SQL and Java

Database Systems Lecture 19

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In this Lecture

- SQL in Java
  - SQL from within other Languages
  - SQL, Java, and JDBC
- For More Information
  - Sun Java tutorial:

  http://java.sun.com/docs/books/tutorial/jdbc
  - Connolly and Begg 29.7

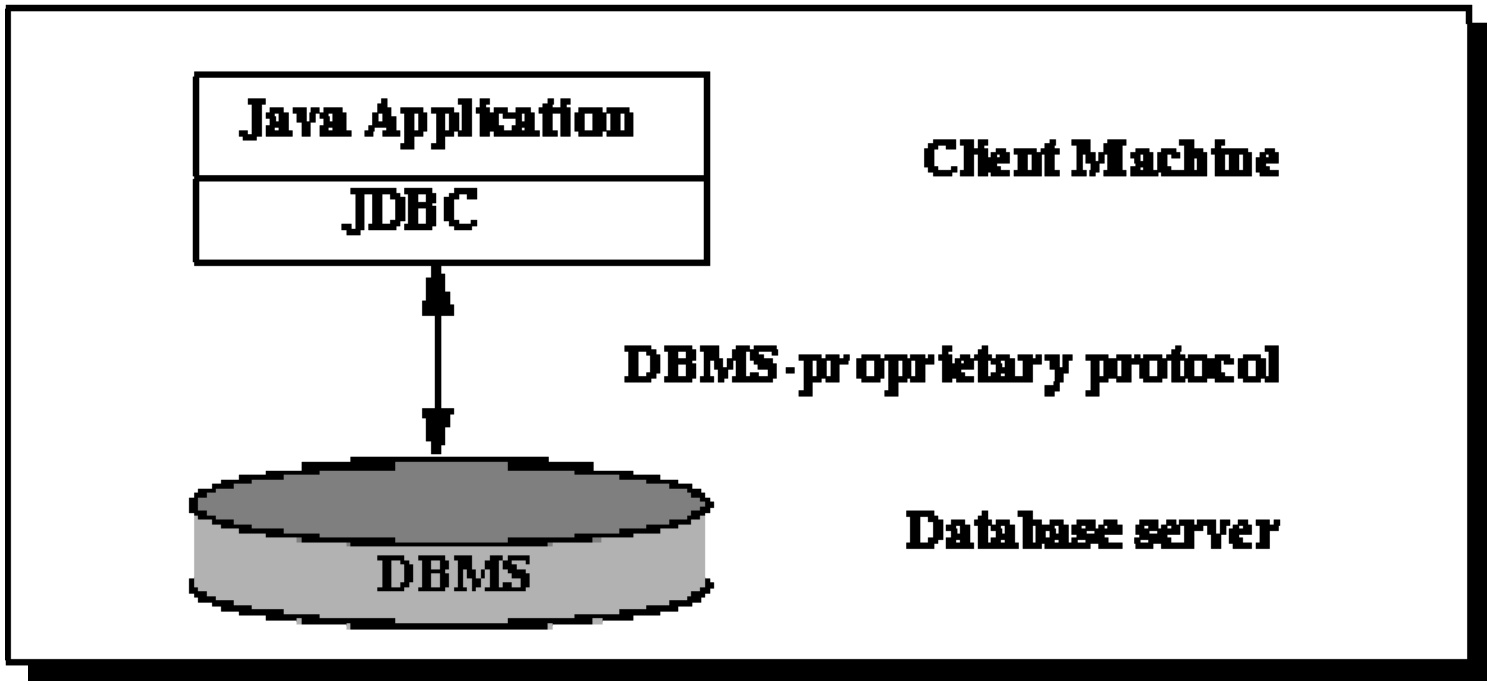
SQL and Other Languages

- Combining SQL and another language
  - Use SQL to run queries on the database
  - Use another language (Java, C, etc) to do the rest of the work: e.g. user interface, or complicated processing
  - Need an interface between the two
- ODBC (Open DB Connectivity) is a common standard
  - Provides an API which is widely supported
  - Allows you to pass queries to a database, and return the results to a program

JDBC

- JDBC is a Java API for database connectivity
  - It is not the same as ODBC but implements a similar specification
  - JDBC enables programmers to write java applications that
    - Connect to a database
    - Send queries and update statements to the database
    - Retrieve and process the results received from the database in answer to the query

JDBC


Java Application
JDBC
Client Machine
DBMS-proprietary protocol
DBMS
Database server

JDBC

- JDBC consists of:
  - The JDBC™ API proper: interfaces, classes and methods for executing SQL statements, retrieving results, and propagating changes back to the database
  - JDBC Driver Manager: a class that defines objects which can connect Java applications to a JDBC driver.
  - JDBC Test Suite
  - JDBC-ODBC Bridge

Using JDBC

- Basic steps when using JDBC
  - Register a database driver
  - Open a connection
  - Pass some queries to the database
  - Process the results as needed
  - Close the connection
  - Deal with any errors
- Preamble: import java.sql.*;

Register a Driver

- We need to register an appropriate driver with the DriverManager
  - There is a different driver for each DBMS
  - We'll need to use the driver for Oracle:

```
DriverManager.registerDriver(
  new oracle.jdbc.driver.OracleDriver()
);
```

Open a Connection

- Next we open a connection to the database from the DriverManager
  - We give the address of the database, a username and a password

```
Connection conn = DriverManager.getConnection (
"jdbc:oracle:thin:@oracle.cs.nott.ac.uk:1521:maindb",
“xxx06u", “somepassword");
```

Your username

Your sqlplus password

Passing Queries to the DB

- Now we can send queries to the DB
  - We do this through a Statement object
  - Each Statement can deal with one query at a time
  - A single Connection can have several statements open at any time
- Statement objects
  - Are created from a Connection
  - The executeUpdate() method runs a query that doesn't return any results (UPDATE, CREATE TABLE, etc)
  - executeQuery() is used when a result is expected

Passing Queries to the DB

```
Statement sttable = conn.createStatement();
sttable.executeUpdate(
"CREATE TABLE Fruit(Name VARCHAR(10),Amount INT)“
);
sttable.close();

Statement stinsert1 = conn.createStatement();
stinsert1.executeUpdate(
"INSERT INTO Fruit VALUES('Apple', 5)“
);
stinsert1.close();
```

Passing Queries to the DB

```
Statement stinsert2 = conn.createStatement();
stinsert2.executeUpdate(
"INSERT INTO Fruit VALUES(‘Pumpkin', 1)“
);
stinsert2.close();
```

Processing Query Results

- When a query returns a result
  - We use the Statement object's executeQuery method
  - The results are put in a ResultSet object
  - Each Statement can deal with a single ResultSet at any one time
- The ResultSet object
  - Is essentially a table
  - Has a cursor that points to the current row of data
  - Initially the cursor is positioned *before* the first row
  - The next() method moves to the next row, and returns false if there isn't one

Processing Query Results

```
Statement stresult = conn.createStatement();
ResultSet fruit = stresult.executeQuery(
"SELECT * FROM Fruit"
);
while(fruit.next()) {
   System.out.println(
      fruit.getString("Name")+ ", " +
      fruit.getInt("Amount"));
}
fruit.close();
```

Working with ResultSets

- We get values from the ResultSet with
  - getInt()
  - getString()
  - getDouble()
  - etc.
- Each takes either
  - The name of the column as a String, or
  - The index of the column as an integer

Advanced ResultSets

- By default a ResultSet
  - Allows you to go over the results once, from start to finish
  - Allows you to read, but not change, the information in the result
- We can change this behaviour so that
  - We can move forward and backwards
  - We can update existing rows
  - We can add rows
  - This is decided when we create the Statement object from the Connection

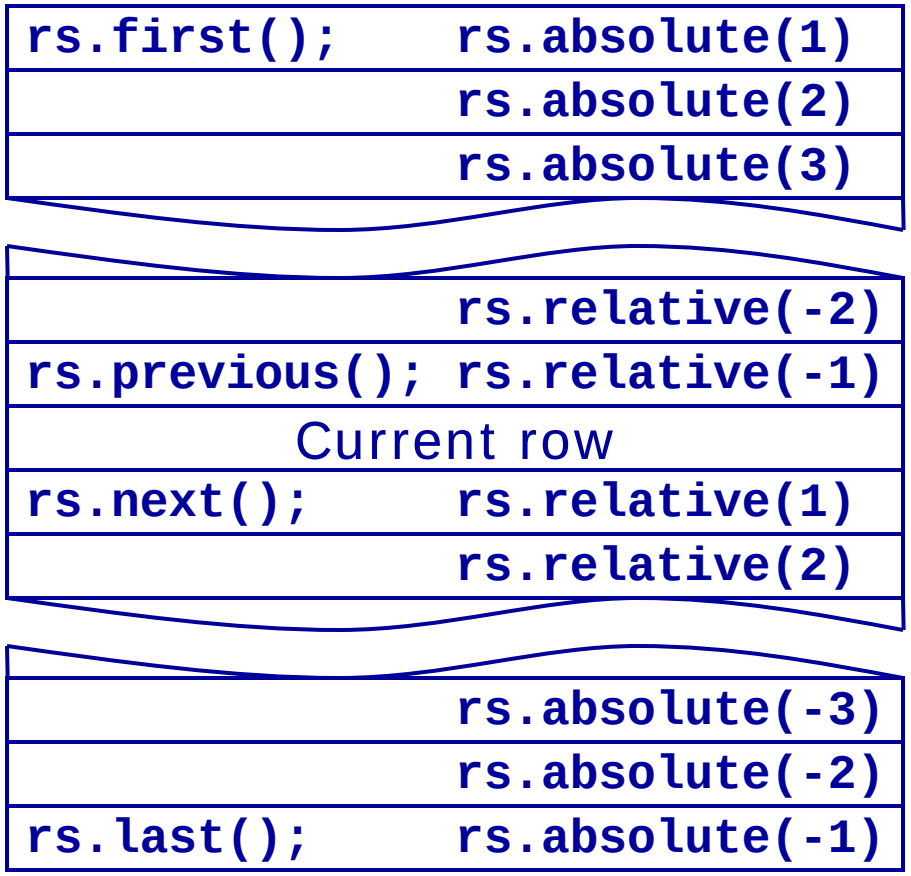
Creating Statements Again

`conn.createStatement(<scroll>, <update>);`

- **`<scroll>`** is one of
  - **`ResultSet.TYPE_FORWARD_ONLY`**
  - **`ResultSet.TYPE_SCROLL_SENSITIVE`**
  - **`ResultSet.TYPE_SCROLL_INSENSITIVE`**
- **`<update>`** is one of
  - **`ResultSet.CONCUR_READ_ONLY`**
  - **`ResultSet.CONCUR_UPDATABLE`**

Scrollable ResultSets

- If we use the option **`TYPE_SCROLL_SENSITIVE`** or **`TYPE_SCROLL_INSENSITIVE`**
  - We can move around the ResultSets made from that statement
  - There are a lot of options available for this
  - For a result set called **`rs`**…



Updating ResultSets

- If we use the option **CONCUR_UPDATABLE**
  - We can update the values in the result set or add a new row
  - In Oracle you can't have an updatable forward-only result set
  - Also in Oracle you have to explicitly specify the columns in your **SELECT** statement if you want to update it (no **SELECT *** ...)

Updating a Row

```
// Make an updatable Statement
Statement result2 = conn.createStatement(
   ResultSet.TYPE_SCROLL_SENSITIVE,
   ResultSet.CONCUR_UPDATABLE);
ResultSet rset2 = result2.executeQuery(
"SELECT Name, Amount FROM Fruit");
rset2.absolute(2);// set current row to second
rset2.updateInt("Amount", 3); //
rset2.updateRow(); // updates the second row
```

Inserting a Row

```
// rset2 is set up as in the previous example
// Get ready to insert a row
rset2.moveToInsertRow();
// Put the values of the new row in each column
rset2.updateString(“Name", “Orange”);
rset2.updateInt(“Amount", 7);
// Add this row
rset2.insertRow();
// Go back to the row we were at before inserting
rset2.moveToCurrentRow();
```

Dealing with Errors

- Things can go wrong with all of this
  - Incorrect SQL statements
  - DBMS might not be available
  - DBMS might not support some features
- If something goes wrong then an SQLException occurs
- If an exception is thrown:
  - We need to deal with it as best we can
  - Make sure any database objects are closed
  - If a connection is left open it can consume resources and might interfere with later use of the database

Exception Handling

```
// Declaration of any database objects
try {
  // Some database code
} catch (Exception e) {
  // Error reporting etc.
} finally {
  // Make sure all database objects are
  // closed and cleaned up
}
```

Closing Objects

- To make sure the object is closed
  - See if the object exists
  - If it does, call its close method
  - This might throw an exception itself, which needs to be caught
  - At some stage we have to stop handling the exceptions

```
Connection conn;
try {
    ...
} finally {
  if (conn != null) {
    try {
      conn.close();
    } catch (...) {
      // what to do?
    }
  }
}
```

That’s it

- If you have revision questions, please contact me.