Module 06 – Piscine Java

JUnit/Mockito

Summary: Today you will learn the basics of module and integration testing

Contents

Chapter I

Foreword

Module and integration tests allow a programmer to ensure correct operation of programs they create. Those testing methods are performed automatically.

Thus, your goal is not just to write a correct code, but also create code to check the validity of your implementation.

Module tests in Java are classes that contain several testing methods for public methods of classes under test. Each module test class shall check the functionality of a single class only. Such tests allow to pinpoint errors accurately. To perform tests without specific dependencies, stub objects with temporary implementation are used.

Unlike module tests, integration tests enable checking bundles of various components.

Below are several best practices for module and integration testing:

- Use adequate names for testing methods.

- Consider different situations.

- Ensure that tests cover at least 80% of code.

- Each test method should contain a small portion of code and be executed quickly.

- Test methods must be isolated from one another and have no side effects.
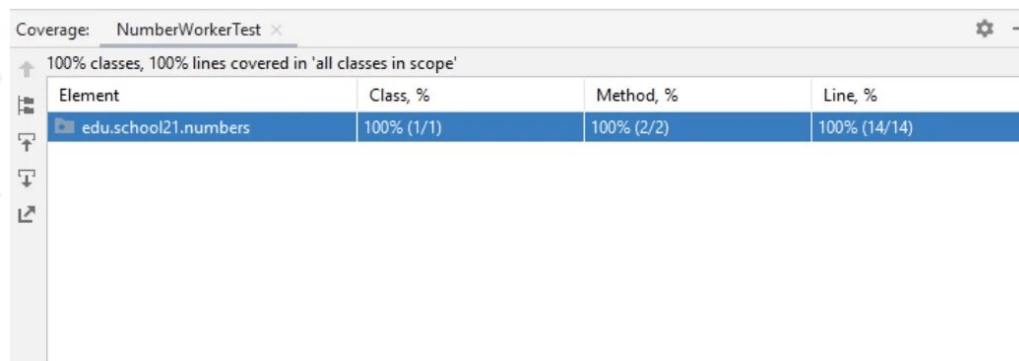
Chapter II

Instructions

- Use this page as the only reference. Do not listen to any rumors and speculations about how to prepare your solution.

- Now there is only one Java version for you, 1.8. Make sure that compiler and interpreter of this version are installed on your machine.

- You can use IDE to write and debug the source code.

- The code is read more often than written. Read carefully the document where code formatting rules are given. When performing each task, make sure you follow the generally accepted Oracle standards

- Comments are not allowed in the source code of your solution. They make it difficult to read the code.

- Pay attention to the permissions of your files and directories.

- To be assessed, your solution must be in your GIT repository.

- Your solutions will be evaluated by your piscine mates.

- You should not leave in your directory any other file than those explicitly specified by the exercise instructions. It is recommended that you modify your .gitignore to avoid accidents.

- When you need to get precise output in your programs, it is forbidden to display a precalculated output instead of performing the exercise correctly.

- Have a question? Ask your neighbor on the right. Otherwise, try with your neighbor on the left.

- Your reference manual: mates / Internet / Google. And one more thing. There's an answer to any question you may have on Stackoverflow. Learn how to ask questions correctly.

- Read the examples carefully. They may require things that are not otherwise specified in the subject.

- And may the Force be with you!

- Never leave that till tomorrow which you can do today ;)

Chapter III

Rules of the Day

- Use JUnit 5 framework in all tasks

- Use the following dependencies and plugins to ensure correct operation:

    - maven-surefire-plugin

    - junit-jupiter-engine

    - junit-jupiter-params

    - junit-jupiter-api

- All tests must be launchable by running mvn clean compile test command

- Source code of the tested class must be fully covered in all implemented tests. Below is an example of a full coverage demonstration with IntelliJ IDEA for Exercise 00:

Coverage: NumberWorkerTest			
100% classes, 100% lines covered in 'all classes in scope'			
Element	Class, %	Method, %	Line, %
edu.school21.numbers	100% (1/1)	100% (2/2)	100% (14/14)

Chapter IV

Exercice 00 : First Tests

	Exercise 00
	First Tests
Turn-in directory : *ex*00/	
Files to turn in : Tests-folder	
Allowed functions :	

Now you need to implement NumberWorker class that contains the following functionality:

```
public boolean isPrime(int number) {
    ...
    }
```

This method determines if a number is prime and returns true/false for all natural (positive integer) numbers. For negative numbers, as well as 0 and 1, the program shall throw an unchecked exception. IllegalNumberException.

```
public int digitsSum(int number) {
    ...
    }
```

This method returns the sum of digits of a source number.

We also need to create NumberWorkerTest class that implements the module testing logic. Methods of NumberWorkerTest class shall check the correct operation of NumberWorker methods for various input data:

1. isPrimeForPrimes method to check isPrime using prime numbers (at least three)
2. isPrimeForNotPrimes method to check isPrime using composite numbers (at least three)
3. isPrimeForIncorrectNumbers method to check isPrime using incorrect numbers (at least three)
4. a method to check digitsSum using a set of at least 10 numbers
5. a method to check digitsSum using an incorrect set.

Requirements:

- NumberWorkerTest class must contain at least 4 methods to test NumberWorker functionality

- Use of @ParameterizedTest and @ValueSource is mandatory for methods 1–3.

- Use of @ParameterizedTest and @CsvFileSource is mandatory for method 4.

- You need to prepare data.csv file for method 4 where you shall specify at least 10 numbers and their correct sum of digits. A file content example:

- 1234, 10

- Similarly, you should prepare data_fails.csv file with a set of incorrect numbers for method 5.

Project structure:
```
Tests
├── src
│   ├── main
│   │   ├── java
│   │   │   └── edu.school21.numbers
│   │   │       └── NumberWorker
│   │   └── resources
│   └── test
│       ├── java
│       │   └── edu.school21.numbers
│       │       └── NumberWorkerTest
│       └── resources
│           ├── data.csv
│           └── data_fails.csv
└── pom.xml
```
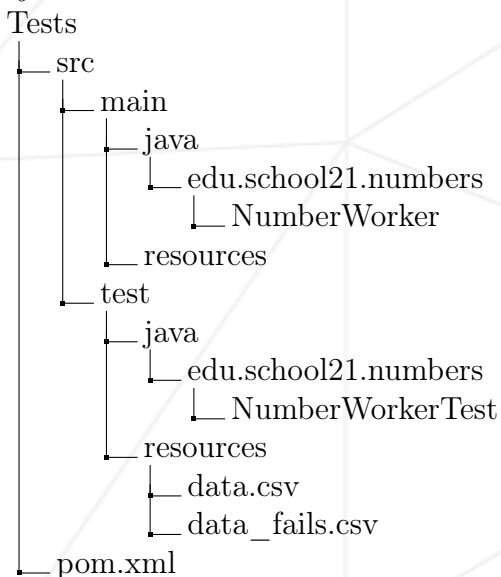
Chapter V

exercice 01 : Embedded DataBase

	Exercise 01
	Embedded DataBase
Turn-in directory : *ex01/*	
Files to turn in : Tests	
Allowed functions :	

Do not use a heavy DBMS (like PostgreSQL) to implement integration testing of components that interact with the database. It is best to create a lightweight in-memory database with prearranged data.

Implement DataSource creation mechanism for HSQL DBMS. To do so, connect spring-jdbc and hsqldb dependencies to the project. Prepare schema.sql and data.sql files where you will describe product table structure and test data (at least five).

Product table structure:

- identifier

- name

- price

Also create EmbeddedDataSourceTest class. In this class, implement init() method marked with @BeforeEach annotation. In this class, implement functionality to create DataSource using EmbeddedDataBaseBuilder (a class in spring-jdbc library). Implement a simple test method to check the return value of getConnection() method created by DataSource (this value must not be null).

Project structure:
```
Tests
└── src
    └── main
        └── java
```

```
          │
          │       └── edu.school21.numbers
          │           └── NumberWorker
          │   └── resources
          └── test
              └── java
                  └── edu.school21
                      └── numbers
                      │   └── NumberWorkerTest
                      └── repositories
                          └── EmbeddedDataSourceTest
              └── resources
                  └── data.csv
                  └── data_fails.csv
                  └── schema.sql
                  └── data.sql
      └── pom.xml
```
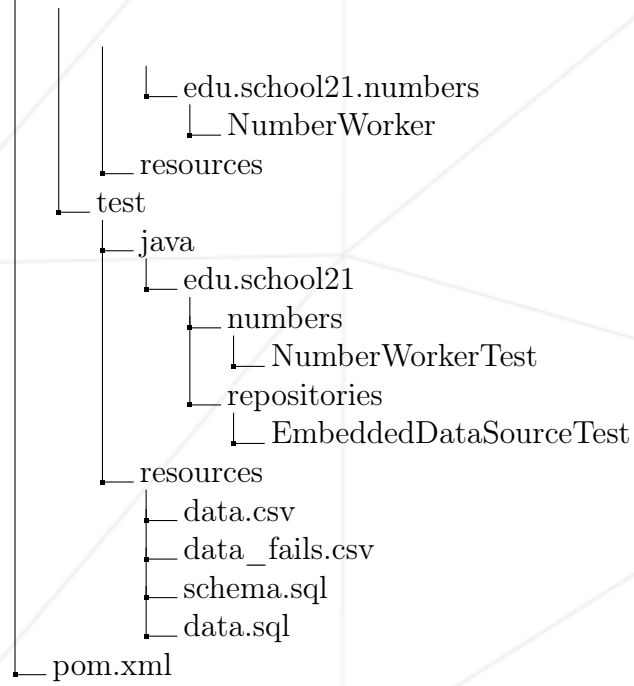
Chapter VI

exercice 02 : Test for JDBC Repository

	Exercise 02
	Test for JDBC Repository
Turn-in directory : *ex02/*	
Files to turn in : Tests	
Allowed functions :	

Implement ProductsRepository/ProductsRepositoryJdbcImpl interface/class pair with the following methods:

```
List<Product> findAll()
Optional<Product> findById(Long id)
void update(Product product)
void save(Product product)
void delete(Long id)
```

You shall implement ProductsRepositoryJdbcImplTest class containing methods checking repository functionality using the in-memory database mentioned in the previous exercise. In this class, you should prepare in advance model objects that will be used for comparison in all tests.
Example of declaring test data is given below:

```
class ProductsRepositoryJdbcImplTest {
    final List<Product> EXPECTED_FIND_ALL_PRODUCTS = ...;
    final Product EXPECTED_FIND_BY_ID_PRODUCT = ...;
    final Product EXPECTED_UPDATED_PRODUCT = ...;
}
```

Notes:

- Each test shall be isolated from behavior of other tests. Thus, the database must be in its initial state before each test is run.

- Test methods may call other methods that are not under the current test. For instance, when testing update() method, findById() method may be called to check the entity update validity in the database.

Project structure:

```
Tests
├── src
│   ├── main
│   │   ├── java
│   │   │   └── edu.school21
│   │   │       ├── numbers
│   │   │       │   └── NumberWorker
│   │   │       ├── models
│   │   │       │   └── Product
│   │   │       └── repositories
│   │   │           ├── ProductsRepository
│   │   │           └── ProductsReposutoryJdbcImpl
│   │   └── resources
│   └── test
│       ├── java
│       │   └── edu.school21
│       │       ├── numbers
│       │       │   └── NumberWorkerTest
│       │       └── repositories
│       │           ├── EmbeddedDataSourceTest
│       │           └── ProductsReposutoryJdbcImplTest
│       └── resources
│           ├── data.csv
│           ├── data_fails.csv
│           ├── schema.sql
│           └── data.sql
└── pom.xml
```
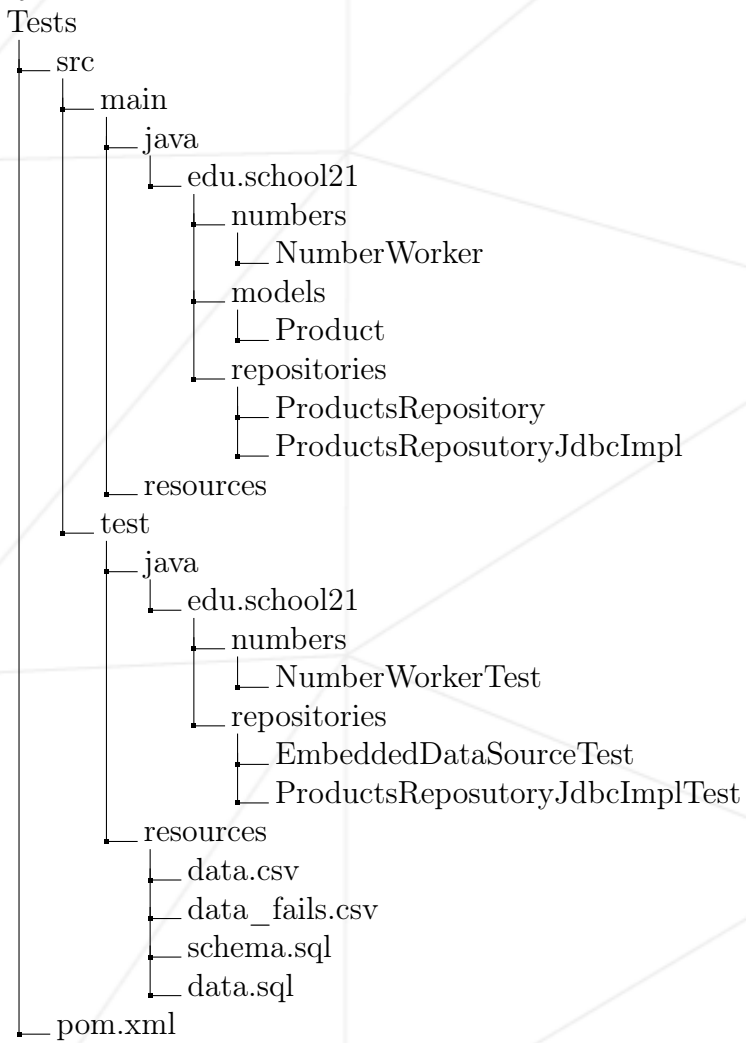
Chapter VII

exercice 03 : Test for Service

	Exercise 03
	Test for Service
Turn-in directory : *ex03/*	
Files to turn in : Tests	
Allowed functions :	

An important rule for module tests: an individual system component shall be tested without calling its dependencies' functionality. This approach allows developers to create and test components independently, as well as postpone the implementation of specific application parts.

Now you need to implement the business logic layer represented by UsersServiceImpl class. This class contains a user authentication logic. It also has a dependency on UsersRepository interface (in this task, you do not need to implement this interface).

UsersRepository interface (that you have described) shall contain the following methods:

```
User findByLogin(String login);
void update(User user);
```

It is assumed that findByLogin method returns a Userobject found via login, or throws EntityNotFoundException if no user is found with the login specified. Update method throws a similar exception when updating a user that does not exist in the database.

User entity shall contain the following fields:

- Identifier

- Login

- Password

- Authentication success status (true - authenticated, false - not authenticated)

In turn, UsersServiceImpl class calls these methods inside the authentication function:

boolean authenticate(String login, String password)

This method:
1. Checks if a user has been authenticated in the system using this login. If authentication was performed, AlreadyAuthenticatedException must be thrown.
2. The user with this login is retrieved from UsersRepository.
3. If the retrieved user password matches the specified password, the method sets the status of the authentication success for the user, updates its information in the database and returns true. If passwords mismatch, the method returns false.
Your goal is to:
1. Create UsersRepository interface
2. Create UsersServiceImpl class and authenticate method
3. Create a module test for UsersServiceImpl class

Since your objective is to check correct operation of authenticate method independently of UsersRepository component, you should use mock object and stubs of findById and update methods (see Mockito library).

Authenticate method shall be checked for three cases:

1. Correct login/password (check calling update method using verify instruction of Mockito library)
2. Incorrect login
3. Incorrect password

Project structure:
```
Tests
└── src
    └── main
        └── java
            └── edu.school21
                ├── exceptions
                │   └── AlreadyAuthenticatedException
                ├── numbers
                │   └── NumberWorker
                ├── models
                │   ├── Product
                │   └── User
                ├── services
                │   └── UsersServiceImpl
                └── repositories
                    ├── ProductsRepository
                    ├── ProductsReposutoryJdbcImpl
                    └── UsersRepository
            └── resources
        └── test
```

```
    └─ java
       └─ edu.school21
          └─ services
             └─ UsersServiceImplTest
          └─ numbers
             └─ NumberWorkerTest
          └─ repositories
             └─ EmbeddedDataSourceTest
             └─ ProductsReposutoryJdbcImplTest
    └─ resources
       └─ data.csv
       └─ data_fails.csv
       └─ schema.sql
       └─ data.sql
└─ pom.xml
```