CS 580 Client-Server Programming
Spring Semester, 2010
Doc 17 JDBC
8 April, 2010

References

http://java.sun.com/javase/6/docs/technotes/guides/jdbc/index.html Sun's on-line JDBC Tutorial & Documentation

SqliteJDBC Docs, http://www.zentus.com/sqlitejdbc/

Java – Connecting To Database

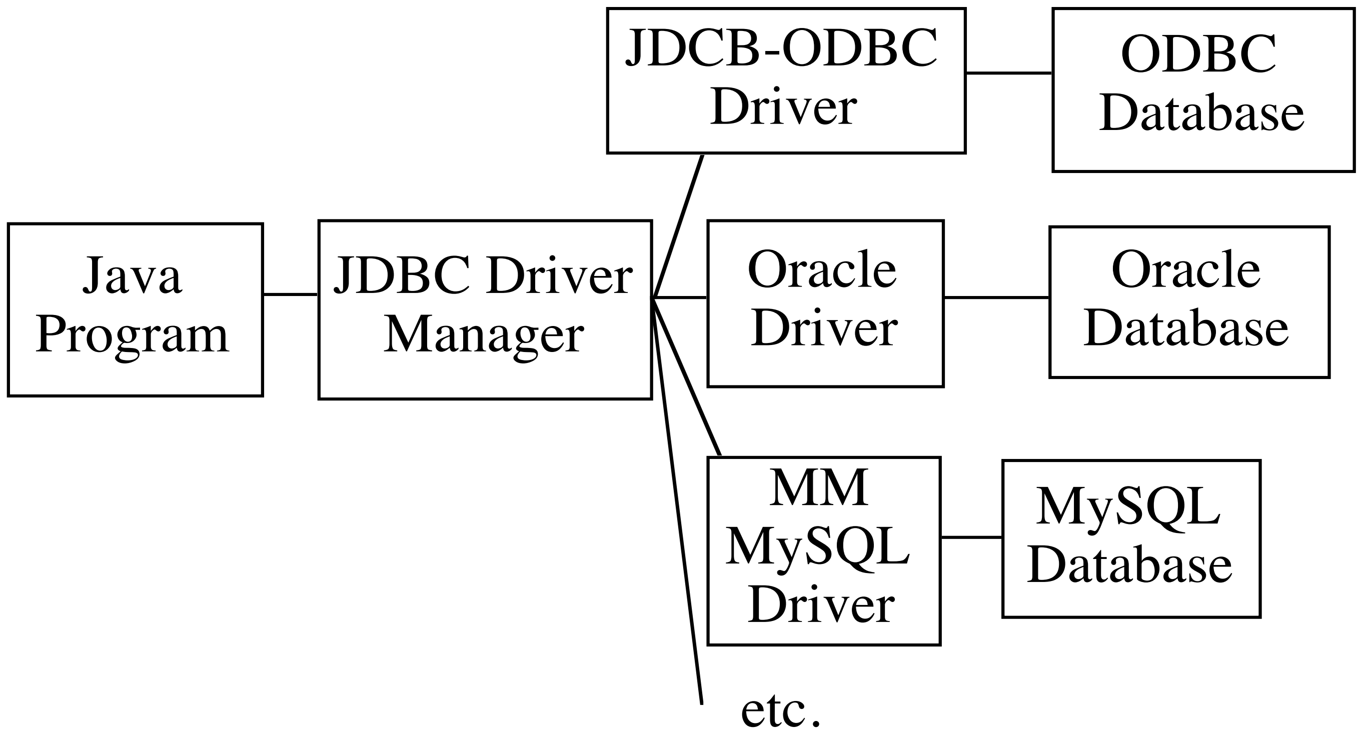
```
import java.sql.*;
public class Test {
  public static void main(String[] args) throws Exception {
    Class.forName("org.sqlite.JDBC");
    Connection conn = DriverManager.getConnection("jdbc:sqlite:test.db");
    Statement stat = conn.createStatement();
    stat.executeUpdate("drop table if exists people;");
    stat.executeUpdate("create table people (name, occupation);");
    PreparedStatement prep = conn.prepareStatement( "insert into people values (?, ?);");

    prep.setString(1, "Gandhi");
    prep.setString(2, "politics");
    prep.addBatch();
    conn.setAutoCommit(false);
    prep.executeBatch();
    conn.setAutoCommit(true);

    ResultSet rs = stat.executeQuery("select * from people;");
    while (rs.next()) {
      System.out.println("name = " + rs.getString("name"));
      System.out.println("job = " + rs.getString("occupation"));
    }
    rs.close();
    conn.close();
  }
```

This is the old way (Pre Java 6) of connecting.

SqliteJDBC Documentation

http://www.zentus.com/sqlitejdbc/

JDBC



Drivers must be in your classpath

JDBC Drivers

Java supports four types of JDBC drivers

JDBC-ODBC bridge plus ODBC driver

Java code access ODBC native binary drivers

ODBC driver accesses databases

ODBC drivers must be installed on each client

Native-API partly-Java driver

Java code accesses database specific native binary drivers

JDBC-Net pure Java driver

Java code accesses database via DBMS-independent net protocol

Native-protocol pure Java driver

Java code accesses database via DBMS-specific net protocol

JDBC URL Structure

jdbc:<subprotocol>:<subname>

<subprotocol>

Name of the driver or database connectivity mechanism

<subname>

Depends on the <subprotocol>, can vary with vender

PostgreSQL

```
jdbc:postgresql:database
jdbc:postgresql://host/database
jdbc:postgresql://host:port/database
```

Sqlite

```
jdbc:sqlite:filename
```

MySQL

```
jdbc:mysql://[host][,failoverhost...][:port]/[database]
[?propertyName1][=propertyValue1][&propertyName2]
[=propertyValue2]...
```

Loading Driver

In your code

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

Command line

```
java –Djdbc.drivers=org.postgresql.Driver
yourProgramName
```

Loading Driver - Java 6, JDBC 4

Auto discovery

```
String dbUrl = "jdbc:postgresql://bismarck.sdsu.edu/test";
String user = "whitney";
String password = "mysecret";
Connection bismarck = DriverManager.getConnection( dbUrl, user, password);
Statement getTables = bismarck.createStatement();
ResultSet tableList = getTables.executeQuery("SELECT * FROM names");
while (tableList.next() )
    System.out.println("Last Name: " + tableList.getString(1) + '\t' +
                "First Name: " + tableList.getString( "first_name"));
bismarck.close();
```

Java 6 introduces auto discovery. We don't have to call Class.forName(). This requires Java 6 and JDBC 4 compliant drivers.

DriverManager.getConnection

Three forms:

getConnection(URL, Properties)
getConnection(URL, userName, Password)
getConnection(URLWithUsernamePassword)

Form 1

```
static String ARS_URL = "jdbc:oracle:@PutDatabaseNameHere";

DriverManager.getConnection(ARS_URL, "whitney","secret");
```

Form 2

```
DriverManager.getConnection(
        "jdbc:oracle:whitney/secret@PutDatabaseNameHere");
```

Form 3

```
java.util.Properties info = new java.util.Properties();
info.addProperty ("user", "whitney");
info.addProperty ("password","secret");

DriverManager getConnection (ARS_URL ,info );
```

java.sql verses javax.sql

java.sql

DriverManager

javax.sql

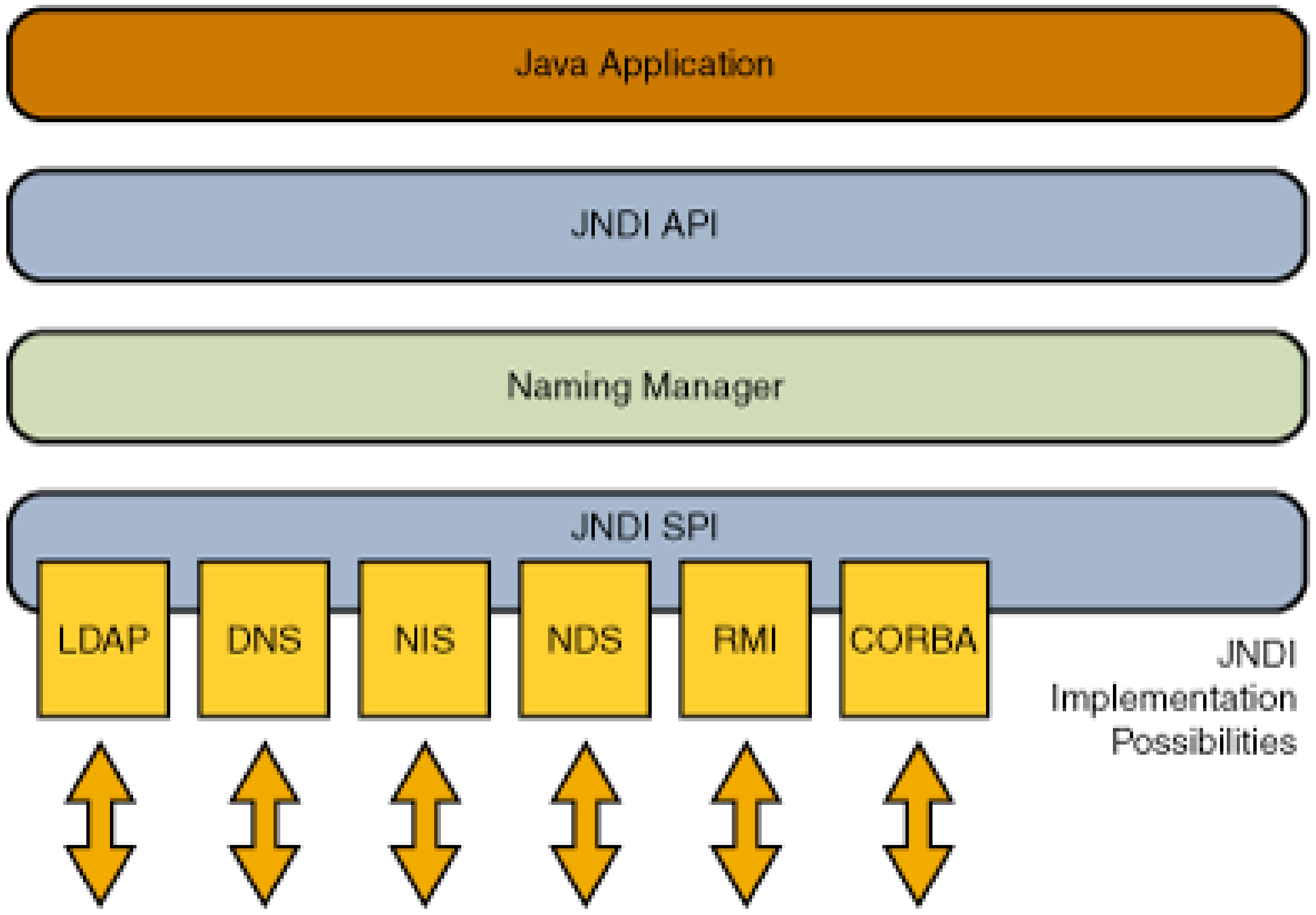
DataSource

- Connection Pools
- Distributed Transactions
- Normally uses JNDI

JNDI

Java Naming and Directory Interface

Need JNDi Service Provider



http://java.sun.com/docs/books/tutorial/jndi/overview/index.html

Queries

executeUpdate

  Use for INSERT, UPDATE, DELETE or SQL that return nothing

executeQuery

  Use for SQL (SELECT) that return a result set

execute

  Use for SQL that return multiple result sets

  Uncommon

ResultSet

ResultSet - Result of a Query

JDBC returns a ResultSet as a result of a query

A ResultSet contains all the rows and columns that satisfy the SQL statement

A cursor is maintained to the current row of the data

The cursor is valid until the ResultSet object or its Statement object is closed

next() method advances the cursor to the next row

You can access columns of the current row by index or name

ResultSet has getXXX methods that:

- have either a column name or column index as argument
- return the data in that column converted to type XXX

getObject

A replacement for the getXXX methods

Rather than

```
ResultSet tableList =
    getTables.executeQuery("SELECT * FROM name");
String firstName = tableList.getString( 1);
```

Can use

```
ResultSet tableList =
    getTables.executeQuery("SELECT * FROM name");
String firstName = (String) tableList.getObject( 1);
```

getObject(int k) returns the object in the k'th column of the current row

getObject(String columnName) returns the object in the named column

Data Conversion

SQL type	Java type
CHAR	String
VARCHAR	String
LONGVARCHAR	String
NUMERIC	java.math.BigDecimal
DECIMAL	java.math.BigDecimal
BIT	boolean
TINYINT	byte
SMALLINT	short
INTEGER	int
BIGINT	long
REAL	float
FLOAT	double
DOUBLE	double
BINARY	byte[]
VARBINARY	byte[]
LONGVARBINARY	byte[]
DATE	java.sql.Date
TIME	java.sql.Time
TIMESTAMP	java.sql.Timestamp

Some Result Set Issues

What happens when we call next() too many times?

What happens if we try to access data before we call next?

In both cases an java.sql.SQLException is thrown

Mixing ResultSets

Can't have two active result sets on same statement

```
Connection rugby;
rugby = DriverManager.getConnection( dbUrl, user, password);
Statement getTables = rugby.createStatement();
ResultSet count =
    getTables.executeQuery("SELECT COUNT(*) FROM name");
ResultSet tableList =
    getTables.executeQuery("SELECT * FROM name");

while (tableList.next() )
    System.out.println("Last Name: " + tableList.getObject(1) + '\t' +
                "First Name: " + tableList.getObject( "first_name"));

// Raises java.sql.SQLException
count.getObject(1);

rugby.close();
```

this can happen when two threads have access to the same statement

Two Statements on one Connection work

```
        Connection rugby;
        rugby = DriverManager.getConnection( dbUrl, user, password);
        Statement getTables = rugby.createStatement();
        Statement tableSize = rugby.createStatement();

        ResultSet count =
            getTables.executeQuery("SELECT COUNT(*) FROM name");
        ResultSet tableList =
            tableSize.executeQuery("SELECT * FROM name");

        while (tableList.next() )
            System.out.println("Last Name: " + tableList.getObject(1) + '\t' +
                                    "First Name: " +
tableList.getObject( "first_name"));
        count.next();
        System.out.println("Count: " + count.getObject(1) );
        count.close();
        tableList.close();
        rugby.close();
```

Threads & Connections

Some JDBC drivers are not thread safe

If two threads access the same connection results may get mixed up

PostgreSQL & MySql drivers are thread safe

When two threads make a request on the same connection

The second thread blocks until the first thread get it its results

Can use more than one connection but

Each connection requires a process on the database

SQLiteJDBC Issues

Only one Connection can write to the database at a time

No write can finish while there is an open reader

So

Close resultsets as soon as you can

SQLiteJDBC Issues

Queries are cheap

SQLiteJDBC Issues

Use PreparedStatement

```
PreparedStatement prep = conn.prepareStatement("insert into mytable values (?);");
```

Converted into SQLite form
(true for most databases)

Second use is fast

SQLiteJDBC Issues

Transactions are Good

Slow

```
PreparedStatement prep = conn.prepareStatement( "insert into mytable values (?);");
for (int i=0; i < 10000; i++) {
    prep.setInt(1, i);
    prep.executeUpdate();
}
```

Fast

```
PreparedStatement prep = conn.prepareStatement( "insert into mytable values (?);");
conn.setAutoCommit(false);
for (int i=0; i < 10000; i++) {
    prep.setInt(1, i);
    prep.executeUpdate();
}
conn.commit();
```