Accessing databases in Java using JDBC

Introduction

JDBC is an API for Java that allows working with relational databases. JDBC offers the possibility to use SQL statements for DDL and DML statements. This API can be regarded as an abstraction layer between the application and the DBMS, programmers being able to work with the database independent of the underlying DBMS. Thus the code does not suffer modifications if the DBMS is changed. This independence is achieved by the fact that JDBC uses drivers, which translate JDBC API method calls to specific DBMS API. When we change the DBMS it is enough to change the driver, which can be done even at runtime.

(Note: Database notions are assumed to be known by the students, this lesson is focused only on using JDBC).

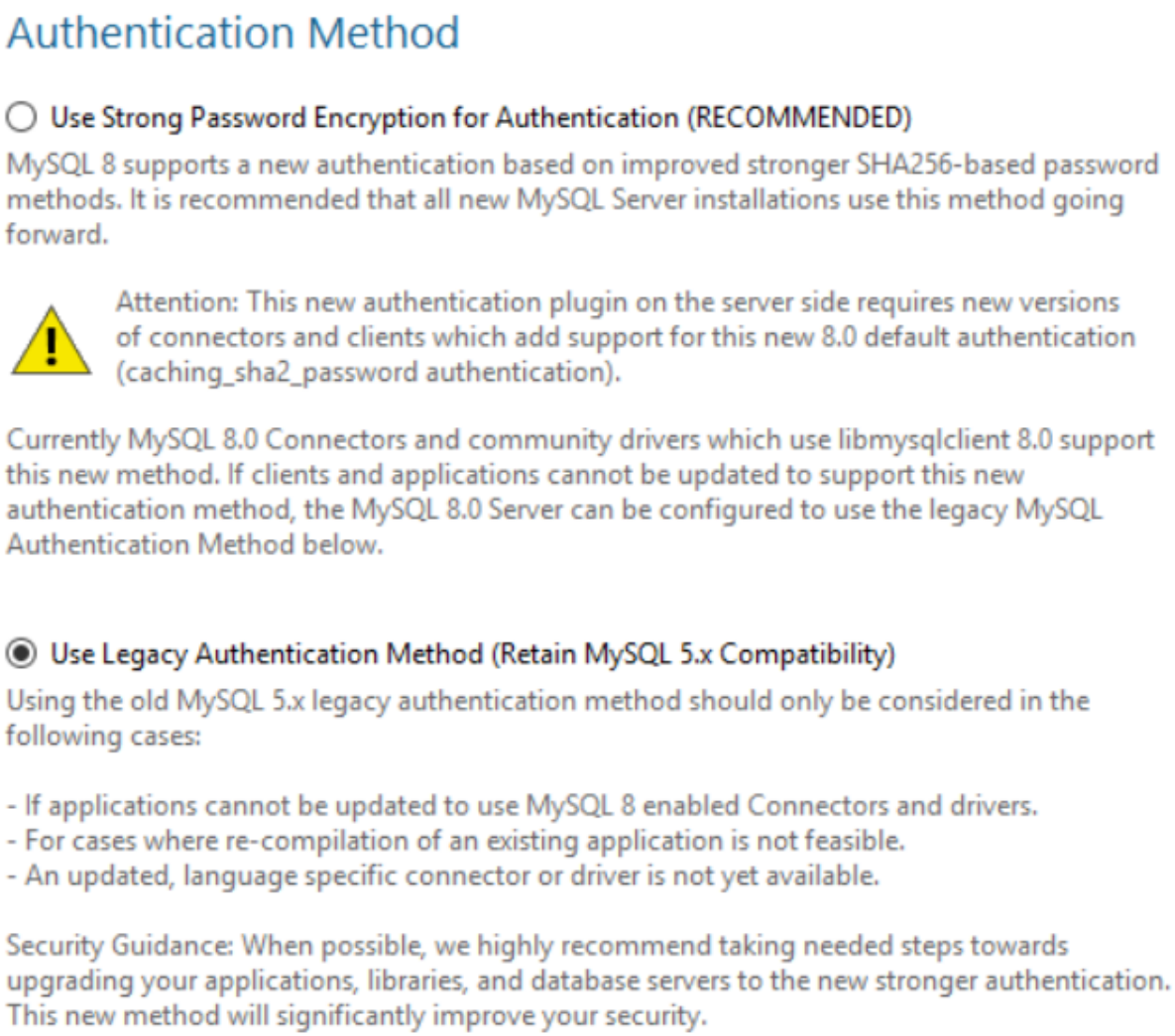
In addition to executing SQL statements, JDBC allows us to invoke stored procedures which are specific to the used DBMS.

Requirements

In this exercise we are using an the MySQL relational database that can be downloaded from https://dev.mysql.com/downloads/mysql/ . The scripts for database creation will be provided in the tutorial, for easier manipulation of the database you can install MySQL Workbench, a visual tool for database administrators (https://www.mysql.com/products/workbench/)

Install MySQL Community Server with the Developer Default option.

When configuring the server be sure to choose legacy authentication:



Use the password “root” for the admin account.

We will use Eclipse as IDE for this example.

Creating the database

Install MySQL (and optionally MySQL workbench) if you have not done it until this step. Make sure that mysql is running.

The following commands are entered from command line.

```
mysql -u root -p
```

Logs in to mysql as admin. You need to enter the password.

```
CREATE DATABASE jdbcex
```

Creates a new database called jdbcex.

```
SHOW DATABASES
```

Check that the database has been created

We should also create a user that can access this database to avoid the security risk of using the admin user.

```
CREATE USER 'jdbcuser'@'localhost' IDENTIFIED BY 'password'

GRANT ALL PRIVILEGES ON jdbcex.* TO 'jdbcuser'@'localhost'

FLUSH PRIVILEGES
```

Connect to the database

```
USE jdbcex
```

We will create a simple database consisting of a Persons table and an Addresses table.

```
CREATE TABLE addresses (

  id INT NOT NULL AUTO_INCREMENT,

  city VARCHAR(45) NOT NULL,

  street VARCHAR(45) NULL,

  PRIMARY KEY (id));
```

```
CREATE TABLE persons (
  id INT NOT NULL AUTO_INCREMENT,
  name VARCHAR(45) NOT NULL,
  address INT NULL,
  PRIMARY KEY (id),
  INDEX fk_address_idx (address ASC),
  CONSTRAINT fk_address
    FOREIGN KEY (address)
    REFERENCES addresses (id)
    ON DELETE NO ACTION
    ON UPDATE NO ACTION);
```

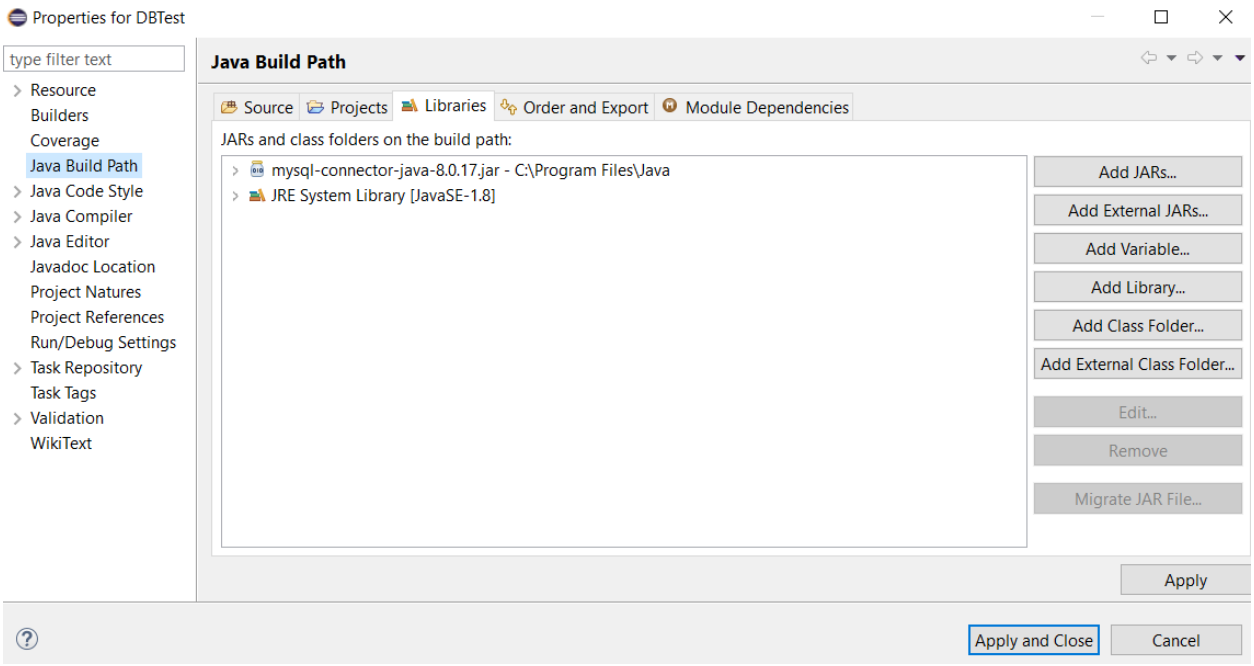
Finally let us introduce some records

```
INSERT INTO addresses (city, street) VALUES ('Bucuresti',
'Politehnicii');

INSERT INTO addresses (city, street) VALUES ('Ploiesti',
'Independetei');

INSERT INTO persons (name, address) VALUES ('Vasile', 1);

INSERT INTO persons (name, address) VALUES ('John', 1);

INSERT INTO persons (name, address) VALUES ('Emily', 2);
```

Accessing a database using JDBC

Basic steps

Create a new Java project in Eclipse. Add the MySQL j-Connector jar. (Properties -> Java Build Path)



We go through the following steps for accessing a database:

1. Making the connection

A connection is identified by an URL with the syntax:

jdbc:<protocol>:<nameOfDatabase>

In our case the URL has the form:

```
jdbc:mysql://localhost:3306/jdbcex
```

We also need a username and a password for connecting to the database (In our case username = jdbcuser, and the password is password). This three arguments (nameOfDatabase, user, password) should not be hardcoded in the application but instead saved in an external file (for example using java.util.Properties) so you can have a reusable class for connecting to the database.

So let`s save the url in a string:

```
String url = "jdbc:mysql://localhost:3306/jdbcex";
```

(note that the port number is 3306 for MySQL)

and then connect to the database:

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

Connection con = DriverManager.getConnection(url, "jdbcuser",
"password");
```

2. Execute an SQL statement

First we create a Statement from the Connection:

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

then we execute this statement. In case of a SELECT statement we use executeQuery() which returns a ResultSet and in case of an UPDATE, DELETE, INSERT, CREATE TABLE, DROP TABLE we use executeUpdate() which returns the number of affected rows. (except for create and drop where it returns 0).

3. Retrieve values from the ResultSet

JDBC returns results in a ResultSet object:

```
String sql = "SELECT * FROM persons";

ResultSet rs=instr.executeQuery(sql);

while(rs.next()){

System.out.println(rs.getString("name"));

}
```

rs.next() points the cursor of the resultset to the next position (initially it is before the first record). The values are extracted using getx() methods where x is the data type and the argument is the position of the column in the table. We could have also used the name of the column :

4. Close the connection

ResultSet, Statement must be closed first:

```
rs.close();

instr.close();
```

and then the Connection:

```
con.close();
```

The complete program :

```
import java.sql.*;

public class Main {

public static void main(String[] args) throws ClassNotFoundException,
SQLException  {

        String url = "jdbc:mysql://localhost:3306/jdbcex";
        Class.forName("com.mysql.cj.jdbc.Driver");
        Connection con = DriverManager.getConnection(url, "jdbcuser",
"password");
        Statement instr = con.createStatement();
        String sql = "SELECT * FROM persons";
        ResultSet rs = instr.executeQuery(sql);
        while (rs.next()) {
            System.out.println(rs.getString("name"));
        }
        rs.close();
      instr.close();
        con.close();
    }
}
```

Using JOIN

Suppose you want to use more tables to perform a certain operation. In this case you join the tables using a value they have in common. (usually a foreign key). In our case we join persons and addresses using persons.address and addresses.id fields:

```
SELECT p.name, a.city FROM persons p INNER JOIN addresses a ON
p.address = a.id

WHERE a.city = 'Bucuresti'
```