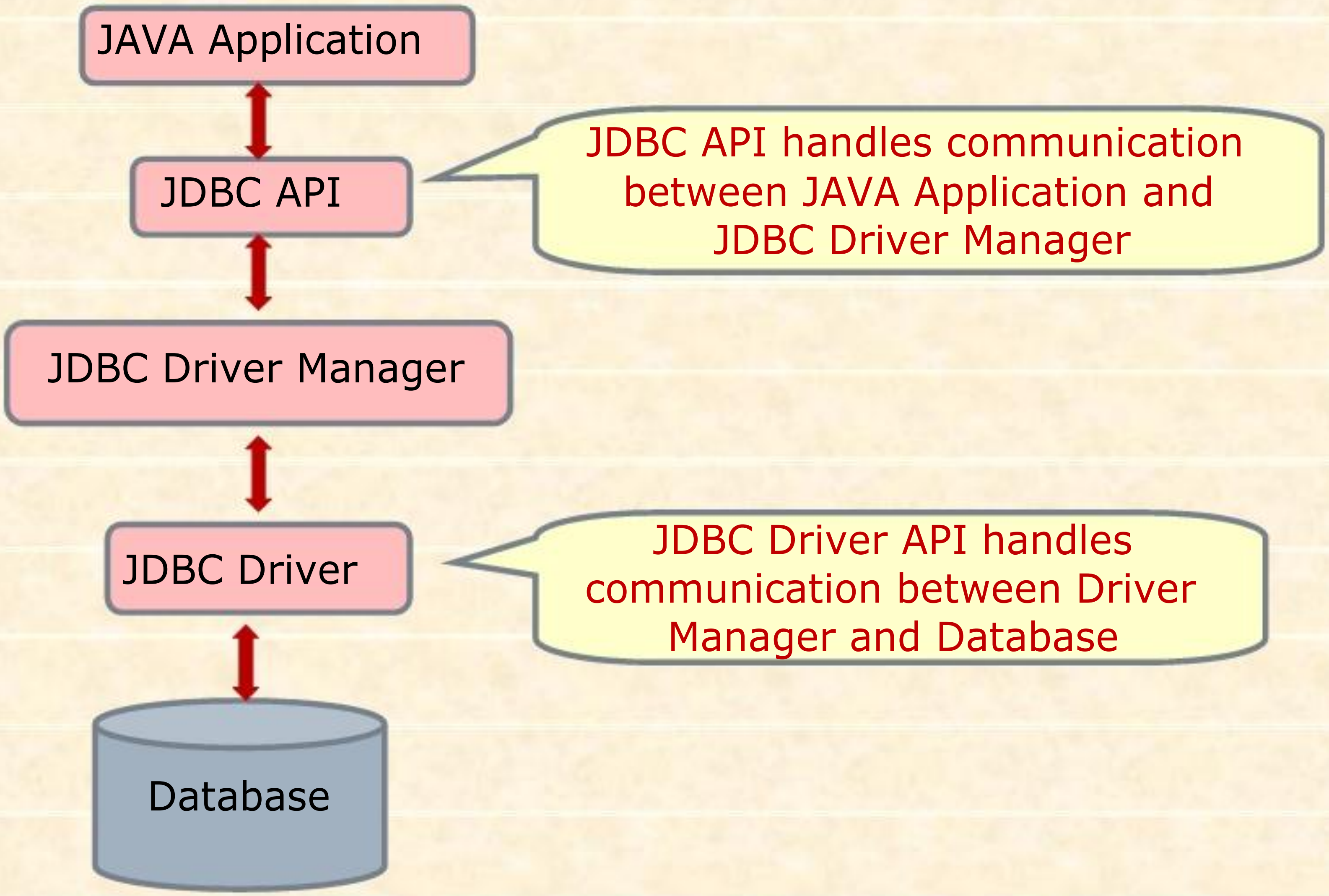
What is JDBC ?

JDBC is JAVA’s Database connection driver interface which performs the following task for the application.

- Establish a connection with a Database.
- Send SQL request (Query) to a Database Server.
- Returns Result obtained against Query.

Some RDBMS like MS Access requires ODBC (Open Database Connection), which can be connect through JDBC-ODBC driver (jdbc.odbcbridge).

Architecture of JDBC


JAVA Application
JDBC API
JDBC Driver Manager
JDBC Driver
Database
JDBC API handles communication between JAVA Application and JDBC Driver Manager
JDBC Driver API handles communication between Driver Manager and Database

Classes used for Database Connectivity

The Core element of JDBC is JDBC API, which consists of a set of Java classes equipped with predefined methods to handle various data access functions such as Selecting appropriate database driver, establishing connection, submitting SQL query and processing results.

JDBC API offers four main classes, which are-

- **Driver Manager Class:** It loads the JDBC driver to locate, logs and access a database.
- **Connection Class:** It manages communication between Java Client Application and Database, through SQL statements.
- **Statement Class:** It contains SQL commands which is submitted to the Database Server and returns ResultSet object containing the result of SQL statement.
- **Result Set Class:** It provides predefined mehods to access and convert data values returned by the executed SQL statement.

A JDBC driver must be registered with JDBC Driver Manage using Class.forName() method before establishing a connection.

Installing JDBC Driver in NetBeans IDE

The Prerequisite for connecting a Java application to MySQL is JDBC driver (also called MySQL Connector/J).

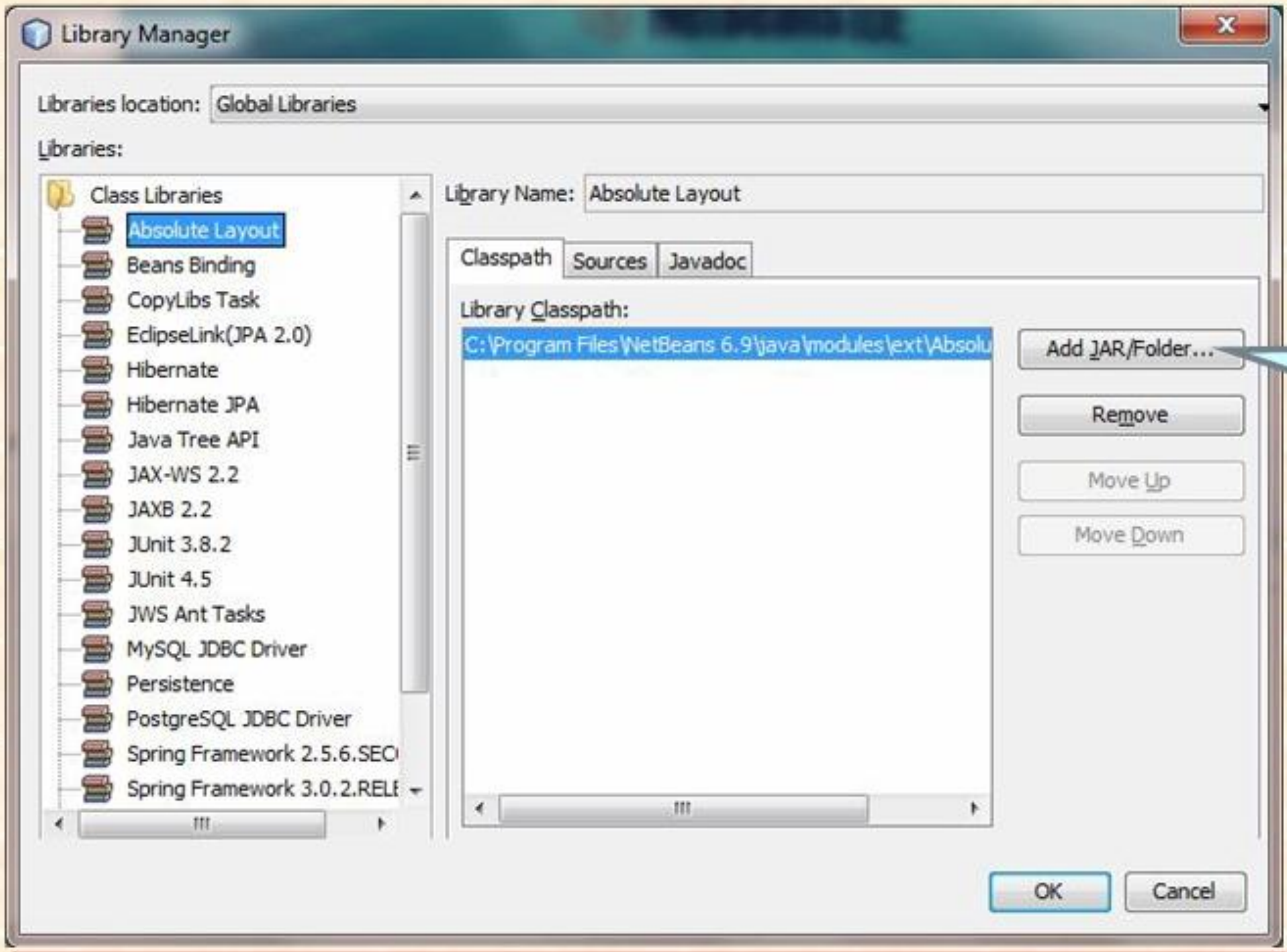
The MySQL Connector/J is freely available and can be downloaded from the URL(dev.mysql.com/downloads/).

After download it can be installed with NetBeans with help of following steps-

- Start NetBeans and Go to Tools->Libraries.
  - Library Manager will be open, check MySQL JDBC Driver under Class libraries. If it is not present, you can add it by the following steps.
- Click on Add Jar Folder button.
  - Specify downloaded uncompressed folder in the drive where JDBC is kept. Press Add Jar button and finally Click OK button.

Installing MySQL JDBC Driver ….

1. Open Library Manager by Tools-> Libraries.


Library Manager

Libraries location: Global Libraries

Libraries:

Class Libraries
- Absolute Layout
- Beans Binding
- CopyLibs Task
- EclipseLink(JPA 2.0)
- Hibernate
- Hibernate JPA
- Java Tree API
- JAX-WS 2.2
- JAXB 2.2
- JUnit 3.8.2
- JUnit 4.5
- JWS Ant Tasks
- MySQL JDBC Driver
- Persistence
- PostgreSQL JDBC Driver
- Spring Framework 2.5.6.SEC
- Spring Framework 3.0.2.RELE

Library Name: Absolute Layout

Classpath | Sources | Javadoc

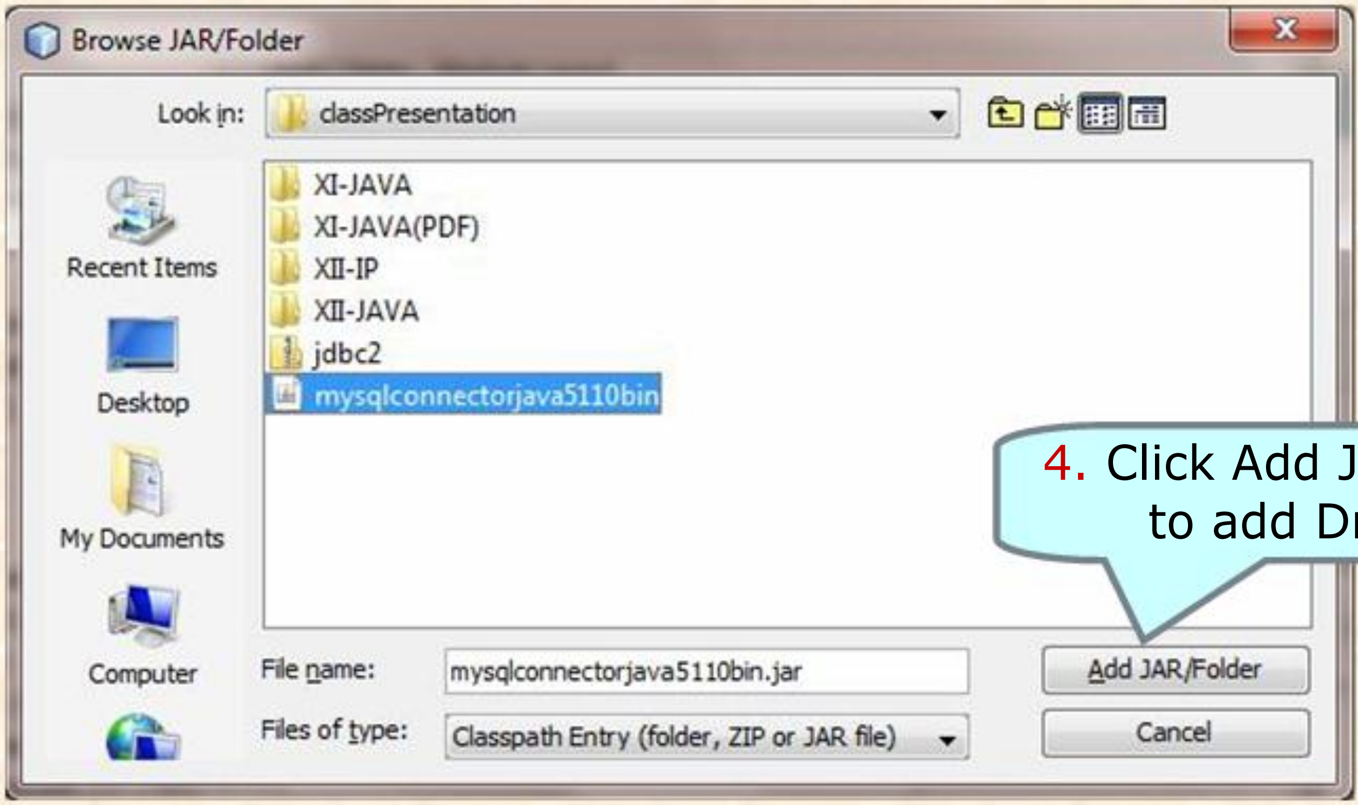
Library Classpath:

C:\Program Files\NetBeans 6.9\java\modules\ext\Absolu

2. Press Add JAR/Folder

Installing MySQL JDBC Driver ….

3. Locate MySQL driver and press Add Jar/folder button



Browse JAR/Folder

Look in: classPresentation

XI-JAVA
XI-JAVA(PDF)
XII-IP
XII-JAVA
jdbc2
mysqlconnectorjava5110bin

File name: mysqlconnectorjava5110bin.jar

Files of type: Classpath Entry (folder, ZIP or JAR file)

4. Click Add Jar/Folder to add Driver.

Connecting MySQL from JAVA Application

After installing JDBC (MySQL Connector/J) Driver, you may access MySQL database through JAVA Application.

The Following Six steps may be followed to establish a connection with MySQL database.

- Step 1: Import Required package/classes in the application.
- Step 2: Register the JDBC Driver to JDBC Driver Manager.
- Step 3: Open a Connection.
- Step 4: Execute a Query.
- Step 5: Extract data from Result set
- Step 6: Close Connection.

Step 1: Importing Required package/classes

This step consists of two sub-steps.

- Import Java.sql Library package containing JDBC classes needed by following import statements.

```
import   java.sql.Connection;
import java.sql.DriverManager;
import    java.sql.Statement;
import java.sql.ResultSet;
```

Or
import java.sql.*;

- Add MySQL JDBC connector in the application.
  - In Project Window expand Libraries node by clicking **+** icon.
- If MySQL Connector is not present then Pres **Add JAR/Folder** and specify the location of Driver folder to add MySQL Driver.

Step 2: Registering the JDBC Driver

To open a Communacation channel, you require to initialize driver by registering the JDBC driver with JDBC river Manager.

Java offers a **Class.forName()** method in java.lang package.

Class.forName("java.sql.driver");

Or

Class.forName("com.mysql.jdbc.Driver");

Step 3: Opening a Connection

DriverManager.getConnection() method is used to create a connection object that represents a physical connection with database.

DriverManager.getConnection() requires the complete address of the database (**Database URL**), **user name** and **password** as a parameter.

A database URL can be formed as-

jdbc:mysql :// localhost/ <database name>

Ex. Sppose school is a database designed in MySQL.

jdbc:mysql://localhost/school

You can assign this string on a variable, which can be used later in DriverManager.getConnection() method.

```
String DB_URL = "jdbc:mysql://localhost/school";
Connection con = DriverManager.getConnection(DB_URL,"root", "abc")
```

Step 4: Executing a Query

You must create a Statement object for building and submitting a SQL query, using CreateStatement() method of Connection object created in Step 3.

Statement stmt = con.createStatement();

To execute a query executeQuery() method along with a valid SQL statement is used, which returns the record from the database (Result Set) on ResultSet type object.

ResultSet rs = stmt.executeQuery("<SQL Query>**");**

The both statements can used as-

```
Statement stmt = con.createStatement();

ResultSet rs = stmt.executeQuery("select roll,name,class  from student");
```

- ➢Result Set refers to a logical set of records from the database by executing a query.
- ➢An executeUpdate() method is used in place of executeQuery() when query contains Insert, Delete or Update command.

Step 5: Extracting Data from ResultSet object

To retrieve the data from the ResultSet object, which contains records, You may use the following method.

<ResulSet object>.get<type>(<column name/number>);

Where <type> may be **Int, Long, String, float** etc depending on the column type of the table.

In general the data values are assigned on the variables and later used in the TextField controls of the Form using setText().

```
int r= rs.getInt("roll");
String   n=   rs.getString("name");
int c= rs.getInt("class");
```

```
int r= rs.getInt(1);
String   n=   rs.getString(2);
int c= rs.getInt(3);
```

You can use Column number instead of column name of the table

The variable can be used to display the values in the Text boxes like this-

jTextField1.setText(""+r);

Step 5: Extracting Data from ResultSet object

Since a ResultSet object may contain more than one records, so a loop is required to process all the records. A while… loop is generally used to read all records.

To break a loop **<ResultSet object>.next()** method is used, which returns false when all the records have been read from the Result set.

```
int r,c ;
String n;
while (rs.next())
{ r= rs.getInt("roll");
  n= rs.getString("name");
  c= rs.getInt("class");
  JOptionPane.showMessageDialog(null, "Name = "+n);
  JOptionPane.showMessageDialog(null, "Roll = "+n);
  JOptionPane.showMessageDialog(null, "Class = "+n);
 }
```

You can use jTextField (s) or jTable swing controls to display the records.

Step 6: Closing connection

After all the processing , the final step is to close the environment by closing the Connection by close() method of ResultSet, Statement and Connection objects.

```
rs.close();
stmt.close();
con.close();
```

To handle errors during establishing connection all the required statements are kept in a try{…} catch (){…} block like this-

```
try{ …………………..

   }
catch (exception <varibale>)
  {
        <error statement>;
  }
```

A Sample Code for Database Connectivity

```
import java.sql.*;                                          // 1. import package at the top//
/* The following code may be placed in ActionPerformed event of a button*/
try{ Class.forName(“java.sql.Driver”);                      // 2. Register Driver //
    String db=“jdbc:mysql://loacalhost/school”);
    String qr= “select   roll, name, class from student”;
    Connection con=Driver.getConnection(db, ”root”, ”xyz”);        //3.Open
Connection//
    Statement stmt=con.createStatement();                        // 4. Execute Query//
    ResultSet rs= stmt.executeQuery( qr);
    int r, c;
    String n;
    while (rs.next())                                           // 5. Extract Data//
          { r= rs.getInt(“roll”);
          n= rs.getString(“name”);
          c= rs.getInt(“class”);
          ……………………………….; // Code to manipulate data//
          }
     rs.close();                                               //6.Close Environment//
     stmt.close();
     con.close();
   }
catch (Exception e)
            { JOptionPane.showMessageDialog(null, ”Error in connection”);     }
```

Commonly used ResultSet Methods

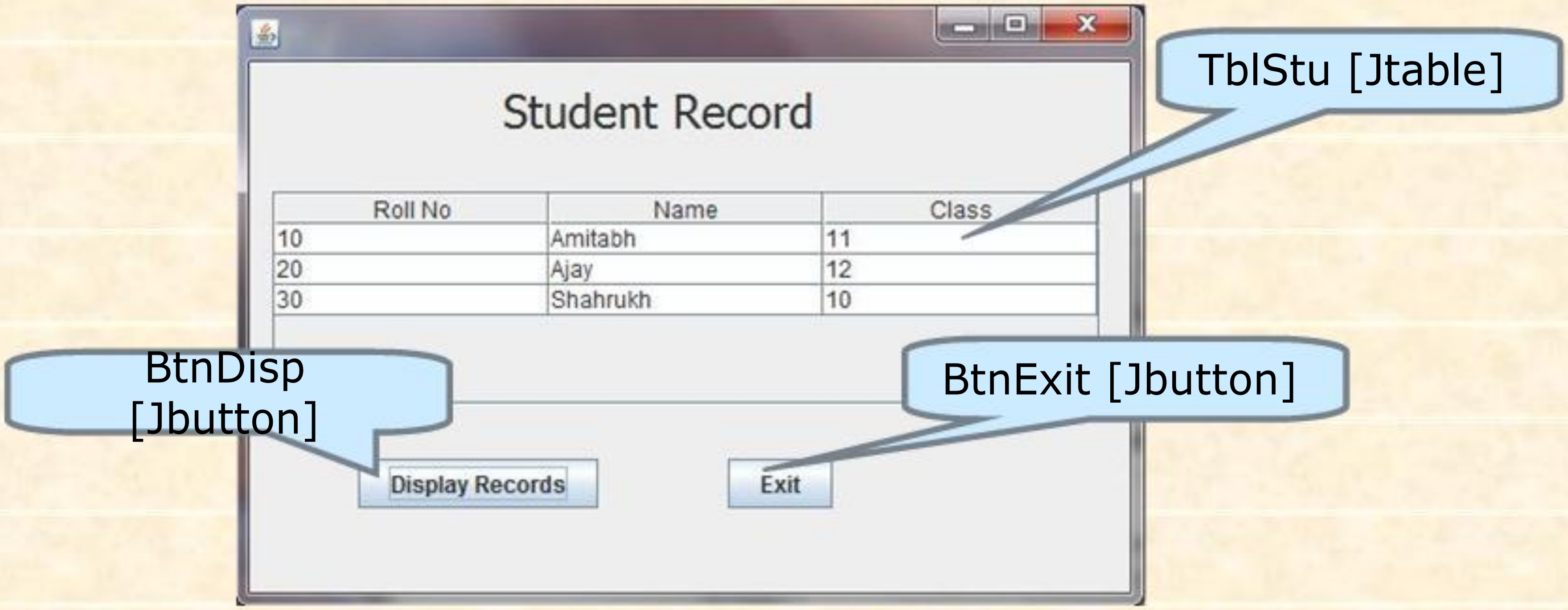
A Result set object maintains a **cursor**, which points to its current row of data. When it is created, cursor is positioned before the first row. You can move the cursor using the following methods.

Method	Purpose
next ()	Moves the cursor forward one row. It returns false when cursor is positioned after the last record.
previous()	Moves cursor to previous record from current position. It returns false when cursor is positioned before the first record.
first()	Moves cursor to first record. It returns true if it positioned at first record otherwise returns false.
last()	Moves cursor to last record. It returns true if it positioned at last record otherwise returns false.
relative(n)	Moves cursor relative to its current position i.e if it is on 2nd row, then relative(3) places cursor at 5th record.
obsolute(n)	Moves cursor at nth record of result set irrespective to its current position.
getRow()	Returns the current row number where cursor is positioned.

Example 1 - A Sample Application

Let us design an Application as per the following screen shot. We assume that a Database named School containing a Student (Roll, Name, Class) table with some test records has been created already in MySQL.

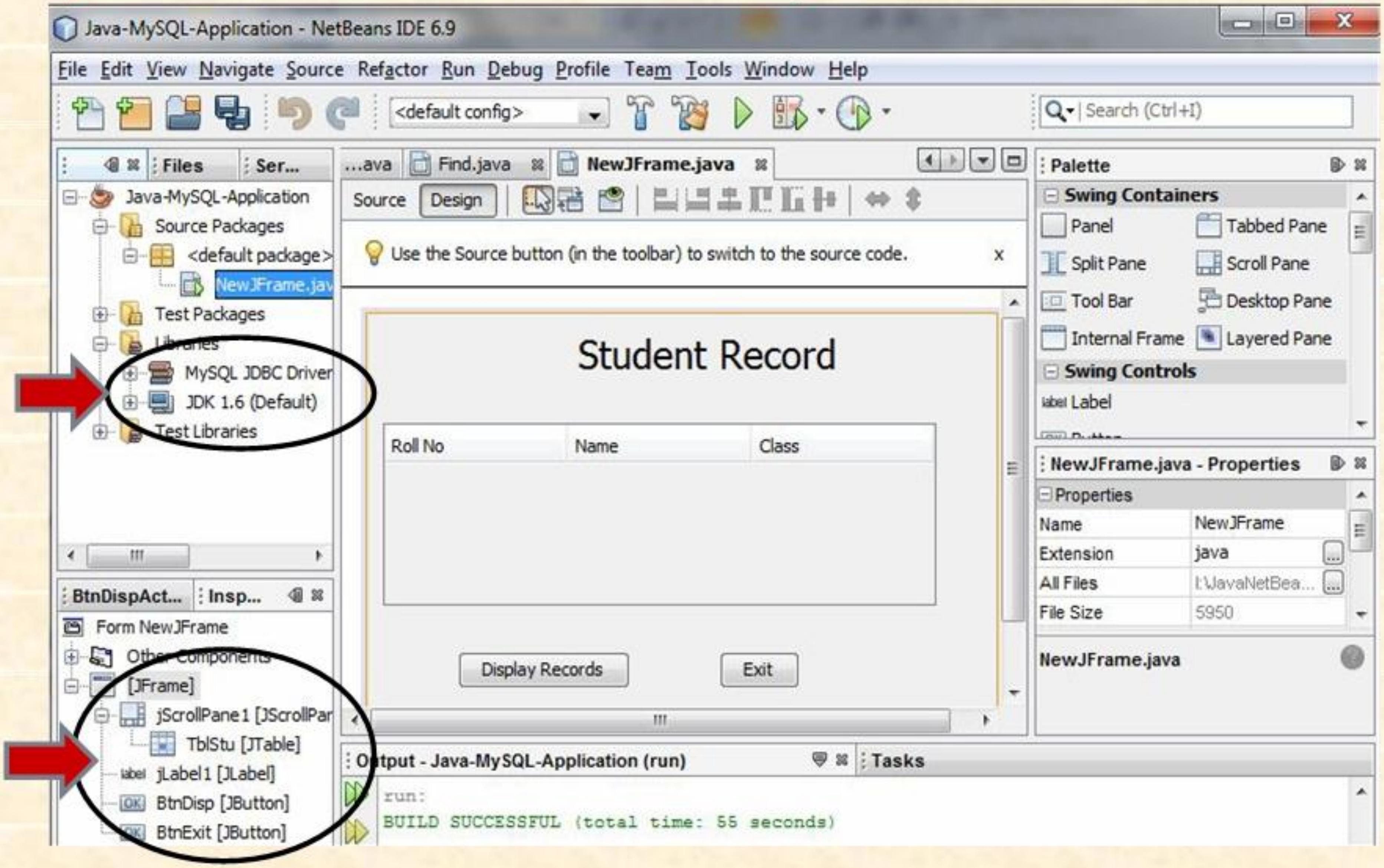
A Simple Database Application using Table



Student Record

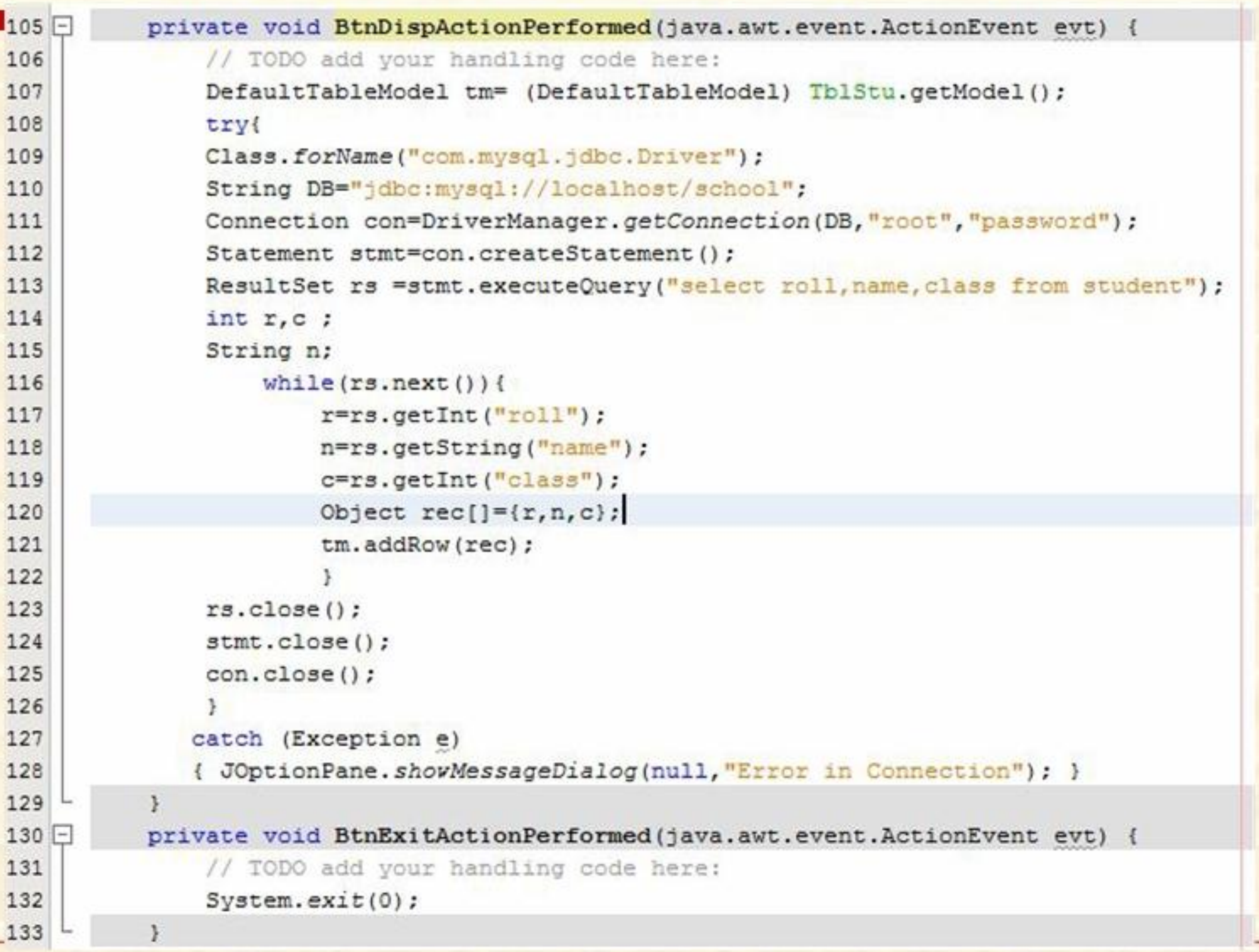
Roll No	Name	Class
10	Amitabh	11
20	Ajay	12
30	Shahrukh	10

Example 1: A Sample Application



```
run:
BUILD SUCCESSFUL (total time: 55 seconds)
```

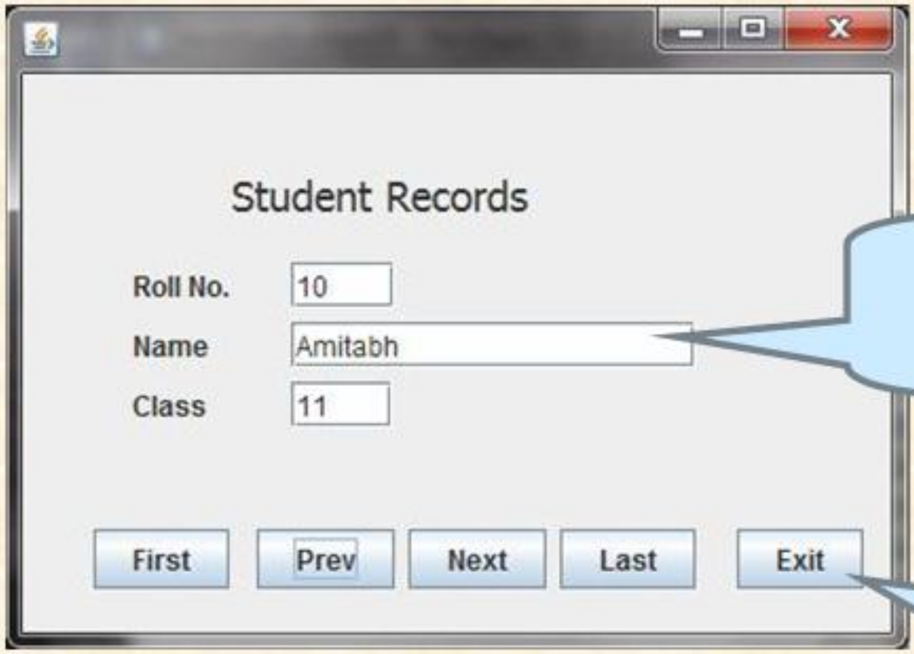
Example- A Sample Application



```
    private void BtnDispActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
        DefaultTableModel tm= (DefaultTableModel) TblStu.getModel();
        try{
        Class.forName("com.mysql.jdbc.Driver");
        String DB="jdbc:mysql://localhost/school";
        Connection con=DriverManager.getConnection(DB,"root","password");
        Statement stmt=con.createStatement();
        ResultSet rs =stmt.executeQuery("select roll,name,class from student");
        int r,c ;
        String n;
            while(rs.next()){
                r=rs.getInt("roll");
                n=rs.getString("name");
                c=rs.getInt("class");
                Object rec[]={r,n,c};
                tm.addRow(rec);
                }
        rs.close();
        stmt.close();
        con.close();
        }
       catch (Exception e)
       { JOptionPane.showMessageDialog(null,"Error in Connection"); }
    }
    private void BtnExitActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
        System.exit(0);
    }
```

Example 2- A Sample Application

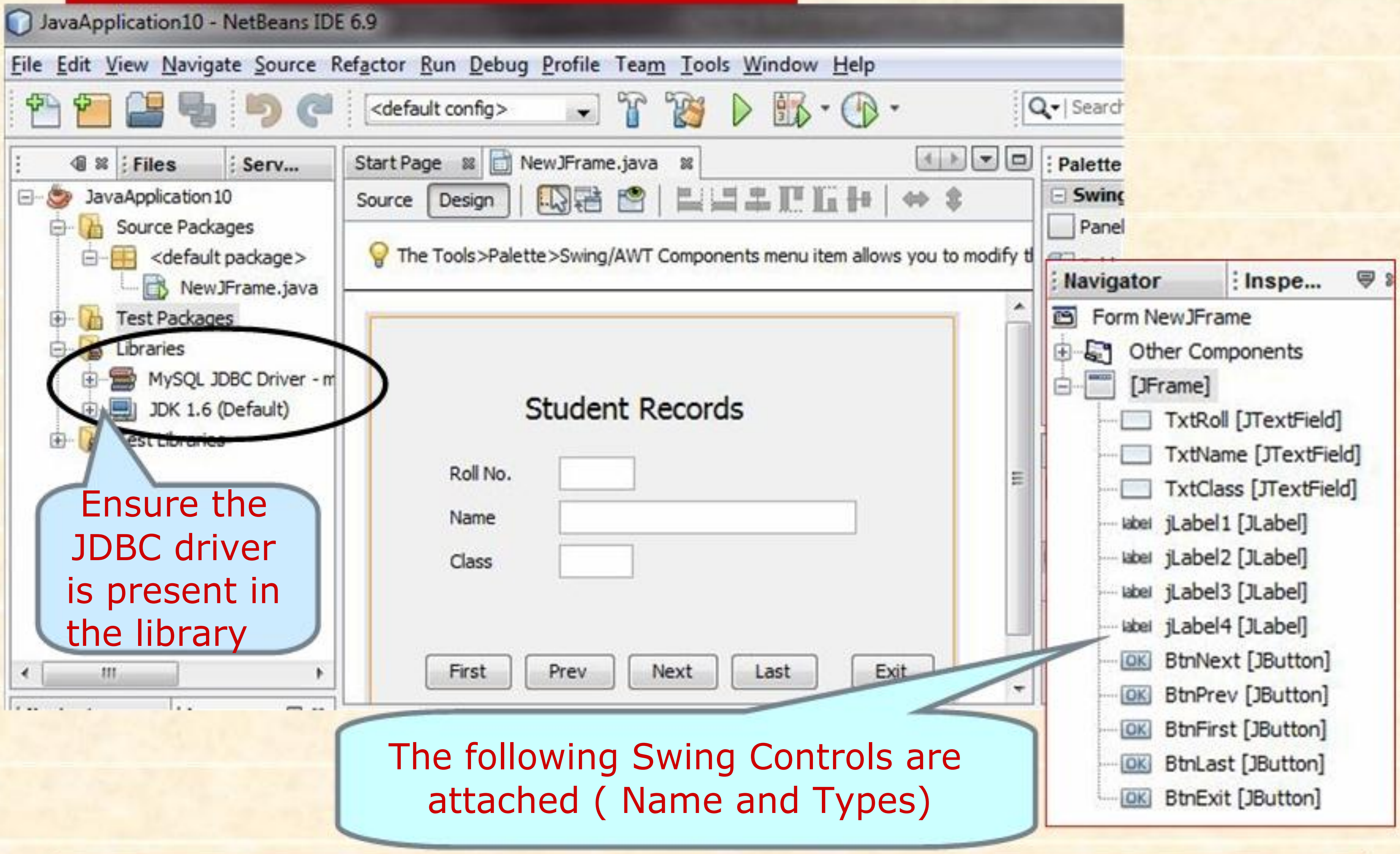
Let us Redesign design the Previous Application as per the following screen shot using Text Fields and Navigation Buttons.
We assume the same Database named School containing a Student (Roll, Name, Class) table with some test records has been created already in MySQL.



JTextField (s) as TxtRoll, TxtName & TxtClass

JButtons as BtnFirst, BtnPrev, BtnNext, BtnLast & BtnExit

Example 2: A Sample Application



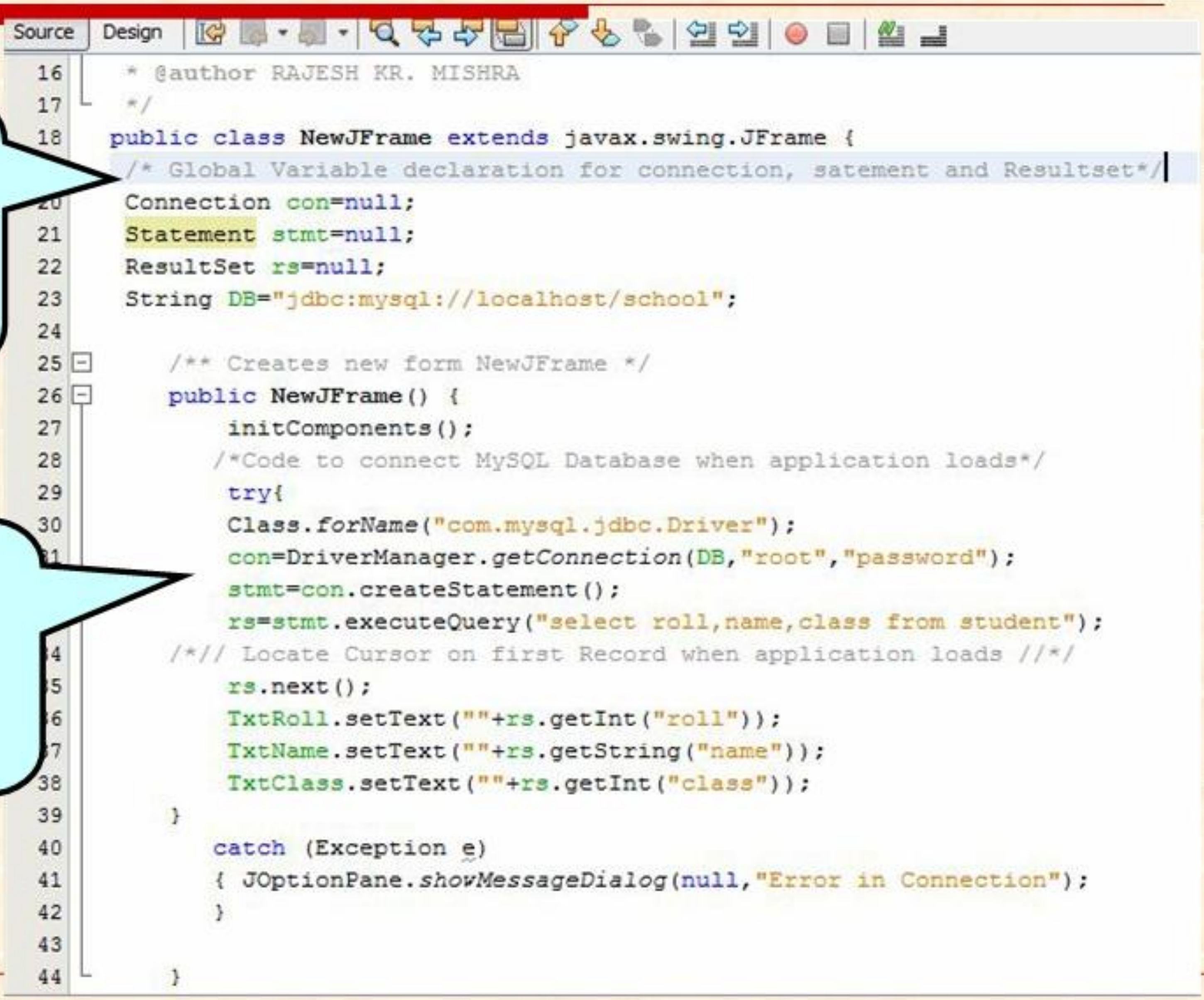
Ensure the JDBC driver is present in the library

The following Swing Controls are attached (Name and Types)

Example 2- A Sample Application

Object are globally declared, so that they can be access in all methods.

Connection is established and cursor is placed on first record when Frame loads.

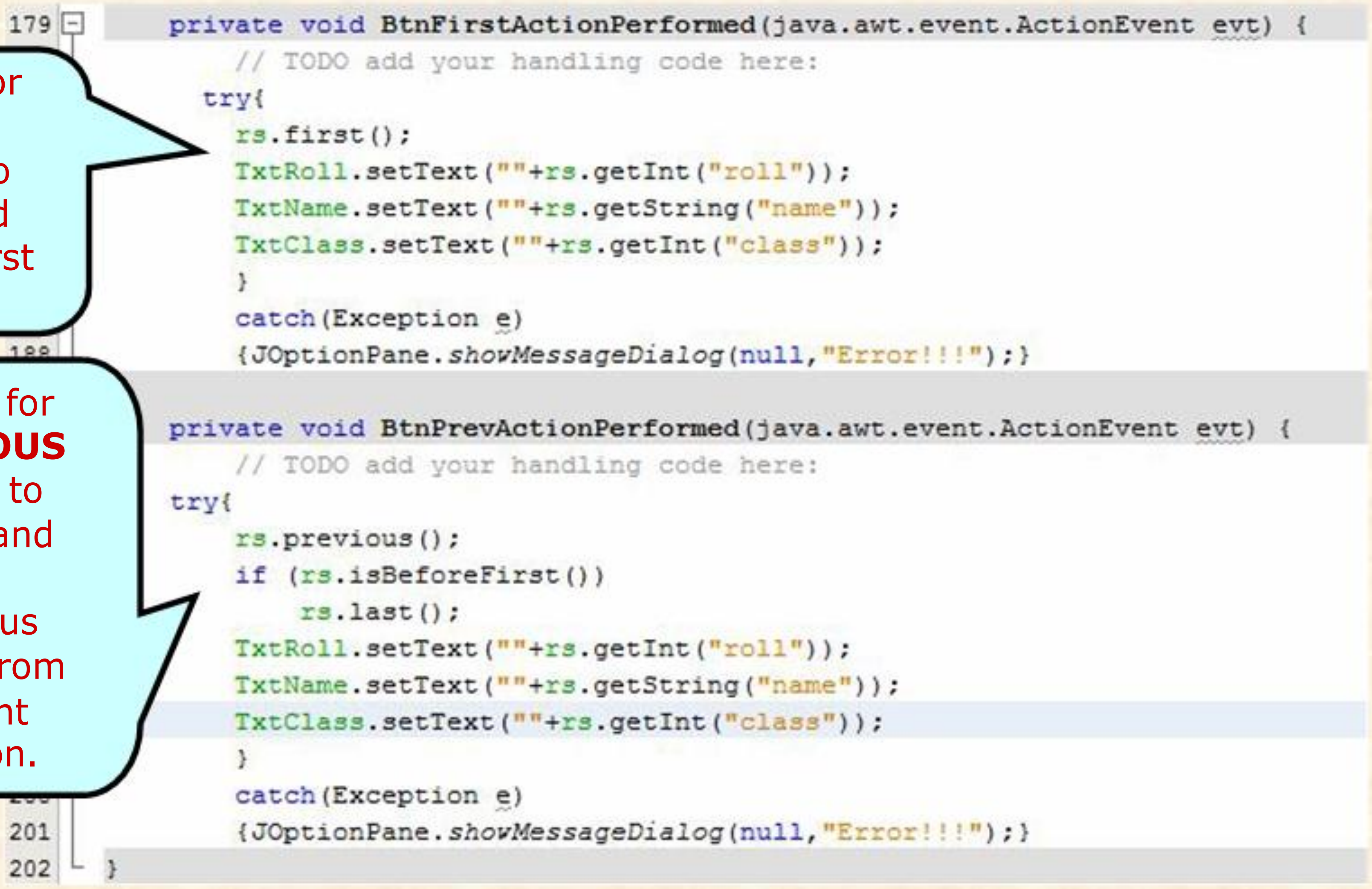


```
 * @author RAJESH KR. MISHRA
 */
public class NewJFrame extends javax.swing.JFrame {
 /* Global Variable declaration for connection, satement and Resultset*/
 Connection con=null;
 Statement stmt=null;
 ResultSet rs=null;
 String DB="jdbc:mysql://localhost/school";

    /** Creates new form NewJFrame */
    public NewJFrame() {
        initComponents();
       /*Code to connect MySQL Database when application loads*/
        try{
        Class.forName("com.mysql.jdbc.Driver");
        con=DriverManager.getConnection(DB,"root","password");
        stmt=con.createStatement();
        rs=stmt.executeQuery("select roll,name,class from student");
    /*// Locate Cursor on first Record when application loads //*/
        rs.next();
        TxtRoll.setText(""+rs.getInt("roll"));
        TxtName.setText(""+rs.getString("name"));
        TxtClass.setText(""+rs.getInt("class"));
    }
       catch (Exception e)
       { JOptionPane.showMessageDialog(null,"Error in Connection");
       }

    }
```

Example 2- A Sample Application



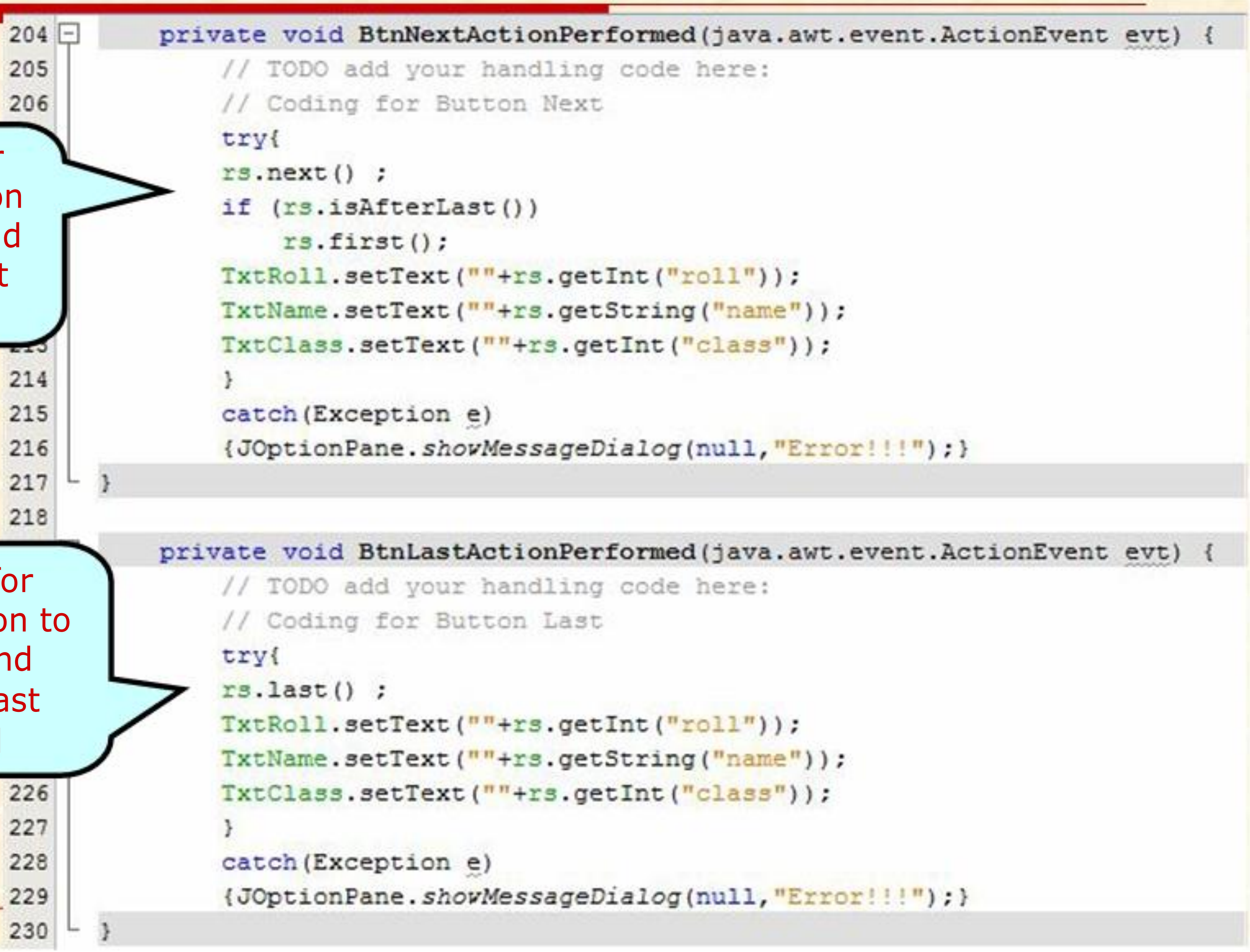
Coding for **FIRST** button to locate and display first record.

```
    private void BtnFirstActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
      try{
        rs.first();
        TxtRoll.setText(""+rs.getInt("roll"));
        TxtName.setText(""+rs.getString("name"));
        TxtClass.setText(""+rs.getInt("class"));
        }
        catch(Exception e)
        {JOptionPane.showMessageDialog(null,"Error!!!");}
```

Coding for **PREVIOUS** button to locate and display previous record from current position.

```
    private void BtnPrevActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
    try{
        rs.previous();
        if (rs.isBeforeFirst())
            rs.last();
        TxtRoll.setText(""+rs.getInt("roll"));
        TxtName.setText(""+rs.getString("name"));
        TxtClass.setText(""+rs.getInt("class"));
        }
        catch(Exception e)
        {JOptionPane.showMessageDialog(null,"Error!!!");}
}
```

Example 2- A Sample Application



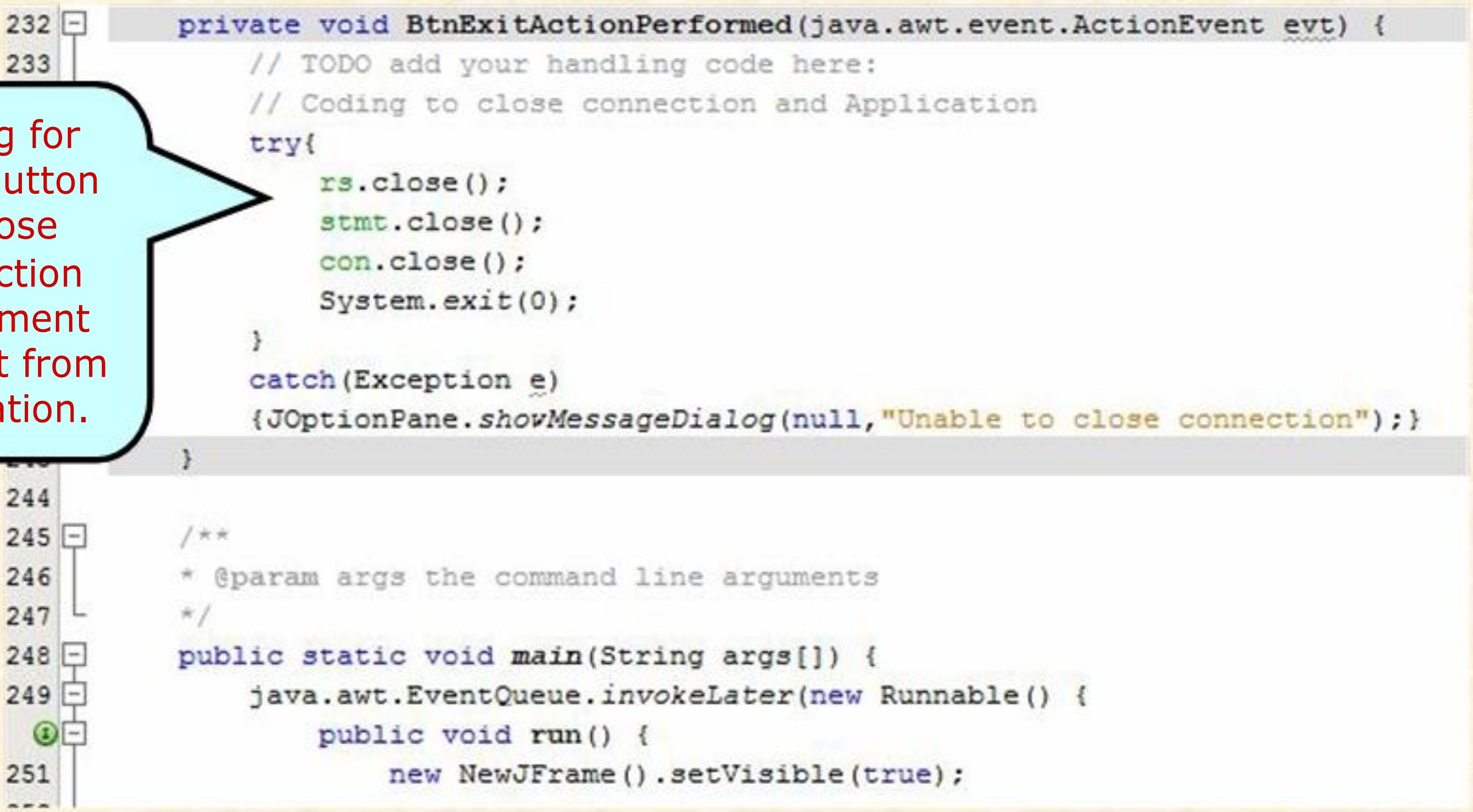
```
    private void BtnNextActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
        // Coding for Button Next
        try{
        rs.next() ;
        if (rs.isAfterLast())
            rs.first();
        TxtRoll.setText(""+rs.getInt("roll"));
        TxtName.setText(""+rs.getString("name"));
        TxtClass.setText(""+rs.getInt("class"));
        }
        catch(Exception e)
        {JOptionPane.showMessageDialog(null,"Error!!!");}
}

    private void BtnLastActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
        // Coding for Button Last
        try{
        rs.last() ;
        TxtRoll.setText(""+rs.getInt("roll"));
        TxtName.setText(""+rs.getString("name"));
        TxtClass.setText(""+rs.getInt("class"));
        }
        catch(Exception e)
        {JOptionPane.showMessageDialog(null,"Error!!!");}
}
```

Coding for **NEXT** button to locate and display next record.

Coding for **LAST** button to locate and display last record

Example 2- A Sample Application



```
    private void BtnExitActionPerformed(java.awt.event.ActionEvent evt) {
        // TODO add your handling code here:
        // Coding to close connection and Application
        try{
            rs.close();
            stmt.close();
            con.close();
            System.exit(0);
        }
        catch(Exception e)
        {JOptionPane.showMessageDialog(null,"Unable to close connection");}
    }

    /**
    * @param args the command line arguments
    */
    public static void main(String args[]) {
        java.awt.EventQueue.invokeLater(new Runnable() {
            public void run() {
                new NewJFrame().setVisible(true);
```

Coding for **EXIT** button to close connection environment and Exit from application.