Unit tests with Java and Spock

Write readable and maintainable tests

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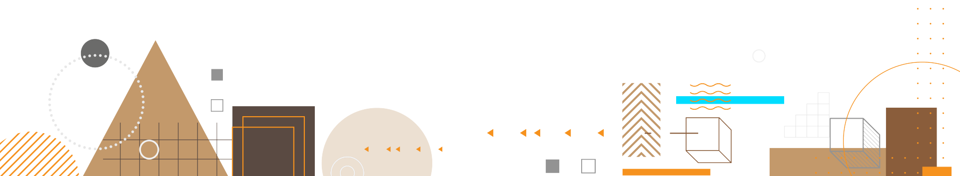

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Part I

Overview and configurations

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Spock concisely

Spock is

- a testing and specification framework
- a beautiful and highly expressive specification language

Spock is compatible with

- JUnit thanks to the JUnit Runner
- most IDEs
- most build tools
- most continuous integration servers

`https://spockframework.org/`

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Project configuration

```xml
<build>
   <plugins>
      <plugin>
         <groupId>org.apache.maven.plugins</groupId>
         <artifactId>maven-compiler-plugin</artifactId>
         <version>3.9.0</version>
         <configuration>
            <source>17</source>
            <target>17</target>
         </configuration>
      </plugin>
   </plugins>
</build>
```

JUnit 5 dependency

```
<dependency>
   <groupId>org.junit.jupiter</groupId>
   <artifactId>junit-jupiter-engine</artifactId>
   <version>5.8.2</version>
   <scope>test</scope>
</dependency>
<dependency>
   <groupId>org.junit.jupiter</groupId>
   <artifactId>junit-jupiter-api</artifactId>
   <version>5.8.2</version>
   <scope>test</scope>
</dependency>
```

JUnit 5 dependency

```
<build>
   <plugins>
      <plugin>
         <groupId>org.apache.maven.plugins</groupId>
         <artifactId>maven-surefire-plugin</artifactId>
         <version>3.0.0-M1</version>
         <configuration>
            <includes>
               <include>**/*Test</include>
               <include>**/*Spec</include>
            </includes>
         </configuration>
      </plugin>
   </plugins>
</build>
```

Groovy dependency

```xml
<dependency>
   <groupId>org.codehaus.groovy</groupId>
   <artifactId>groovy</artifactId>
   <version>3.0.9</version>
</dependency>
```

Configuration Groovy

```xml
<build>
   <plugins>
      <plugin>
         <groupId>org.codehaus.gmavenplus</groupId>
         <artifactId>gmavenplus-plugin</artifactId>
         <version>1.13.1</version>
         <executions>
            <execution>
               <goals>
                  <goal>compileTests</goal>
               </goals>
            </execution>
         </executions>
      </plugin>
   </plugins>
</build>
```

Spock dependency

```
<dependencyManagement>
   <dependencies>
      <dependency>
         <groupId>org.spockframework</groupId>
         <artifactId>spock-bom</artifactId>
         <version>2.0-groovy-3.0</version>
         <type>pom</type>
         <scope>import</scope>
      </dependency>
   </dependencies>
</dependencyManagement>
```

```
<dependency>
   <groupId>org.spockframework</groupId>
   <artifactId>spock-core</artifactId>
</dependency>
```

Full configuration

Based on the documentation

https://gist.github.com/adrien1212/2497ad62af0be75e28dc4dce1e3c1c3d

Documentation

https://github.com/groovy/GMavenPlus/wiki/Examples#spock-2-and-junit

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Eclipse Configurations

Disclaimer

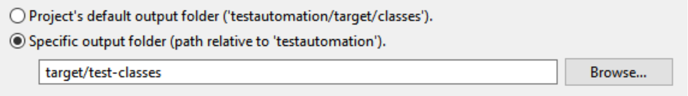
This configuration is done in January 2022 the Eclipse version 12-2022

1. Install *Groovy Development Tools* to
   - Compile Groovy script before run it in test
     `MySpec.groovy` → `Right Click` → `Run As` → `Junit Test`
   - Else, you need to compile your Groovy script each time with Maven
2. Configure Groovy compiler
   - Go to `Windows` → `Preferences` → `Groovy : Compiler`
   - Switch to 3.0.9 compiler

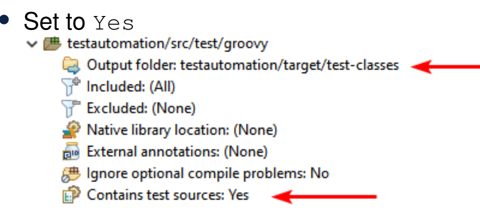
Eclipse Configurations

Configure the output folder for the Groovy tests like Java tests

- Output folder
  - `Build Path` → `Configure Build Path` → `Source` → `monprojet/src/test/groovy`
  - Setup the output folder



- Contains test sources
  - Set to `Yes`



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Create JUnit test

Create a new test classe

```
MyProject
 ├─ src/main/java
 ├─ src/test/java
 │   └─ FirstTest.java
 └─ pom.xml
```

```
import
    org.junit.jupiter.api.Assertions;
import org.junit.jupiter.api.Test;

public class FirstTest {
   @Test
   public void firstAssert() {
      Assertions
         .assertEquals(10, 10);
   }
}
```

Launch the test with Maven

- Run the following command `mvn clean install test`
- and check the result

```
[INFO] ------------------------------------------
[INFO]  T E S T S
[INFO] ------------------------------------------
[INFO] Running FirstTest
[INFO] Tests run: 1, Failures: 0, Errors: 0, [...]
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0
```

Create Spock test

To create a test with Spock we need to :

- Create a new directory `/src/test/groovy`
- Create a Groovy script `SecondSpec.groovy`

Create a new test classe

```
MonProjet
 ├── src/main/java
 ├── src/test/java
 │    └── FirstTest.java
 ├── src/main/groovy
 │    └── SecondSpec.groovy
 └── pom.xml
```

```
import spock.lang.Specification

class SecondSpec extends
    Specification {
   def "one plus one equal two"() {
     expect:
     1 + 1 == 2
   }
}
```

Launch the test with Maven

- Run the following command `mvn clean install test`
- and check the results (JUnit + Spock)

```
[INFO] -------------------------------------------
[INFO]  T E S T S
[INFO] -------------------------------------------
[INFO] Running FirstTest
[INFO] Tests run: 1, Failures: 0, Errors: 0, [...]
[INFO] Running SecondSpec
[INFO] Tests run: 1, Failures: 0, Errors: 0, [...]
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 2, Failures: 0, Errors: 0, Skipped: 0
```

Launch the test with Eclipse

This step ensures you that you will be able to run Groovy test without recompiling the Maven project after each modification.

- Run the `SecondSpec` test with Eclipse
  - `SecondSpec.groovy` → `Right Click` → `Run As` → `Junit Test`
  - Check that the test succeeds
- Set the expectation $1 + 1 == 2$ to $1 + 1 == 3$
- Run again the `SecondSpec` test with Eclipse
  - `SecondSpec.groovy` → `Right Click` → `Run As` → `Junit Test`
  - Check that the test fails

SecondSpec [Runner: JUnit 5] (0,267 s)
one plus one equals two (0,267 s)

SecondSpec [Runner: JUnit 5] (0,499 s)
one plus one equals two (0,499 s)

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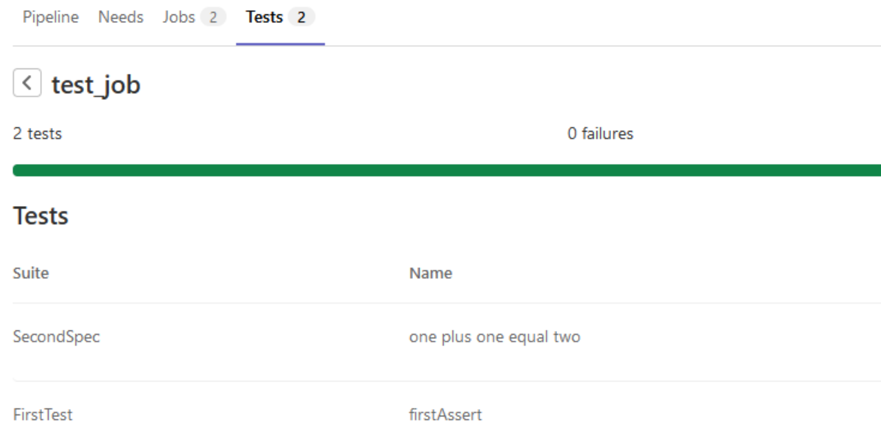
Example

Spock tests, like all JUnit tests, are managed by the CI/CD provided by GitLab.



Configuration

This integration does not require any addition to the default job
https://docs.gitlab.com/ee/ci/unit_test_reports.html#maven

```
java:
  stage: test
  script:
    - mvn verify
  artifacts:
    when: always
    reports:
      junit:
        - target/surefire-reports/TEST-*.xml
        - target/failsafe-reports/TEST-*.xml
```

Part II

Writing tests with Spock

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  - Where block
- Comparison of JUnit test and Spock test

10 Helper methods

11 Assert multiple expectations together

Documentation

`https://spockframework.org/spock/docs/2.0/index.html`

This part summarizes the section *Spock Primer* of the documentation

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Fields and Shared Fields

- Objects stored into instance fields are not shared between feature methods
- To share an object between feature methods declare a `@Shared` field

```
def number = 5;

def "first"() {
    when: number = 6
    then: number == 6
}

def "second"() {
    expect: number == 5
}
```

```
@Shared number = 5;

def "first"() {
    when: number = 6
    then: number == 6
}

def "second"() {
    expect: number == 6
}
```

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Fixture Methods

- Responsible for setting up and cleaning up the environment
- All fixture methods are optional
- Equivalent to JUnit

Spock	JUnit 5
setup()	@BeforeEach
cleanup()	@AfterEach
setupSpec()	@BeforeAll
cleanupSpec()	@AfterAll

```
def setupSpec() // runs before the first feature method
def setup()   // runs before every feature method
def cleanup() // runs after every feature method
def cleanupSpec() // runs after the last feature method
```

Fixture Methods

- `setupSpec()` and `cleanupSpec()` cannot reference field annoted with `@Shared`

```
@Shared number

def setupSpec() {
   number = 7
}

def "second"() {
   expect: number == 7
}
```

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Conceptual phases

Conceptually, a feature method consists of four phases:

1. Set up the feature's fixture - [Given]
2. Provide a *stimulus* to the system under specification - [When]
3. Describe the *response* expected from the system - [Then]
4. Clean up the feature's fixture

```
def "pushing an element on the stack"() {
  // blocks go here
}
```

Name your tests

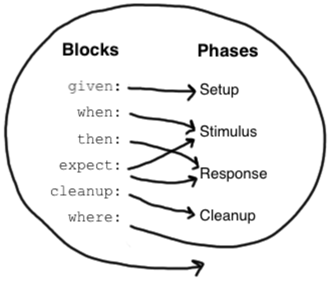
- Choose a good name
- Free to write : string

Blocks

The feature methods are structured in the following blocks

- `given`
- `when`
- `then`
- `expect`
- `cleanup`
- `where`

Each block is mapped to a conceptual phases of a feature method



Blocks’ advantages

- Before you could follow the
  - `Given-When-Then` structure
  - `Arrange-Act-Assert` structure
  - or another homemade structure
- Now, we have a common structure for testing

Advantages

- Tests are structured
- These structure is common to all developers
- Improve the **readability** and **maintainability** of tests
- $\Rightarrow$ Tests have their own "grammar"

When and Then Blocks

- The `when` and `then` blocks always occur together
- A feature method may contain multiple pairs of when-then blocks.

```
when: // stimulus
then: // response
```

```
when:
  stack.push(elem)

then:
  !stack.empty
  stack.size() == 1
  stack.peek() == elem
```

Conditions

- `then` and `expect` receive conditions
- Conditions are written as plain boolean expressions
- When condition is violated Spock provide a feedback

```
Condition not satisfied:

stack.size() == 2
|     |      |
|     1      false
[push me]
```

There are two types of conditions

- *implicit* conditions
  - essential ingredient of `then` blocks and `expect` blocks
  - expressions in these blocks are implicitly treated as conditions
- *explicit* conditions
  - to use conditions in other places
  - use Groovy's `assert` keyword

When-Then block VS Expect block

An `expect` block

- is more limited than a `then` block
- it may only contain conditions and variable definitions
- usefull to describe stimulus and expected response in a single expression

```
when:
def x = Math.max(1, 2)

then:
x == 2
```

```
// Prefered

expect:
Math.max(1, 2) == 2
```

- use `when-then` to describe methods with side effects
- and `expect` to describe purely functional methods.

Cleanup block

- Is used to free any resources used by a feature method
- Is run even if the feature method has produced an exception

```
given:
  def file = new File("/some/path")
  file.createNewFile()
  // ...
cleanup:
  file.delete()
```

- Object-level specifications usually don't need a `cleanup` method
- Automatically reclaimed by the garbage collector
- Might use a `cleanup` block
  - to clean up the file system
  - to close a database connection
  - to shut down a network service

Where block

- Always comes last in a method
- May not be repeated
- Used to write data-driven feature methods

```
def "computing the maximum of two numbers"() {
  expect:
    Math.max(a, b) == c

  where:
    a << [5, 3]
    b << [1, 9]
    c << [5, 9]
}
```

This `where` block creates two "versions" of the feature method

- First with $a = 5$, $b = 1$ and $c = 5$
- Second with $a = 3$, $b = 9$ and $c = 9$

Comparison of JUnit test and Spock test

```
@Test
public void givenTwoAndTwo_whenAdding_thenIsFour() {
  int first = 2, second = 2; // Given
  int result = first + second; // When
  assertTrue(result == 4) // Then
}
```

```
def "two plus two should equal four"() {
   given:
      int left = 2
      int right = 2
   when:
      int result = left + right
   then:
      result == 4
}
```

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Helper methods

```
def "offered PC matches preferred configuration"() {
  when:
    def pc = shop.buyPc()

  then:
    pc.vendor == "Sunny"
    pc.clockRate >= 2333
    pc.ram >= 4096
    pc.os == "Linux"
}
```

- Avoid grow large method
- Avoid duplicated code
- $\Rightarrow$ Introduce one or more helper methods to factoring out

Helper methods

Two points need to be considered when creating a helper method

- implicit conditions must be turned into explicit conditions
  $\Rightarrow$ use the `assert` keyword
- must have return type `void`

```
def "offered PC matches preferred configuration"() {
  when:
    def pc = shop.buyPc()
  then:
    matchesPreferredConfiguration(pc)
}

void matchesPreferredConfiguration(pc) {
  assert pc.vendor == "Sunny"
  assert pc.clockRate >= 2333
  assert pc.ram >= 4096
  assert pc.os == "Linux"
}
```

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Assert multiple expectations together

- Normal expectations fail the test on the first failed assertions
- Sometimes it is helpful to collect these failures before failing the test

```
def "my test"() {
    expect:
    verifyAll {
        2 == 3
        4 == 5
    }
}
```

```
condition not satisfed :
2 == 3
condition not satisted :
4 == 5
```

```
def "my test"() {
    expect:
        2 == 3
        4 == 5
}
```

```
condition not satisfed :
2 == 3
```

Part III

Data Driven Testing with Spock

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- Double Pipe
- Data Pipes

Definition

Data Driven Testing

- Is a software testing method in which test data is stored in table or spreadsheet format
- Is useful because we provide multiple data sets for a single test and an individual test is created with each data

Documentation

Documentation

`https://spockframework.org/spock/docs/2.0/index.html`

This part summarizes the section *Data Driven Testing* of the documentation

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Data Tables

```
class MathSpec extends Specification {
  def "maximum of two numbers"(int a, int b, int c) {
    expect:
     Math.max(a, b) == c

    where:
     a | b | c
     1 | 3 | 3
     7 | 4 | 7
     0 | 0 | 0
  }
}
```

- The first line is the *table header*, declares the data variables
- The subsequent lines are *table rows*, the corresponding values
- For each row, an *iteration* of feature method will get executed

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Isolated Execution of Iterations

Iterations are isolated from each other

- Each iteration gets its own instance of the specification class
- The `setup` and `cleanup` methods will be called before and after each iteration

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Double Pipe

```
class MathSpec extends Specification {
  def "maximum of two numbers"() {
    expect:
      Math.max(a, b) == c

    where:
      a | b || c
      1 | 3 || 3
      7 | 4 || 7
      0 | 0 || 0
  }
}
```

- Method parameters can be ommited
  - You can also omit some parameters and specify others, for example to have them typed
- Inputs and expected outputs can be separated with a double pipe symbol

Data Pipes

```
...
where:
  a << [1, 7, 0]
  b << [3, 4, 0]
  c << [3, 7, 0]
```

- Connects a data variable to a data provider
  - the data provider holds all values for the variable, one per iteration
- Any object that Groovy knows how to iterate over can be used as a data provider
  - `Collection`
  - `String`
  - `Iterable`
  - objects implementing the `Iterable` contract

Part IV

Interaction Based Testing

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Definition

Interaction Based Testing

- Checks how different objects interact with each other
- Help verify the functionality of code that depends on the interaction between multiple classes or interfaces
- The interaction testing uses a *mock object* to check that the expected behavior happened

Documentation

Documentation

`https://spockframework.org/spock/docs/2.0/index.html`

This part summarizes the section *Interaction Based Testing* of the documentation

When we need Mocking

Mock object is useful when you

- want to **test interactions** between a class under test and a particular interface.
- the execution of a method passes outside of that method, into another object : dependencies
- have complicated object as a parameter, and it would be a pain to simply instantiate this object

See also :
`https://odetocode.com/blogs/scott/archive/2008/05/01/mocks-its-a-question-of-when.aspx`

Mock implementation with Spock

- Java world provides of popular and mature mocking frameworks
  - Mockito
  - EasyMock
  - ...
- These frameworks can be used together with Spock
- But Spock integrates its own mocking framework
  - all features of Spock's mocking framework work both for testing Java and Groovy code

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Definition

Definition

- Mock objects are simulated objects that mimic the behavior of real objects

The application

Publisher

- subscribers : List<Subscriber>
- messageCount : int

+ send(message : String) void

<<interface>>
Subscriber

+ receive(message : String)

```
void send(String message){
   for(Subscriber s : subscribers) {
      s.receive(message);
   }
   messageCount++
}
```

Creating Mock Objects

- We create two fake implementations of `Subscriber`

```
def subscriber = Mock(Subscriber)
def subscriber2 = Mock(Subscriber)
```

Or

```
Subscriber subscriber = Mock()
Subscriber subscriber2 = Mock()
```

Injecting Mock Objects into Code Under Specification

- We set the `Publisher` with the fake `Subscriber`

```
class PublisherSpec extends Specification {
 Publisher publisher = new Publisher()
 Subscriber subscriber = Mock()
 Subscriber subscriber2 = Mock()

 def setup() {
  publisher.subscribers << subscriber // <=> List.add()
  publisher.subscribers << subscriber2
 }
```

Creating the test

```
def "should send messages to all subscribers"() {
  when:
    publisher.send("hello")

  then:
    1 * subscriber.receive("hello")
    1 * subscriber2.receive("hello")
}
```

- **When** the publisher sends a ’hello’ message
- **Then** both subscribers should receive that message exactly once

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Stubbing

- Is the act of making collaborators respond to method calls in a certain way
- We don't care if and how many times the method is going to be called
  - we just want it to return some value
  - or perform some side effect

Example

Whenever the subscriber receives a message, make it respond with 'ok'

Returning Fixed Values

- Whenever the subscriber receives a message, make it respond with 'ok'

```
subscriber.receive(_) >> "ok"
```

- Return different values for different invocations
    - *ok* whenever *message1* is received
    - *fail* whenever *message2* is received

```
subscriber.receive("message1") >> "ok"
subscriber.receive("message2") >> "fail"
```

Returning Sequences of Values

- Use triple-right-shift >>>
- Return different values on successive invocations
  - *ok* for the first invocation
  - *error* for the second invocation
  - *error* for the third invocation
  - *ok* for all remaining invocations

```
subscriber.receive(_) >>> ["ok", "error", "error", "ok"]
```

Computing Return Values

- Return value based on the method's argument
  - *ok* if the message is more than three characters
  - *fail* otherwise

```
subscriber.receive(_) >>
{ args -> args[0].size() > 3 ? "ok" : "fail" }
```

Or

```
subscriber.receive(_) >>
{ String message -> message.size() > 3 ? "ok" : "fail" }
```

- Method arguments will be mapped one-by-one to closure parameters
- Behaves the same as the previous one, but is arguably more readable

Chaining Method Responses

- Method responses can be chained
  - *ok* for the first invocation
  - *fail* for the second invocation
  - *ok* for the third invocation
  - throw `InternalError` for the fourth invocation
  - *ok* for any further invocation

```
subscriber.receive(_)
>>> ["ok", "fail", "ok"]
>> { throw new InternalError() }
>> "ok"
```

Returning a default response

- Don't really care what you return
- But you must return a non-null value
- Use _

```
subscriber.receive(_) >> _
```

- This will use the same logic to compute a response as `Stub`

Part V

Use third-party libraries

Plan

19 Introduction

20 Selenium
- Include Maven dependency
- Preparing our tests
- Writing out tests

Introduction

Use framework

- As with Junit, we can use third-party framework
- Spock accept their uses
- By adding the Maven dependency

Plan

19 Introduction

20 Selenium
- Include Maven dependency
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Include Maven dependency

```
<dependency>
   <groupId>org.seleniumhq.selenium</groupId>
   <artifactId>selenium-java</artifactId>
   <version>4.1.1</version>
</dependency>
```

Preparing our tests

```
class SeleniumSpec extends Specification {
   @Shared WebDriver driver

   def setupSpec() {
      System.setProperty("webdriver.gecko.driver",
                         "D:/.../geckodriver.exe");
      driver = new FirefoxDriver()
   }
   def cleanupSpec() {
      if(driver != null) { driver.close() }
   }

   /* Methodes de test */
}
```

- `driver` is a shared field
- `setupSpec` is run once before the first test
- `cleanupSpec` is run once after the last test

Writing out tests

```
def "selenium integration with spock"() {
    when:
     driver.get "https://spockframework.org/"

    then:
     driver.title == "Spock"
}

def "selenium integration with spock bis"() {
    when:
     driver.get "https://selenium.dev"

    then:
     driver.title == "Selenium"
}
```