CS 580 Client-Server Programming
Spring Semester, 2009
Doc 12 JDBC
12 March, 2009

References

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

Connector-J, MySql JDBC Driver Documentation, http://www.mysql.com/products/connector/j/

PostgreSQL JDBC Documentation, http://jdbc.postgresql.org/documentation/docs.html

Ruby PostgreSQL, http://ruby.scripting.ca/postgres/rdoc/ (No longer available)

Set up for Example

```
CREATE TABLE names (
    last_name    varchar NOT NULL,
    first_name    varchar  NOT NULL,
    id    SERIAL    PRIMARY KEY
);
```

```
INSERT INTO names (last_name, first_name)
VALUES ('Whitney', 'Roger');
```

Java – Connecting To Database

```
import java.sql.*;

public class SampleConnection  {
    public static void main (String args[]) throws Exception       {
            String dbUrl = "jdbc:postgresql://bismarck.sdsu.edu/test";
            String user = "whitney";
            String password = "notMyRealPassword";
            System.out.println("Load Driver!");
            Class.forName("org.postgresql.Driver");

            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();
            }
}
```


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

Documentation

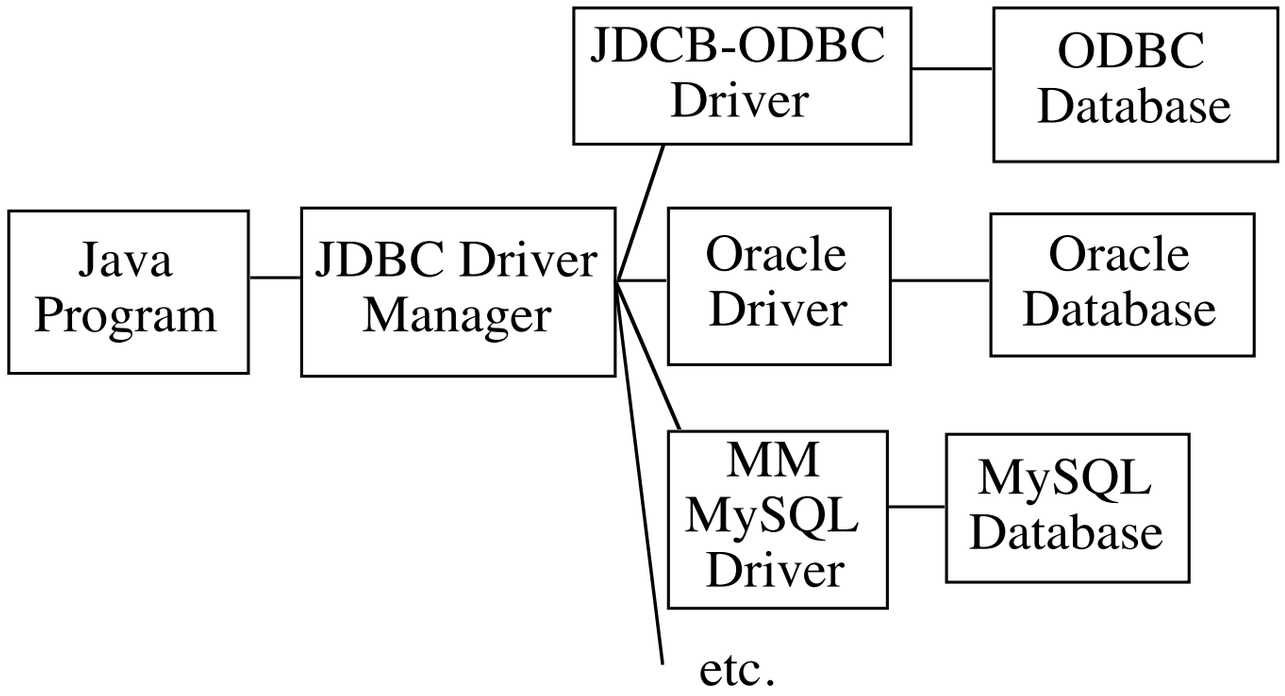
MySQL

http://dev.mysql.com/doc/

PostgreSQL

http://www.postgresql.org/docs/

JDBC



MySQL jdbc driver

http://dev.mysql.com/downloads/connector/j/5.1.html

PostgreSQL jdbc driver

http://jdbc.postgresql.org/index.html

Drivers must be in your classpath

Course accounts use PostgreSQL 8.2.3

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

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

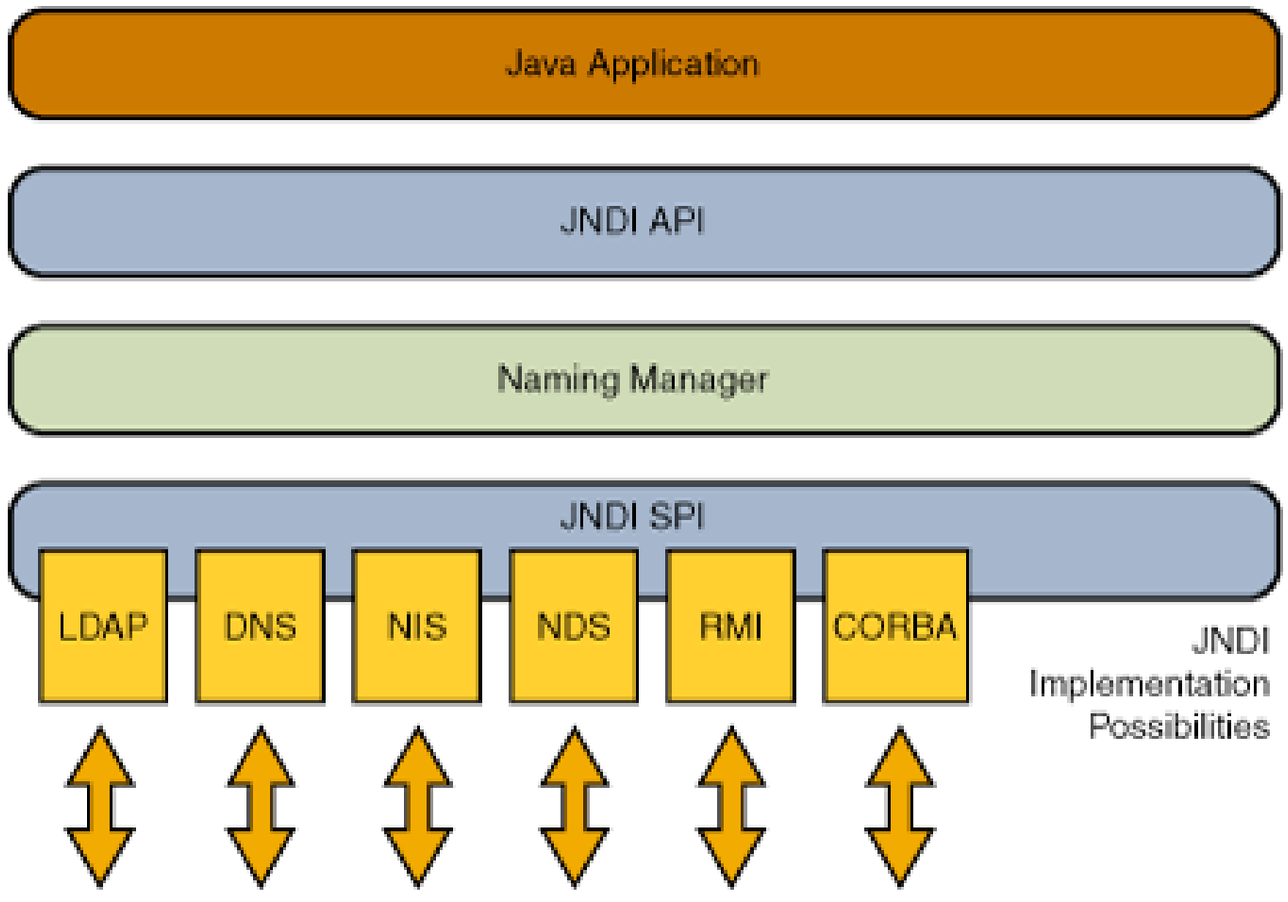
Transactions

- 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

Ruby MySQL

Documentation & Directions

http://www.kitebird.com/articles/ruby-mysql.html

Ruby PostgreSQL

Install

gem install ruby-postgres --rdoc

Docs

http://ruby.scripting.ca/postgres/rdoc/

Examples (Unix)

/usr/lib/ruby/gems/1.8/gems/ruby-postgres-0.7.1.2005.12.21/sample

Ruby PostgreSQL Example

```
require "postgres"

cs580 = PGconn.connect('bismarck.sdsu.edu',5432, nil, nil, 'cs580whitney', 'cs580whitney', 'password')

cs580.exec("DROP TABLE test") rescue nil
cs580.exec("CREATE TABLE test (first_name VARCHAR(20), last_name VARCHAR(20))")
cs580.exec("INSERT INTO test VALUES ('Roger', 'Whitney')")
cs580.exec("INSERT INTO test VALUES ('Roger', 'Rabbit')")

result = cs580.exec("SELECT * FROM test")
for field in result.fields
    printf("%-15s",field)
end
printf("\n")
result.result.each do |tuple|
  tuple.each do |fld|
    printf("%-15s",fld)
  end
  printf("\n")
end
```