
JDBC Basics - Java Database Connectivity Steps:

Before you can create a java JDBC connection to the database, you must first import the java.sql package.Import java.sql.*; The star (*) indicates that all of the classes in the package java.sql are to be imported.

1. Loading a database driver:

In this step of the JDBC connection process, we load the driver class by calling Class.forName() with the Driver class name as an argument. Once loaded, the Driver class creates an instance of itself. A client can connect to Database Server through JDBC Driver. Since most of the Database servers support ODBC driver therefore JDBC-ODBC Bridge driver is commonly used.
The return type of the Class.forName (String ClassName) method is "Class". Class is a class in java.lang package.

```
try
{
       Class.forName("sun.jdbc.odbc.JdbcOdbcDriver"); //Or any other driver
}
catch(Exception x)
{
       System.out.println( "Unable to load the driver class!" );
}
```

2. Creating a oracle JDBC Connection:

The JDBC DriverManager class defines objects which can connect Java applications to a JDBC driver. DriverManager is considered the backbone of JDBC architecture. DriverManager class manages the JDBC drivers that are installed on the system. Its getConnection() method is used to establish a connection to a database. It uses a username, password, and a JDBC URL to establish a connection to the database and returns a connection object. A JDBC Connection represents a session/connection with a specific database. Within the context of a Connection, SQL, PL/SQL statements are executed and results are returned. An application can have one or more connections with a single database, or it can have many connections with different databases. A Connection object provides metadata i.e. information about the database, tables, and fields. It also contains methods to deal with transactions.

```
JDBC URL Syntax::     jdbc: <subprotocol>: <subname>
```

JDBC URL Example:: jdbc: <subprotocol>: <subname>

•Each driver has its own subprotocol.
•Each subprotocol has its own syntax for the source.

We're using the jdbc odbc subprotocol, so the DriverManager knows to use the sun.jdbc.odbc.JdbcOdbcDriver.

```
try
{
Connection
dbConnection=DriverManager.getConnection(url,"loginName","Password");
}
catch( SQLException x )
{
System.out.println( "Couldn't get connection!" );
}
```

3. Creating a JDBC Statement object:

Once a connection is obtained we can interact with the database. Connection interface defines methods for interacting with the database via the established connection. To execute SQL statements, you need to instantiate a Statement object from your connection object by using the createStatement() method.

Statement statement = dbConnection.createStatement();

A statement object is used to send and execute SQL statements to a database.

Three kinds of Statements:

Statement: Execute simple sql queries without parameters.
Statement createStatement()
Creates an SQL Statement object.

Prepared Statement: Execute precompiled sql queries with or without parameters.
PreparedStatement prepareStatement(String sql)
returns a new PreparedStatement object. PreparedStatement objects are precompiled SQL statements.

Callable Statement: Execute a call to a database stored procedure.
CallableStatement prepareCall(String sql)
returns a new CallableStatement object. CallableStatement objects are SQL stored procedure call statements.

4. Executing a SQL statement with the Statement object:

Statement interface defines methods that are used to interact with database via the execution of SQL statements. The Statement class has three methods for executing statements: executeQuery(), executeUpdate(), and execute(). For a SELECT statement, the method to use is executeQuery. For statements that create or modify tables, the method to use is executeUpdate.

Note: Statements that create a table, alter a table, or drop a table are all examples of DDL statements and are executed with the method executeUpdate. execute() executes an SQL statement that is written as String object.

5. Processing ResultSet: Provides access to a table of data generated by executing a Statement. The table rows are retrieved in sequence. A ResultSet maintains a cursor pointing to its current row of data. The next() method is used to successively step through the rows of the tabular results.
ResultSetMetaData Interface holds information on the types and properties of the columns in a ResultSet. It is constructed from the Connection object.

6. Closing the statement: Syntax: statement_object.close();

7. Closing the connection: Syntax: connection_object.close();

JDBC EXAMPLE – Sample Program:

```
import java.sql.*;
public class JDBC
{
  public static void main(String[] args)
  {

     try
     {
```

```
        Class.forName("sun.jdbc.odbc.JdbcOdbcDriver");
        Connection con = DriverManager.getConnection("jdbc:odbc:ds1","","");
        Statement s = con.createStatement();
        s.execute("create table player(pno integer,runs integer)");
        s.execute("insert into player values(8,4500)");
        s.execute("insert into player values(6,7200)");
        s.execute("select pno, runs from player");
        ResultSet rs = s.getResultSet();
        while(rs.next())
        {
          System.out.println("Data from PLAYER No: " + rs.getInt(1));
          System.out.println("Data from RUNS: " + rs.getInts(2));
        }
       s.close();
       con.close();
      }
      catch (Exception err)
     {
       System.out.println("ERROR: " + err);
     }
   }
}
```

JDBC – Statements:

Once a connection is obtained we can interact with the database. The JDBC *Statement, CallableStatement,* and *PreparedStatement* interfaces define the methods and properties that enable you to send SQL or PL/SQL commands and receive data from your database.

They also define methods that help bridge data type differences between Java and SQL data types used in a database.

Following table provides a summary of each interface's purpose to understand how do you decide which interface to use?

Interfaces	Recommended Use
Statement	Use for general-purpose access to your database. Useful when you are using static SQL statements at runtime. The Statement interface cannot accept parameters.
PreparedStatement	Use when you plan to use the SQL statements many times. The PreparedStatement interface accepts input parameters at runtime.
CallableStatement	Use when you want to access database stored procedures. The CallableStatement interface can also accept runtime input parameters.

The Statement Objects:

Creating Statement Object:

Before you can use a Statement object to execute a SQL statement, you need to create one using the Connection object's createStatement( ) method, as in the following example:

```
Statement stmt = null;
try {
   stmt = conn.createStatement( );
   . . .
}
catch (SQLException e) {
   . . .
}
finally {
   . . .
}
```

Once you've created a Statement object, you can then use it to execute a SQL statement with one of its three execute methods.

1. **boolean execute(String SQL)** : Returns a boolean value of true if a ResultSet object can be retrieved; otherwise, it returns false. Use this method to execute SQL DDL statements or when you need to use truly dynamic SQL.
2. **int executeUpdate(String SQL)** : Returns the numbers of rows affected by the execution of the SQL statement. Use this method to execute SQL statements for which you expect to get a number of rows affected - for example, an INSERT, UPDATE, or DELETE statement.
3. **ResultSet executeQuery(String SQL)** : Returns a ResultSet object. Use this method when you expect to get a result set, as you would with a SELECT statement.

Closing Statement Object:

Just as you close a Connection object to save database resources, for the same reason you should also close the Statement object.

A simple call to the close() method will do the job. If you close the Connection object first it will close the Statement object as well. However, you should always explicitly close the Statement object to ensure proper cleanup.

```
Statement stmt = null;
try {
   stmt = conn.createStatement( );
   . . .
}
catch (SQLException e) {
   . . .
}
finally {
   stmt.close();
}
```

The PreparedStatement Objects:

The *PreparedStatement* interface extends the Statement interface which gives you added functionality with a couple of advantages over a generic Statement object.

This statement gives you the flexibility of supplying arguments dynamically.

Creating PreparedStatement Object:

```
PreparedStatement pstmt = null;
try {
   String SQL = "Update Employees SET age = ? WHERE id = ?";
   pstmt = conn.prepareStatement(SQL);
   . . .
}
catch (SQLException e) {
   . . .
}
finally {
   . . .
}
```

All parameters in JDBC are represented by the **?** symbol, which is known as the parameter marker. You must supply values for every parameter before executing the SQL statement.

The **setXXX()** methods bind values to the parameters, where **XXX** represents the Java data type of the value you wish to bind to the input parameter. If you forget to supply the values, you will receive an SQLException.

Each parameter marker is referred to by its ordinal position. The first marker represents position 1, the next position 2, and so forth. This method differs from that of Java array indices, which start at 0.

All of the **Statement object's** methods for interacting with the database (a) execute(), (b) executeQuery(), and (c) executeUpdate() also work with the PreparedStatement object. However, the methods are modified to use SQL statements that can take input the parameters.

Closing PreparedStatement Obeject:

Just as you close a Statement object, for the same reason you should also close the PreparedStatement object.

A simple call to the close() method will do the job. If you close the Connection object first it will close the PreparedStatement object as well. However, you should always explicitly close the PreparedStatement object to ensure proper cleanup.

```
PreparedStatement pstmt = null;
try {
   String SQL = "Update Employees SET age = ? WHERE id = ?";
   pstmt = conn.prepareStatement(SQL);
   . . .
}
catch (SQLException e) {
   . . .
}
finally {
   pstmt.close();
}
```

The CallableStatement Objects:

Just as a Connection object creates the Statement and PreparedStatement objects, it also creates the CallableStatement object which would be used to execute a call to a database stored procedure.

Creating CallableStatement Object:

Suppose, you need to execute the following Oracle stored procedure:

```
CREATE OR REPLACE PROCEDURE getEmpName
```

```
   (EMP_ID IN NUMBER, EMP_FIRST OUT VARCHAR) AS
BEGIN
   SELECT first INTO EMP_FIRST
   FROM Employees
   WHERE ID = EMP_ID;
END;
```

NOTE: Above stored procedure has been written for Oracle, but we are working with MySQL database so let us write same stored procedure for MySQL as follows to create it in EMP database:

```
DELIMITER $$

DROP PROCEDURE IF EXISTS `EMP`.`getEmpName` $$
CREATE PROCEDURE `EMP`.`getEmpName`
   (IN EMP_ID INT, OUT EMP_FIRST VARCHAR(255))
BEGIN
   SELECT first INTO EMP_FIRST
   FROM Employees
   WHERE ID = EMP_ID;
END $$

DELIMITER ;
```

Three types of parameters exist: IN, OUT, and INOUT. The PreparedStatement object only uses the IN parameter. The CallableStatement object can use all three.

Here are the definitions of each:

Parameter	Description
IN	A parameter whose value is unknown when the SQL statement is created. You bind values to IN parameters with the setXXX() methods.
OUT	A parameter whose value is supplied by the SQL statement it returns. You retrieve values from the OUT parameters with the getXXX() methods.
INOUT	A parameter that provides both input and output values. You bind variables with the setXXX() methods and retrieve values with the getXXX() methods.

The following code snippet shows how to employ the **Connection.prepareCall()** method to instantiate a **CallableStatement** object based on the preceding stored procedure:

```
CallableStatement cstmt = null;
try {
   String SQL = "{call getEmpName (?, ?)}";
   cstmt = conn.prepareCall (SQL);
   . . .
}
catch (SQLException e) {
   . . .
}
finally {
   . . .
}
```

The String variable SQL represents the stored procedure, with parameter placeholders.

Using CallableStatement objects is much like using PreparedStatement objects. You must bind values to all parameters before executing the statement, or you will receive an SQLException.

If you have IN parameters, just follow the same rules and techniques that apply to a PreparedStatement object; use the setXXX() method that corresponds to the Java data type you are binding.

When you use OUT and INOUT parameters you must employ an additional CallableStatement method, registerOutParameter(). The registerOutParameter() method binds the JDBC data type to the data type the stored procedure is expected to return.

Once you call your stored procedure, you retrieve the value from the OUT parameter with the appropriate getXXX() method. This method casts the retrieved value of SQL type to a Java data type.

Closing CallableStatement Obeject:

Just as you close other Statement object, for the same reason you should also close the CallableStatement object.

A simple call to the close() method will do the job. If you close the Connection object first it will close the CallableStatement object as well. However, you should always explicitly close the CallableStatement object to ensure proper cleanup.

```
CallableStatement cstmt = null;
try {
   String SQL = "{call getEmpName (?, ?)}";
   cstmt = conn.prepareCall (SQL);
   . . .
}
catch (SQLException e) {
   . . .
}
finally {
   cstmt.close();
}
```

JDBC - Result Sets:

The SQL statements that read data from a database query return the data in a result set. The SELECT statement is the standard way to select rows from a database and view them in a result set. The *java.sql.ResultSet* interface represents the result set of a database query.

A ResultSet object maintains a cursor that points to the current row in the result set. The term "result set" refers to the row and column data contained in a ResultSet object.

The methods of the ResultSet interface can be broken down into three categories:

1. **Navigational methods:** used to move the cursor around.
2. **Get methods:** used to view the data in the columns of the current row being pointed to by the cursor.
3. **Update methods:** used to update the data in the columns of the current row. The updates can then be updated in the underlying database as well.

The cursor is movable based on the properties of the ResultSet. These properties are designated when the corresponding Statement that generated the ResultSet is created.

JDBC provides following connection methods to create statements with desired ResultSet:

1. **createStatement(int RSType, int RSConcurrency);**
2. **prepareStatement(String SQL, int RSType, int RSConcurrency);**
3. **prepareCall(String sql, int RSType, int RSConcurrency);**

The first argument indicate the type of a ResultSet object and the second argument is one of two ResultSet constants for specifying whether a result set is read-only or updatable.

Type of ResultSet:

The possible RSType are given below, If you do not specify any ResultSet type, you will automatically get one that is TYPE_FORWARD_ONLY.

Type	Description
ResultSet.TYPE_FORWARD_ONLY	The cursor can only move forward in the result set.
ResultSet.TYPE_SCROLL_INSENSITIVE	The cursor can scroll forwards and backwards, and the result set is not sensitive to changes made by others to the database that occur after the result set was created.
ResultSet.TYPE_SCROLL_SENSITIVE.	The cursor can scroll forwards and backwards, and the result set is sensitive to changes made by others to the database that occur after the result set was created.

Concurrency of ResultSet:

The possible RSConcurrency are given below, If you do not specify any Concurrency type, you will automatically get one that is CONCUR_READ_ONLY.

Concurrency	Description
ResultSet.CONCUR_READ_ONLY	Creates a read-only result set. This is the default
ResultSet.CONCUR_UPDATABLE	Creates an updateable result set.

Our all the examples written so far can be written as follows which initializes a Statement object to create a forward-only, read only ResultSet object:

```
try {
   Statement stmt = conn.createStatement(
                            ResultSet.TYPE_FORWARD_ONLY,
                            ResultSet.CONCUR_READ_ONLY);
}
catch(Exception ex) {
   ....
}
finally {
   ....
}
```

Navigating a Result Set:

There are several methods in the ResultSet interface that involve moving the cursor, including:

S.N.	Methods & Description
1	**public void beforeFirst() throws SQLException** Moves the cursor to just before the first row
2	**public void afterLast() throws SQLException** Moves the cursor to just after the last row
3	**public void first() throws SQLException** Moves the cursor to the first row
4	**public void last() throws SQLException** Moves the cursor to the last row.

5	**public boolean absolute(int row) throws SQLException** Moves the cursor to the specified row
6	**public boolean relative(int row) throws SQLException** Moves the cursor the given number of rows forward or backwards from where it currently is pointing.
7	**public boolean previous() throws SQLException** Moves the cursor to the previous row. This method returns false if the previous row is off the result set
8	**public boolean next() throws SQLException** Moves the cursor to the next row. This method returns false if there are no more rows in the result set
9	**public int getRow() throws SQLException** Returns the row number that the cursor is pointing to.
10	**public void moveToInsertRow() throws SQLException** Moves the cursor to a special row in the result set that can be used to insert a new row into the database. The current cursor location is remembered.
11	**public void moveToCurrentRow() throws SQLException** Moves the cursor back to the current row if the cursor is currently at the insert row; otherwise, this method does nothing

Viewing a Result Set:

The ResultSet interface contains dozens of methods for getting the data of the current row.

There is a get method for each of the possible data types, and each get method has two versions:

1. One that takes in a column name.
2. One that takes in a column index.

For example, if the column you are interested in viewing contains an int, you need to use one of the getInt() methods of ResultSet:

S.N.	Methods & Description
1	**public int getInt(String columnName) throws SQLException** Returns the int in the current row in the column named columnName
2	**public int getInt(int columnIndex) throws SQLException** Returns the int in the current row in the specified column index. The column index starts at 1, meaning the first column of a row is 1, the second column of a row is 2, and so on.

Similarly there are get methods in the ResultSet interface for each of the eight Java primitive types, as well as common types such as java.lang.String, java.lang.Object, and java.net.URL

There are also methods for getting SQL data types java.sql.Date, java.sql.Time, java.sql.TimeStamp, java.sql.Clob, and java.sql.Blob. Check the documentation for more information about using these SQL data types.

Updating a Result Set:

The ResultSet interface contains a collection of update methods for updating the data of a result set.

As with the get methods, there are two update methods for each data type:

1. One that takes in a column name.
2. One that takes in a column index.

For example, to update a String column of the current row of a result set, you would use one of the following updateString() methods:

S.N.	Methods & Description
1	**public void updateString(int columnIndex, String s) throws SQLException** Changes the String in the specified column to the value of s.
2	**public void updateString(String columnName, String s) throws SQLException** Similar to the previous method, except that the column is specified by its name instead of its index.

There are update methods for the eight primitive data types, as well as String, Object, URL, and the SQL data types in the java.sql package.

Updating a row in the result set changes the columns of the current row in the ResultSet object, but not in the underlying database. To update your changes to the row in the database, you need to invoke one of the following methods.

S.N.	Methods & Description
1	**public void updateRow()** Updates the current row by updating the corresponding row in the database.
2	**public void deleteRow()** Deletes the current row from the database
3	**public void refreshRow()** Refreshes the data in the result set to reflect any recent changes in the database.
4	**public void cancelRowUpdates()** Cancels any updates made on the current row.
5	**public void insertRow()** Inserts a row into the database. This method can only be invoked when the cursor is pointing to the insert row.

JDBC DRIVERS TYPES:

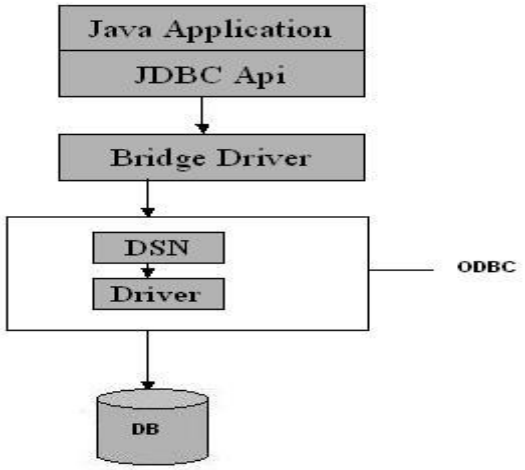
JDBC drivers are divided into four types or levels. The **different types of JDBC drivers** are:

Type 1: JDBC-ODBC Bridge driver (Bridge)
Type 2: Native-API/partly Java driver (Native)
Type 3: AllJava/Net-protocol driver (Middleware)
Type 4: All Java/Native-protocol driver (Pure)

Type 1 JDBC Driver

JDBC-ODBC Bridge driver

The Type 1 driver translates all JDBC calls into ODBC calls and sends them to the ODBC driver. ODBC is a generic API. The JDBC-ODBC Bridge driver is recommended only for experimental use or when no other alternative is available.



Type 1: JDBC-ODBC Bridge

Advantage:

The JDBC-ODBC Bridge allows access to almost any database, since the database's ODBC drivers are already available.

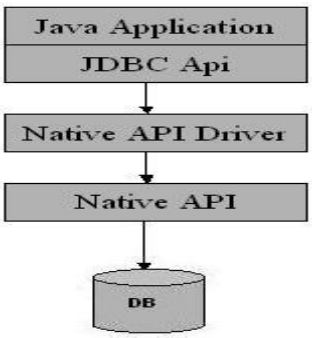
Disadvantages:

1. Since the Bridge driver is not written fully in Java, Type 1 drivers are not portable.
2. A performance issue is seen as a JDBC call goes through the bridge to the ODBC driver, then to the database, and this applies even in the reverse process. They are the slowest of all driver types.
3. The client system requires the ODBC Installation to use the driver.
4. Not good for the Web.

Type 2 JDBC Driver

Native-API/partly Java driver

The distinctive characteristic of type 2 jdbc drivers are that Type 2 drivers convert JDBC calls into database-specific calls i.e. this driver is specific to a particular database. Some distinctive characteristic of type 2 jdbc drivers are shown below. Example: Oracle will have oracle native api.



Type 2: Native api/ Partly Java Driver

Advantage:

The distinctive characteristic of type 2 jdbc drivers are that they are typically offer better performance than the JDBC-ODBC Bridge as the layers of communication (tiers) are less than that of Type
1 and also it uses Native api which is Database specific.

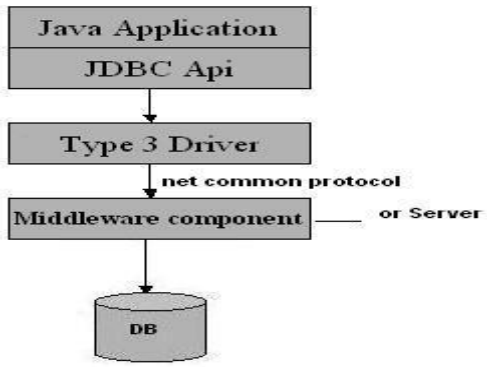
Disadvantage:

1. Native API must be installed in the Client System and hence type 2 drivers cannot be used for the Internet.
2. Like Type 1 drivers, it's not written in Java Language which forms a portability issue.
3. If we change the Database we have to change the native api as it is specific to a database
4. Mostly obsolete now
5. Usually not thread safe.

Type 3 JDBC Driver:

All Java/Net-protocol driver

Type 3 database requests are passed through the network to the middle-tier server. The middle-tier then translates the request to the database. If the middle-tier server can in turn use Type1, Type 2 or Type 4 drivers.



Type 3: All Java/ Net-Protocol Driver

Advantage:

1. This driver is server-based, so there is no need for any vendor database library to be present on client machines.
2. This driver is fully written in Java and hence Portable. It is suitable for the web.
3. There are many opportunities to optimize portability, performance, and scalability.
4. The net protocol can be designed to make the client JDBC driver very small and fast to load.

5. The type 3 driver typically provides support for features such as caching (connections, query results, and so on), load balancing, and advanced
system administration such as logging and auditing.
6. This driver is very flexible allows access to multiple databases using one driver.
7. They are the most efficient amongst all driver types.

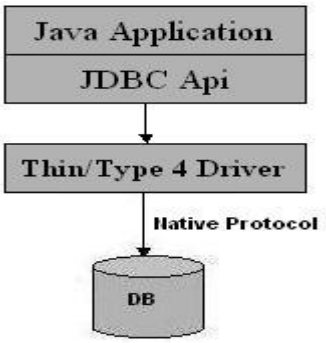
Disadvantage:

It requires another server application to install and maintain. Traversing the recordset may take longer, since the data comes through the backend server.

Type 4 JDBC Driver:

Native-protocol/all-Java driver

The Type 4 uses java networking libraries to communicate directly with the database server.



Type 4: Native-protocol/all-Java driver

Advantage:

1. The major benefit of using a type 4 jdbc drivers are that they are completely written in Java to achieve platform independence and eliminate deployment administration issues. It is most suitable for the web.
2. Number of translation layers is very less i.e. type 4 JDBC drivers don't have to translate database requests to ODBC or a native connectivity interface or to pass the request on to another server, performance is typically quite good.
3. You don't need to install special software on the client or server. Further, these drivers can be downloaded dynamically.

Disadvantage:

With type 4 drivers, the user needs a different driver for each database.

JDBC - Statement Object Example:

Following is the example which makes use of following three queries along with opening and closing statment:

1. **boolean execute(String SQL)** : Returns a boolean value of true if a ResultSet object can be retrieved; otherwise, it returns false. Use this method to execute SQL DDL statements or when you need to use truly dynamic SQL.
2. **int executeUpdate(String SQL)** : Returns the numbers of rows affected by the execution of the SQL statement. Use this method to execute SQL statements for which you expect to get a number of rows affected - for example, an INSERT, UPDATE, or DELETE statement.
3. **ResultSet executeQuery(String SQL)** : Returns a ResultSet object. Use this method when you expect to get a result set, as you would with a SELECT statement.

This sample code has been written based on the environment and database setup done in previous chapters.

Copy and past following example in JDBCExample.java, compile and run as follows:

```
//STEP 1. Import required packages
import java.sql.*;

public class JDBCExample {
   // JDBC driver name and database URL
   static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";
   static final String DB_URL = "jdbc:mysql://localhost/EMP";

   //  Database credentials
   static final String USER = "username";
   static final String PASS = "password";

   public static void main(String[] args) {
   Connection conn = null;
   Statement stmt = null;
   try{
      //STEP 2: Register JDBC driver
      Class.forName("com.mysql.jdbc.Driver");

      //STEP 3: Open a connection
      System.out.println("Connecting to database...");
      conn = DriverManager.getConnection(DB_URL,USER,PASS);

      //STEP 4: Execute a query
      System.out.println("Creating statement...");
      stmt = conn.createStatement();
      String sql = "UPDATE Employees set age=30 WHERE id=103";

      // Let us check if it returns a true Result Set or not.
      Boolean ret = stmt.execute(sql);
      System.out.println("Return value is : " + ret.toString() );

      // Let us update age of the record with ID = 103;
      int rows = stmt.executeUpdate(sql);
      System.out.println("Rows impacted : " + rows );

      // Let us select all the records and display them.
      sql = "SELECT id, first, last, age FROM Employees";
      ResultSet rs = stmt.executeQuery(sql);

      //STEP 5: Extract data from result set
      while(rs.next()){
         //Retrieve by column name
         int id  = rs.getInt("id");
```

```
         int age = rs.getInt("age");
         String first = rs.getString("first");
         String last = rs.getString("last");

         //Display values
         System.out.print("ID: " + id);
         System.out.print(", Age: " + age);
         System.out.print(", First: " + first);
         System.out.println(", Last: " + last);
      }
      //STEP 6: Clean-up environment
      rs.close();
      stmt.close();
      conn.close();
   }catch(SQLException se){
      //Handle errors for JDBC
      se.printStackTrace();
   }catch(Exception e){
      //Handle errors for Class.forName
      e.printStackTrace();
   }finally{
      //finally block used to close resources
      try{
         if(stmt!=null)
            stmt.close();
      }catch(SQLException se2){
      }// nothing we can do
      try{
         if(conn!=null)
            conn.close();
      }catch(SQLException se){
         se.printStackTrace();
      }//end finally try
   }//end try
   System.out.println("Goodbye!");
}//end main
}//end JDBCExample
```

Now let us compile above example as follows:

```
C:\>javac JDBCExample.java
C:\>
```

When you run **JDBCExample**, it produces following result:

```
C:\>java JDBCExample
Connecting to database...
Creating statement...
Return value is : false
Rows impacted : 1
ID: 100, Age: 18, First: Zara, Last: Ali
ID: 101, Age: 25, First: Mahnaz, Last: Fatma
ID: 102, Age: 30, First: Zaid, Last: Khan
ID: 103, Age: 30, First: Sumit, Last: Mittal
Goodbye!
C:\>
```

JDBC - PreparedStatement Object Example:

Following is the example which makes use of PreparedStatement along with opening and closing statments:

This sample code has been written based on the environment and database setup done in previous chapters.

Copy and past following example in JDBCExample.java, compile and run as follows:

```
//STEP 1. Import required packages
import java.sql.*;

public class JDBCExample {
   // JDBC driver name and database URL
   static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";
   static final String DB_URL = "jdbc:mysql://localhost/EMP";

   //  Database credentials
   static final String USER = "username";
   static final String PASS = "password";

   public static void main(String[] args) {
   Connection conn = null;
   PreparedStatement stmt = null;
   try{
      //STEP 2: Register JDBC driver
      Class.forName("com.mysql.jdbc.Driver");

      //STEP 3: Open a connection
      System.out.println("Connecting to database...");
      conn = DriverManager.getConnection(DB_URL,USER,PASS);

      //STEP 4: Execute a query
      System.out.println("Creating statement...");
      String sql = "UPDATE Employees set age=? WHERE id=?";
      PreparedStatement stmt = conn.prepareStatement(sql);

      //Bind values into the parameters.
      stmt.setInt(1, 35);  // This would set age
      stmt.setInt(2, 102); // This would set ID

      // Let us update age of the record with ID = 102;
      int rows = stmt.executeUpdate();
      System.out.println("Rows impacted : " + rows );

      // Let us select all the records and display them.
      sql = "SELECT id, first, last, age FROM Employees";
      ResultSet rs = stmt.executeQuery(sql);

      //STEP 5: Extract data from result set
      while(rs.next()){
         //Retrieve by column name
         int id  = rs.getInt("id");
         int age = rs.getInt("age");
         String first = rs.getString("first");
         String last = rs.getString("last");

         //Display values
         System.out.print("ID: " + id);
         System.out.print(", Age: " + age);
         System.out.print(", First: " + first);
         System.out.println(", Last: " + last);
      }
```

```
      //STEP 6: Clean-up environment
      rs.close();
      stmt.close();
      conn.close();
   }catch(SQLException se){
      //Handle errors for JDBC
      se.printStackTrace();
   }catch(Exception e){
      //Handle errors for Class.forName
      e.printStackTrace();
   }finally{
      //finally block used to close resources
      try{
         if(stmt!=null)
            stmt.close();
      }catch(SQLException se2){
      }// nothing we can do
      try{
         if(conn!=null)
            conn.close();
      }catch(SQLException se){
         se.printStackTrace();
      }//end finally try
   }//end try
   System.out.println("Goodbye!");
}//end main
}//end JDBCExample
```

Now let us compile above example as follows:

```
C:\>javac JDBCExample.java
C:\>
```

When you run **JDBCExample**, it produces following result:

```
C:\>java JDBCExample
Connecting to database...
Creating statement...
Rows impacted : 1
ID: 100, Age: 18, First: Zara, Last: Ali
ID: 101, Age: 25, First: Mahnaz, Last: Fatma
ID: 102, Age: 35, First: Zaid, Last: Khan
ID: 103, Age: 30, First: Sumit, Last: Mittal
Goodbye!
C:\>
```

JDBC - CallableStatement Object Example:

Following is the example which makes use of CallableStatement along with the following **getEmpName()** MySQL stored procedure:

Make sure you have created this stored procedure in your EMP Database. You can use MySQL Query Browser to get it done.

```
DELIMITER $$

DROP PROCEDURE IF EXISTS `EMP`.`getEmpName` $$
CREATE PROCEDURE `EMP`.`getEmpName`
   (IN EMP_ID INT, OUT EMP_FIRST VARCHAR(255))
```

```
BEGIN
   SELECT first INTO EMP_FIRST
   FROM Employees
   WHERE ID = EMP_ID;
END $$

DELIMITER ;
```

This sample code has been written based on the environment and database setup done in previous chapters.

Copy and past following example in JDBCExample.java, compile and run as follows:

```
//STEP 1. Import required packages
import java.sql.*;

public class JDBCExample {
   // JDBC driver name and database URL
   static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";
   static final String DB_URL = "jdbc:mysql://localhost/EMP";

   //  Database credentials
   static final String USER = "username";
   static final String PASS = "password";

   public static void main(String[] args) {
   Connection conn = null;
   CallableStatement stmt = null;
   try{
      //STEP 2: Register JDBC driver
      Class.forName("com.mysql.jdbc.Driver");

      //STEP 3: Open a connection
      System.out.println("Connecting to database...");
      conn = DriverManager.getConnection(DB_URL,USER,PASS);

      //STEP 4: Execute a query
      System.out.println("Creating statement...");
      String sql = "{call getEmpName (?, ?)}";
      stmt = conn.prepareCall(sql);

      //Bind IN parameter first, then bind OUT parameter
      int empID = 102;
      stmt.setInt(1, empID); // This would set ID as 102
      // Because second parameter is OUT so register it
      stmt.registerOutParameter(2, java.sql.Types.VARCHAR);

      //Use execute method to run stored procedure.
      System.out.println("Executing stored procedure..." );
      stmt.execute();

      //Retrieve employee name with getXXX method
      String empName = stmt.getString(2);
      System.out.println("Emp Name with ID:" +
               empID + " is " + empName);
      stmt.close();
      conn.close();
   }catch(SQLException se){
      //Handle errors for JDBC
      se.printStackTrace();
   }catch(Exception e){
      //Handle errors for Class.forName
      e.printStackTrace();
```

```
   }finally{
      //finally block used to close resources
      try{
         if(stmt!=null)
            stmt.close();
      }catch(SQLException se2){
      }// nothing we can do
      try{
         if(conn!=null)
            conn.close();
      }catch(SQLException se){
         se.printStackTrace();
      }//end finally try
   }//end try
   System.out.println("Goodbye!");
}//end main
}//end JDBCExample
```

Now let us compile above example as follows:

```
C:\>javac JDBCExample.java
C:\>
```

When you run **JDBCExample**, it produces following result:

```
C:\>java JDBCExample
Connecting to database...
Creating statement...
Executing stored procedure...
Emp Name with ID:102 is Zaid
Goodbye!
C:\>
```
