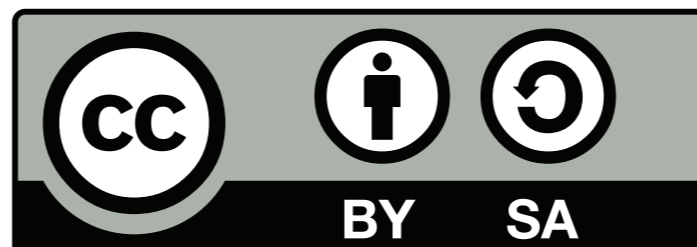


Tecnologia e Applicazioni Internet 2010/11

Lezione 5 - Persistenza

Matteo Vaccari

<http://matteo.vaccari.name/>
matteo.vaccari@uninsubria.it

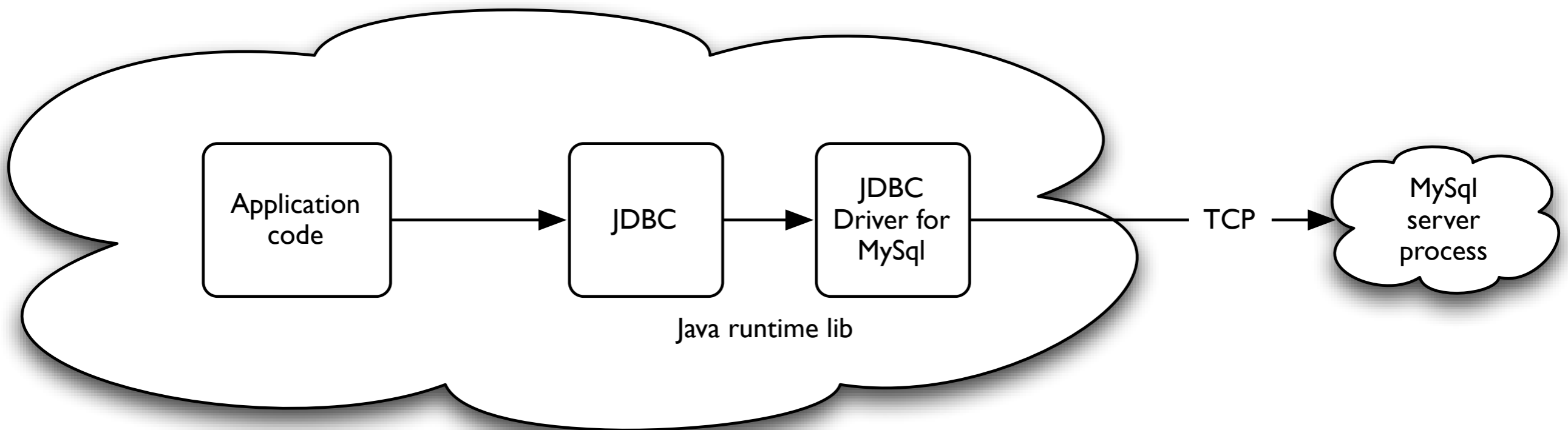


Perché usare un DB relazionale?

- Per l'accesso concorrente ai dati (e svincolare il codice applicativo dalla concorrenza)
- Per estrarre i dati in maniera veloce
- Per fare fronte a nuovi requisiti tramite una semplice riconfigurazione dello schema (cf. usare il filesystem)

Java and JDBC

A Java process



Get a JDBC connection

```
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.SQLException;

public class DatabaseConnector {

    // Should be loaded from external configuration
    final String USERNAME = "myuser";
    final String PASSWORD = "mypassword";
    final String URL = "jdbc:mysql://localhost/mydatabase";
    final String DRIVER = "com.mysql.jdbc.Driver";

    public Connection getConnection() throws ClassNotFoundException, SQLException {
        // load JDBC driver
        Class.forName(DRIVER);

        // create connection
        return DriverManager.getConnection(URL, USERNAME, PASSWORD);
    }
}
```

Execute sql code

```
Statement statement = connection.createStatement();
```

```
String sql = "INSERT INTO my_table (col_string) VALUES('a string')";
```

```
statement.executeUpdate(sql);
```

Use a *prepared statement*

```
String sql = "INSERT INTO my_table (col_string) VALUES (?);  
PreparedStatement statement = connection.prepareStatement(sql);  
statement.setString(1, "pippo");  
statement.executeUpdate();
```

... and close the statement

```
PreparedStatement statement;  
try {  
    String sql = "INSERT INTO my_table (col_string) VALUES (?);";  
    statement = connection.prepareStatement(sql);  
    statement.setString(1, "pippo");  
    statement.executeUpdate();  
} finally {  
    if (null != statement) {  
        try {  
            statement.close();  
        } catch (Exception ignored) {}  
    }  
}
```

Note

- *statement.finalize()* chiuderebbe lo statement, ma viene chiamato dal garbage collector non si sa quando
- Bisogna chiudere esplicitamente lo statement, altrimenti se abbiamo molte operazioni concorrenti alcune falliranno
- Bisogna ignorare le eccezioni in *statement.close()*, altrimenti *oscureranno* l'eventuale eccezione lanciata da *statement.executeUpdate()*

Reading data from a table

```
Statement statement = connection.createStatement();
ResultSet resultSet = statement.executeQuery("SELECT * FROM my_table");

while (resultSet.next()) {
    String s = resultSet.getString("col_string");
}
```

... and close objects

```
Statement statement;  
ResultSet resultSet;  
try {  
    statement = connection.createStatement();  
    resultSet = statement.executeQuery("SELECT * FROM my_table");  
  
    while (resultSet.next()) {  
        String s = resultSet.getString("col_string");  
    }  
} finally {  
    if (null != resultSet) {  
        try {  
            resultSet.close();  
        } catch(Exception ignored) {}  
    }  
    if (null != statement) {  
        try {  
            statement.close();  
        } catch(Exception ignored) {}  
    }  
}
```

Usare uno script per generare il database

- Crea due database, uno per unit test e uno per sviluppo
- Però prima li cancella se esistono
- Carica lo schema dei dati
- Crea un utente applicativo e gli dà i diritti

Usare uno script per generare il database, perchè?

- Bisogna sempre automatizzare tutto
- Mette i colleghi in grado di partire velocemente
- Cristallizza le informazioni necessarie per installare l'applicazione
- Se ho lo script, modificare lo schema costa poco

```

# define key information
src=sql          # sql sources directory
dbname=tai_chat  # name of development db
dbname_test=tai_chat_test # name of test db
dbuser=tai_chat  # name of application user
dbpassword=tai_chat # password of application user

# ask mysql root password
read -s -p "mysql root password? (type return for no password) " MYSQL_ROOT_PASSWORD
if [ "$MYSQL_ROOT_PASSWORD" != "" ]; then
    MYSQL_ROOT_PASSWORD=-p$MYSQL_ROOT_PASSWORD
fi

# drop and create databases
mysqladmin -uroot $MYSQL_ROOT_PASSWORD drop $dbname
mysqladmin -uroot $MYSQL_ROOT_PASSWORD --force drop $dbname_test
mysqladmin -uroot $MYSQL_ROOT_PASSWORD create $dbname
mysqladmin -uroot $MYSQL_ROOT_PASSWORD create $dbname_test

# create application user and give grants
echo "grant all on $dbname.* to '$dbuser'@localhost identified by '$dbpassword';" \
    | mysql -uroot $MYSQL_ROOT_PASSWORD $dbname
echo "grant all on $dbname_test.* to '$dbuser'@localhost identified by '$dbpassword';" \
    | mysql -uroot $MYSQL_ROOT_PASSWORD $dbname_test

# load schema
cat $src/???.*.sql | mysql -u$dbuser -p$dbpassword $dbname
cat $src/???.*.sql | mysql -u$dbuser -p$dbpassword $dbname_test

```

Astrarre il database

Una semplice interfaccia al DB

```
public interface Database {  
    void execute(String sql, Object ... params);  
  
    Map<String, Object> selectOneRow(String sql, Object ... params);  
  
    List<Map<String, Object>> selectMultipleRows(String sql, Object ... params);  
}
```

```
database.execute(  
    "UPDATE users SET email = ? WHERE user_id = ?", "foo@bar.com" , 1234);
```

L'implementazione del “database” astratto

```
Database database = new MySQLDatabase(  
    "localhost", "blog_test", "blog_user", "password");
```

```
@Test
```

```
public void selectsOneRow() throws Exception {  
    List<DatabaseRow> rows = database.select("select 2+2");  
    assertEquals(1, rows.size());  
    assertEquals(new Long(4), rows.get(0).getLong(0));  
}
```

```
@Test
```

```
public void selectsMoreRows() throws Exception {  
    List<DatabaseRow> rows = database.select("(select 2) union (select 3)");  
    assertEquals(2, rows.size());  
    assertEquals("2", rows.get(0).getString(0));  
    assertEquals("3", rows.get(1).getString(0));  
}
```


Il metodo *execute*

```
public void execute(String sql, Object ... params) {
    Connection connection = getConnection();
    PreparedStatement statement = null;
    try {
        statement = connection.prepareStatement(sql);
        for (int i=0; i<params.length; i++) {
            statement.setObject(i+1, params[i]);
        }
        statement.executeUpdate();
    } catch (SQLException e) {
        throw new RuntimeException(e);
    } finally {
        safelyClose(statement);
    }
}

// example
String sql = "insert into my_table (foo, bar) values (?, ?)";
executor.execute(sql, "a string", 123);
```

```
private void safelyClose(Statement statement) {  
    if (null != statement) {  
        try {  
            statement.close();  
        } catch (SQLException ignored) {}  
    }  
}
```

Astrarre la persistenza

The *Repository* pattern:

“A mechanism for encapsulating

1. storage,

2. retrieval, and

3. search

which emulates a collection of objects”

-- Eric Evans, *Domain Driven Design*

Example *repository*

```
public interface AllPictures {  
    // storage  
    void add(Picture picture);  
    void remove(Object pictureId);  
  
    // retrieval  
    List<Picture> withId(Object pictureId);  
  
    // search  
    List<Picture> withAuthor(String authorName);  
    List<Picture> paintedInYears(int startYear, int endYear);  
}
```

Altro nome possibile: *PictureRepository*
-- decidi quale ti piace di più

Example *repository*

```
public interface AllPictures {  
    // storage  
    void add(Picture picture);  
    void remove(Object pictureId);  
  
    // retrieval  
    List<Picture> withId(Object pictureId);  
  
    // search  
    List<Picture> withAuthor(String authorName);  
    List<Picture> paintedInYears(int startYear, int endYear);  
}
```

```
public class AllPicturesInDatabase implements AllPictures {  
    public AllPicturesInDatabase(Database dataSource) {...}  
}
```

Altro nome possibile: *PictureRepository*
-- decidi quale ti piace di più

Aggregati

- Un *aggregato* è un insieme di oggetti collegati che servono ad eseguire un'operazione
- Esempio: la *Picture*, il suo *File*, i suoi *UserComments*
- L'oggetto *Picture* è lo *aggregate root*

Mapper objects

```
// map a resultSet row to a domain object
```

```
public interface Mapper<T> {  
    public T map(ResultSet resultSet);  
}
```

```
public class MessageMapper implements Mapper<Message> {
```

```
    public Message map(ResultSet resultSet) {
```

```
        try {
```

```
            return new Message(resultSet.getString("text"));
```

```
        } catch (SQLException e) {
```

```
            throw new RuntimeException(e);
```

```
        }
```

```
    }
```

```
}
```

```

// in class DatabaseExecutor
public <T> List<T> select(String sql, Mapper<T> mapper) {
    Connection connection = getConnection();
    Statement statement = null;
    ResultSet resultSet = null;
    try {
        statement = connection.createStatement();
        resultSet = statement.executeQuery(sql);
        List<T> result = new ArrayList<T>();
        while (resultSet.next()) {
            T object = mapper.map(resultSet);
            result.add(object);
        }
        return result;
    } catch (SQLException e) {
        throw new RuntimeException(e);
    } finally {
        safelyClose(resultSet);
        safelyClose(statement);
    }
}

// in class MessageRepository
public List<Message> getAllMessages() {
    return executor.select("select * from messages", new MessageMapper());
}

```


Una transazione HTTP

==

Una transazione DB

```
@Override
```

```
protected void service(HttpServletRequest request, HttpServletResponse response) throws
```

```
    Connection connection = null;
```

```
    try {
```

```
        Connection = new Connector("localhost", "blog_test", "blog_user", "password")
```

```
        Database db = new Database();
```

```
        PicturesDirectory pictures = new DbPicturesDirectory(db);
```

```
        GalleryController controller = new GalleryController(pictures);
```

```
        controller.service(request, response);
```

```
        connection.commit();
```

```
    } catch (Exception e) {
```

```
        rollback(connection);
```

```
        throw new ServletException(e);
```

```
    } finally {
```

```
        close(connection);
```

```
    }
```

```
}
```