JUnit in Practice

Course of Software Engineering I
A.A. 2011/2012

Valerio Maggio, PhD Student
Prof. Adriano Peron

Outline

- ► Brief introduction to JUnit
  - Introducing Junit 4.x
  - Main differences with JUnit 3.x
  - JUnit Examples in practice
  - Further Insights
    - (Extensions and compatibilities)
- ► Working (hopefully) Examples

JUnit Testing Framework

JUnit Preliminaries

- **Q:** How many “types” of testing do you know?

  A: System Testing, Integration Testing, Unit Testing....

- **Q:** How many “testing techniques” do you know?

  A: Black Box and White Box Testing

  - Which is the difference?

- **Q:** What type and technique do you think Junit covers?

Junit: Java Unit Testing framework

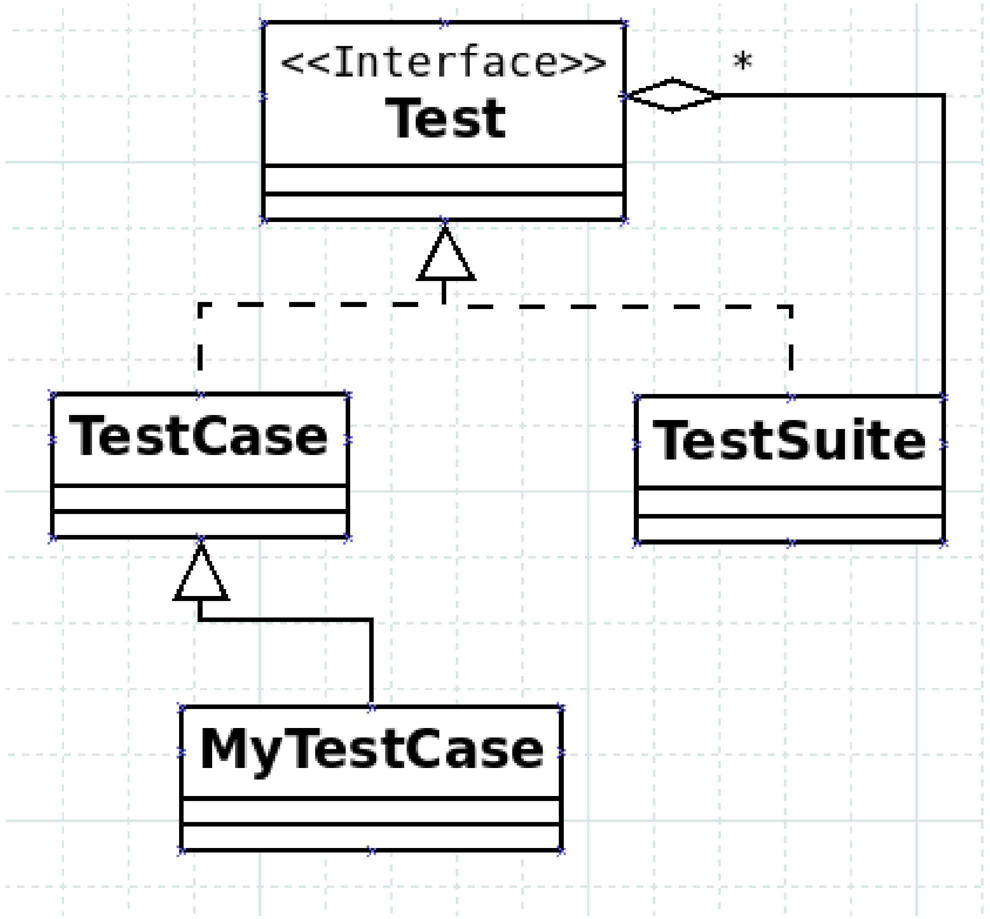
- **JUnit** is a simple, open source framework to write and run repeatable tests.
  It is an instance of the **xUnit** architecture for unit testing frameworks. *(source:* `http://junit.org`*)*

- JUnit features include:
  - Assertions for testing expected results
  - Test fixtures for sharing common test data
  - Test runners for running tests

- Originally written by *Erich Gamma* and *Kent Beck*.

Junit 3.x Design

- Design that is compliant with *xUnit framework* guidelines



Junit 3.x (Mandatory) Design Rules

- All the Test classes **must** extend `TestCase`
  - Functionalities by inheritance

- All the test method's names **must** start with `test` to be executed by the framework
  - `TestSomething(...)`
  - `TestSomethingElse(...)`

- Let's do an example...

Junit 3.x Typical Example

```
package it.unina.dsf.knomelab

import junit.framework.TestCase;

public class AdditionTest extends TestCase {

  private int x = 1;
  private int y = 1;

  public void testAddition() {
    int z = x + y;
    assertEquals(2, z);
  }

}
```

JUnit 4.x Design

- Main features inspired from other Java Unit Testing Frameworks
  - TestNG
- Test Method **Annotations**
  - Requires Java5+ instead of Java 1.2+
- Main Method Annotations
  - `@Before, @After`
  - `@Test, @Ignore`
  - `@SuiteClasses, @RunWith`

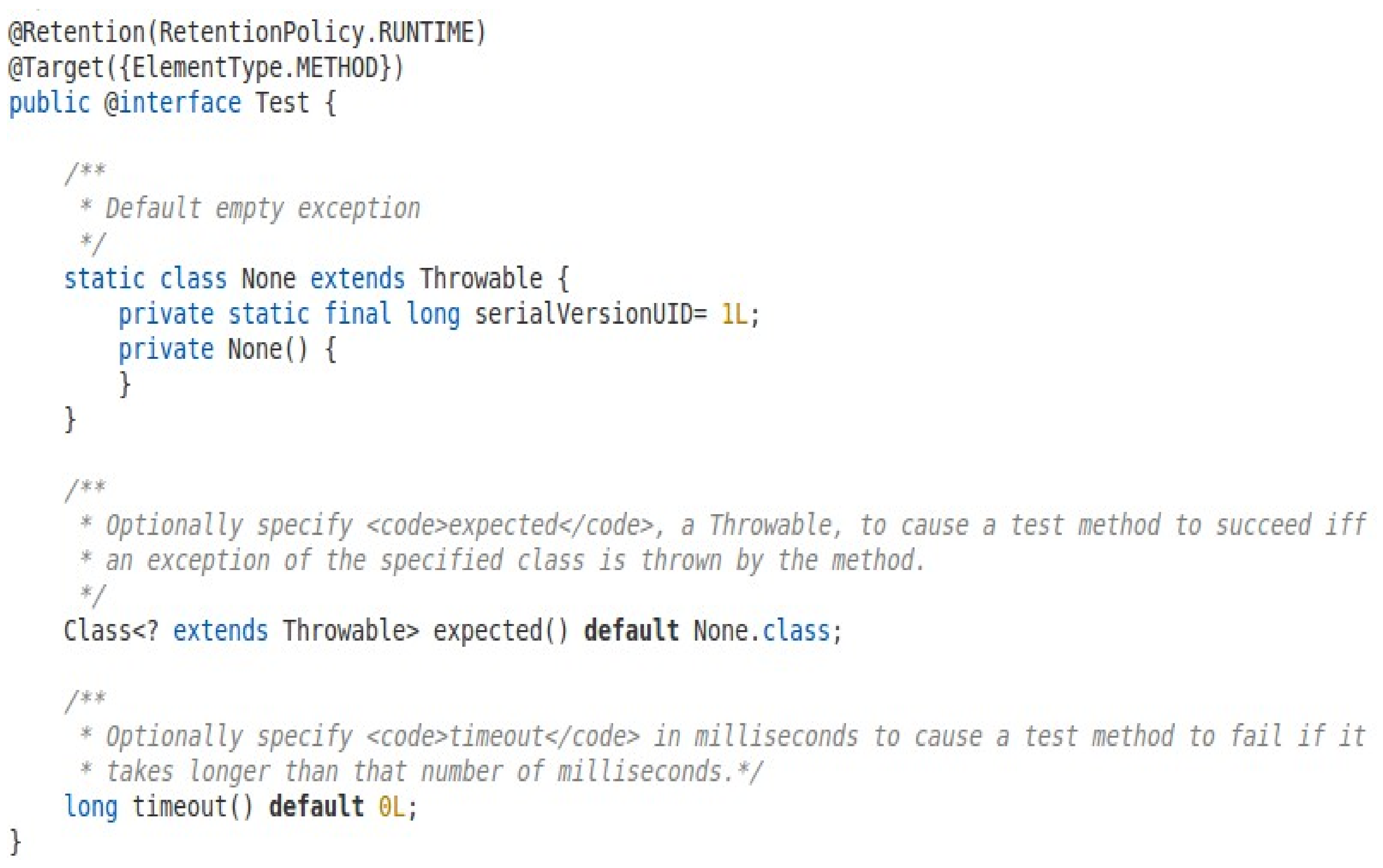
Java5 Annotations at glance

- Meta Data Tagging
  - java.lang.annotation
  - java.lang.annotation.ElementType
    - FIELD
    - METHOD
    - CLASS
    - …
- Target
  - Specify to which ElementType is applied
- Retention
  - Specify how long annotation should be available

Java5 Annotations at glance

- Meta Data Tagging
  - java.lang.annotation
  - java.lang.annotation.ElementType
    - FIELD
    - METHOD
    - CLASS
    - …
- Target
  - Specify to which ElementType is applied
- Retention
  - Specify how long annotation should be available

JUnit Test Annotation



```
@Retention(RetentionPolicy.RUNTIME)
@Target({ElementType.METHOD})
public @interface Test {

    /**
     * Default empty exception
     */
    static class None extends Throwable {
        private static final long serialVersionUID= 1L;
        private None() {
        }
    }

    /**
     * Optionally specify <code>expected</code>, a Throwable, to cause a test method to succeed iff
     * an exception of the specified class is thrown by the method.
     */
    Class<? extends Throwable> expected() default None.class;

    /**
     * Optionally specify <code>timeout</code> in milliseconds to cause a test method to fail if it
     * takes longer than that number of milliseconds.*/
    long timeout() default 0L;
}
```

JUnit Testing Annotation (1)

- `@Test public void method()`
  - Annotation @Test identifies that this method is a test method.
- `@Before public void method()`
  - Will perform the method() **before** each test.
  - This method can prepare the **test environment**
  - E.g. read input data, initialize the class, ...
- `@After public void method()`

JUnit Testing Annotation (2)

- `@Ignore`
  - Will ignore the test method
  - E.g. Useful if the underlying code has been changed and the test has not yet been adapted.

- `@Test(expected=Exception.class)`
  - Tests if the method throws the named exception.

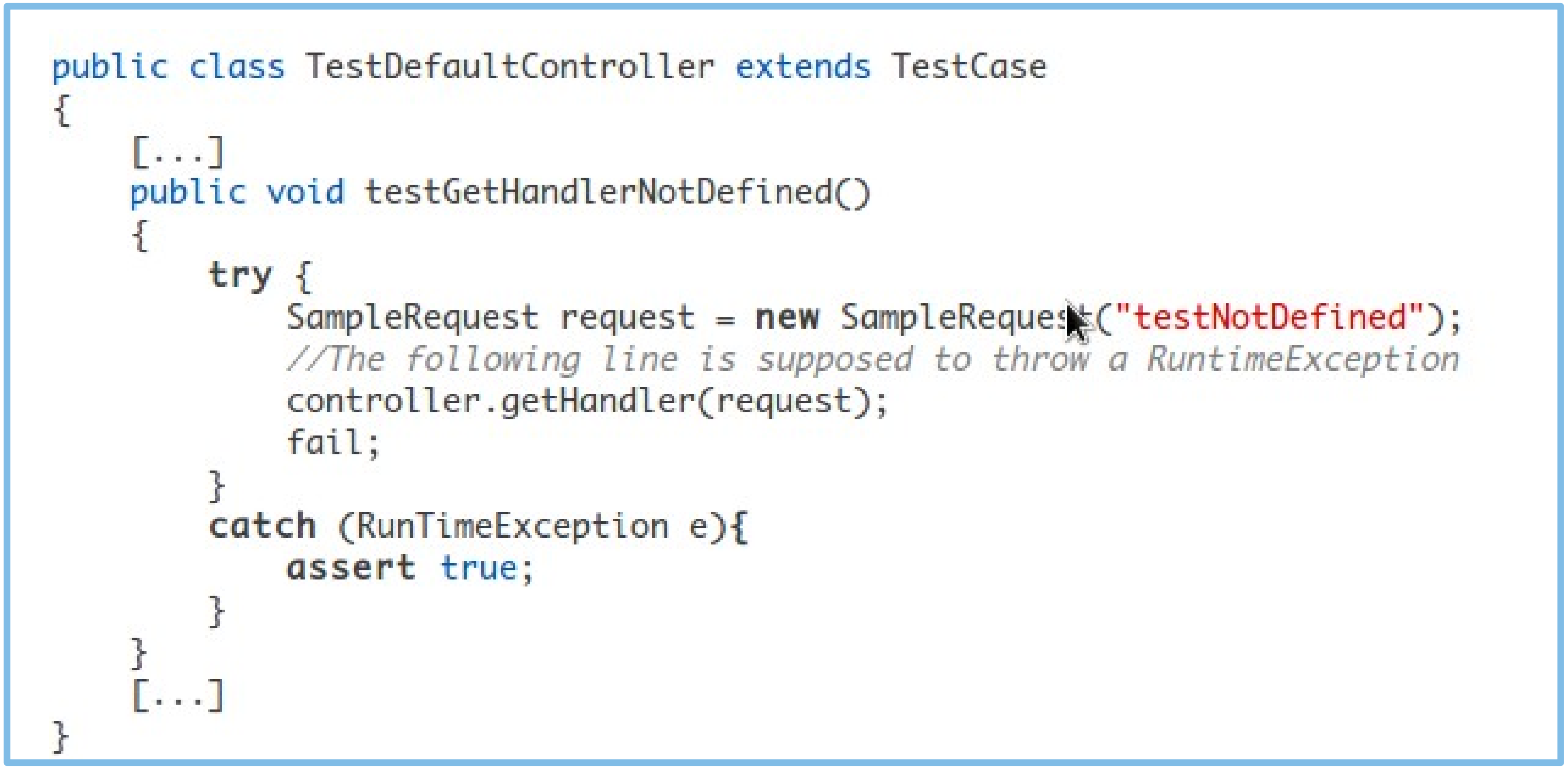
- `@Test(timeout=100)`
  - Fails if the method takes longer than 100 milliseconds.

JUnit Assert Statements

- `assertNotNull([message], object)`
  - Test passes if Object is not null.
- `assertNull([message], object)`
  - Test passes if Object is null.
- `assertEquals([message],expected, actual)`
  - Asserts equality of two values
- `assertTrue(true|false)`
  - Test passes if condition is True
- `assertNotSame([message], expected, actual)`
  - Test passes if the two Objects are not the same Object
- `assertSame([message], expected, actual)`
  - Test passes if the two Objects are the same Object

Testing Exception Handling

► *Test anything that could possibly fail*



```
public class TestDefaultController extends TestCase
{
    [...]
    public void testGetHandlerNotDefined()
    {
        try {
            SampleRequest request = new SampleRequest("testNotDefined");
            //The following line is supposed to throw a RuntimeException
            controller.getHandler(request);
            fail;
        }
        catch (RunTimeException e){
            assert true;
        }
    }
    [...]
}
```

New way of Testing exception handling

- *Test anything that could possibly fail*

```
public class TestDefaultController
{
    [...]
    @Test(expected=RuntimeException.class)
    public void testGetHandlerNotDefined()
    {
        SampleRequest request = new SampleRequest("testNotDefined");
        //The following line is supposed to throw a RuntimeException
        controller.getHandler(request);
    }
    [...]
}
```

Junit by shots

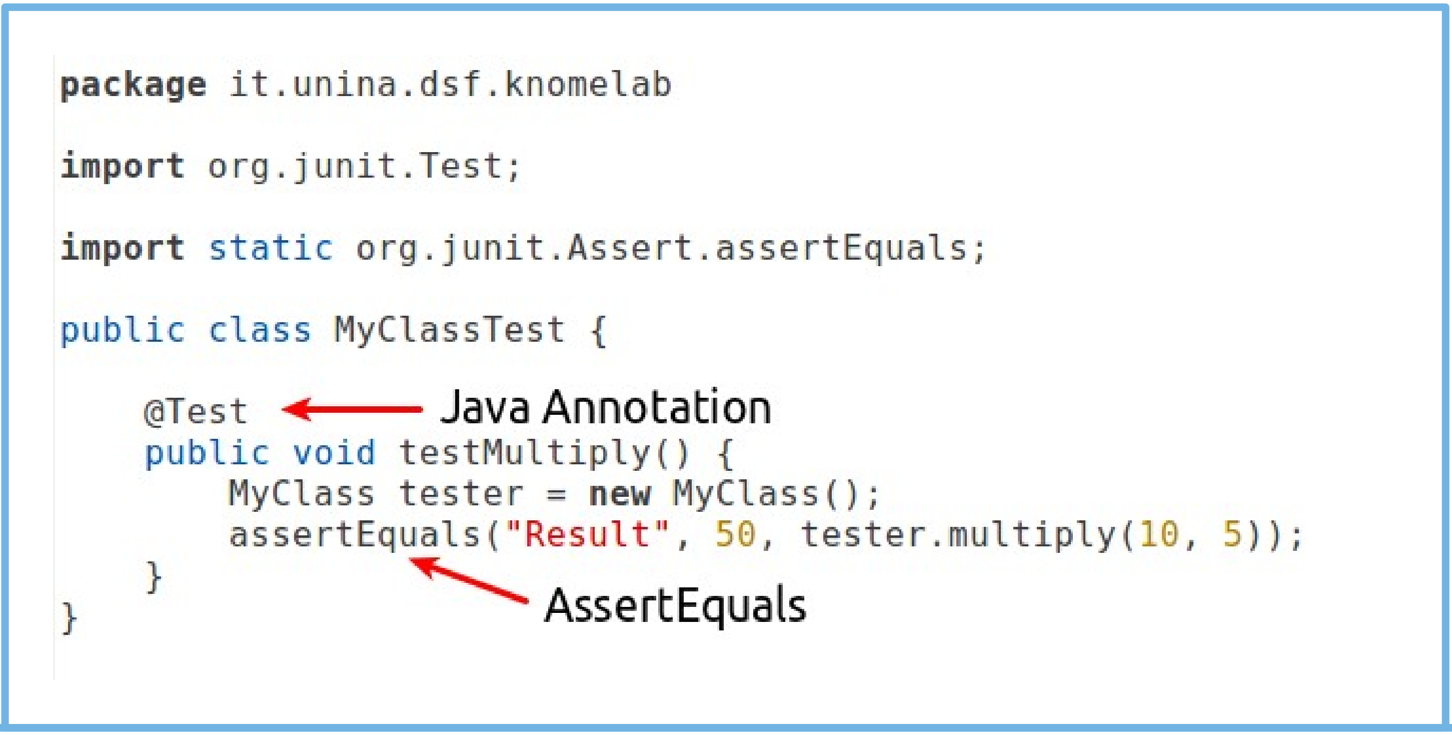
JUnit Example: **TestCase** and **ClassUnderTest**

```
package it.unina.dsf.knomelab

public class MyClass {
    public int multiply(int x, int y) {
        return x * y;
    }
}
```

```
package it.unina.dsf.knomelab

import org.junit.Test;

import static org.junit.Assert.assertEquals;

public class MyClassTest {

    @Test
    public void testMultiply() {
        MyClass tester = new MyClass();
        assertEquals("Result", 50, tester.multiply(10, 5));
    }
}
```

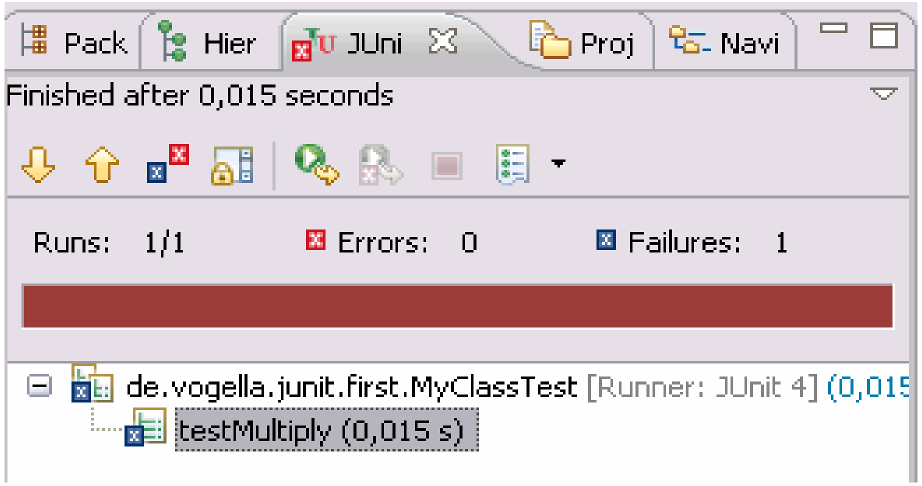
JUnit Example: **TestCase** and **ClassUnderTest**

```java
package it.unina.dsf.knomelab

public class MyClass {
    public int multiply(int x, int y) {
        return x * y;
    }
}
```



```java
package it.unina.dsf.knomelab

import org.junit.Test;

import static org.junit.Assert.assertEquals;

public class MyClassTest {

    @Test
    public void testMultiply() {
        MyClass tester = new MyClass();
        assertEquals("Result", 50, tester.multiply(10, 5));
    }
}
```

JUnit Example: Execution



Finished after 0,015 seconds

Runs: 1/1 Errors: 0 Failures: 1

de.vogella.junit.first.MyClassTest [Runner: JUnit 4] (0,015

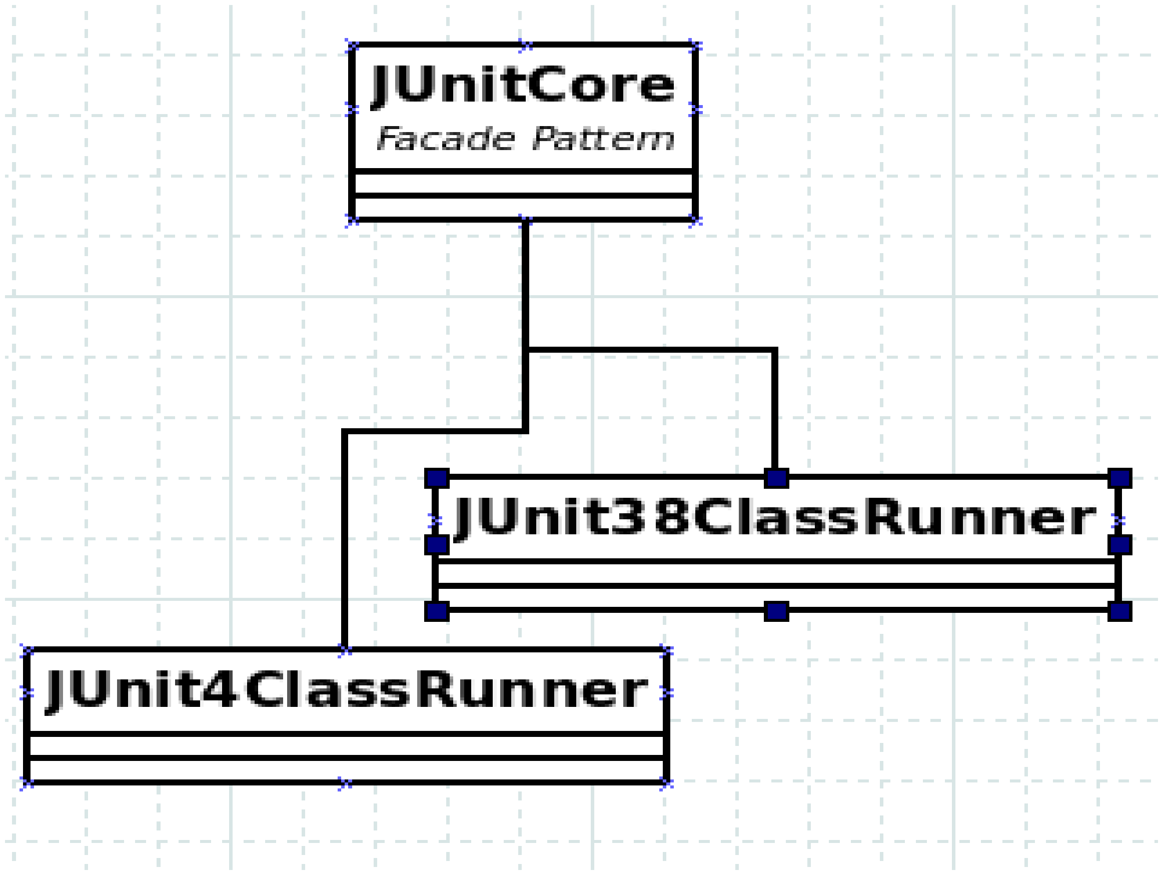
testMultiply (0,015 s)

```
package it.unina.dsf.knomelab

import org.junit.runner.JUnitCore;
import org.junit.runner.Result;
import org.junit.runner.notification.Failure;

public class MyTestRunner {
    public static void main(String[] args) {
        Result result = JUnitCore.runClasses(MyClassTest.class);
        for (Failure failure : result.getFailures()) {
            System.out.println(failure.toString());
        }
    }
}
```

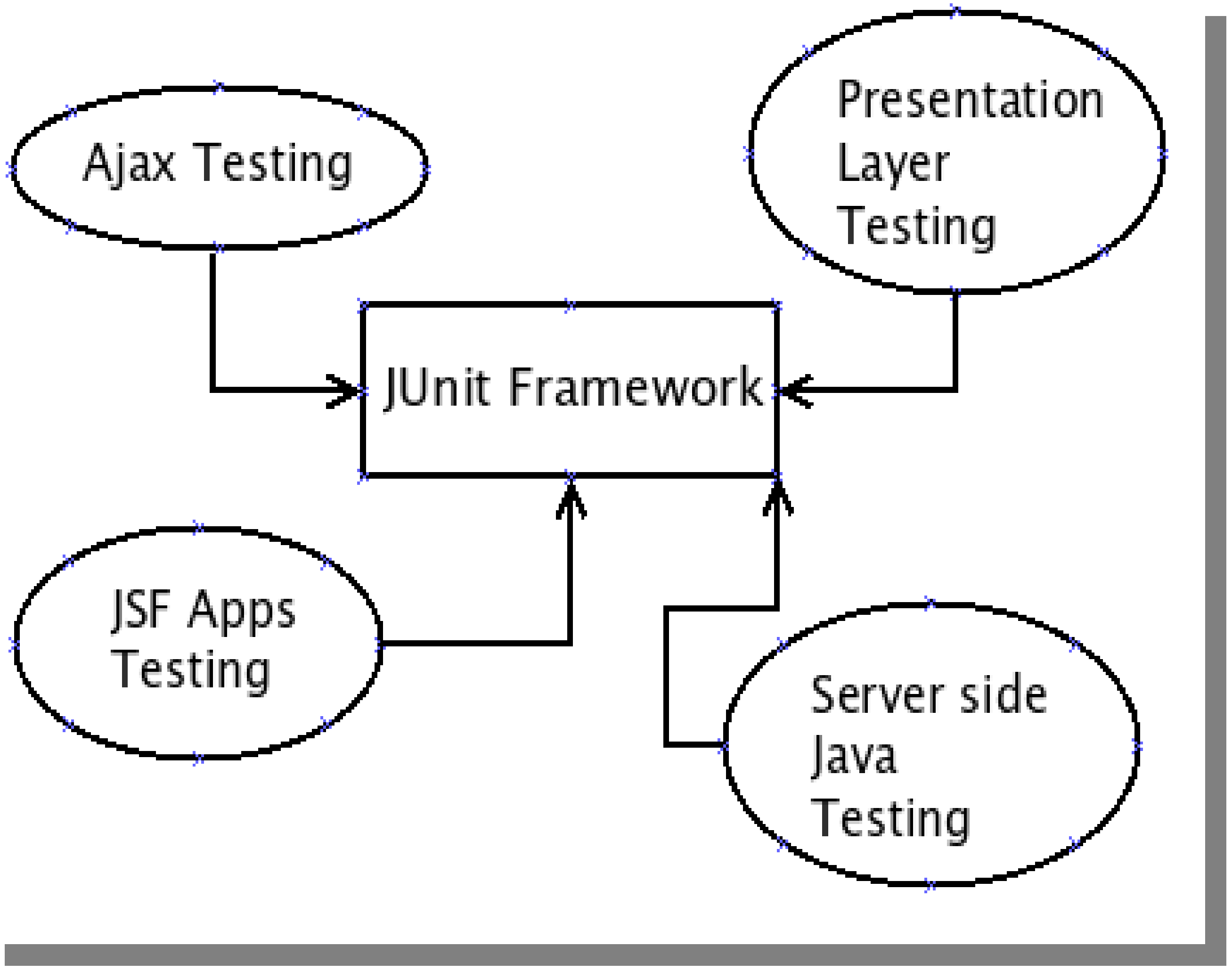
Junit Further Insights

JUnit 4.x backward compatibility

- JUnit provides a façade class which operates with any of the test runners.
  - `org.junit.runner.JUnitCore`



JUnit 4.x Extensions



JUnit Matchers: Hamcrest

- Junit 4.4+ introduces matchers
  - Imported from **Hamcrest project**
  - http://code.google.com/p/hamcrest/
- Matchers improve testing code refactoring
  - Writing more and more tests assertion became hard to read
  - **Remember:**
    - **Documentation purposes**
- Let's do an example …

Matchers Example

```
public class HamcrestTest {
    private List<String> values;
    @Before
    public void setUpList() {
        values = new ArrayList<String>();
        values.add("x");
        values.add("y");
        values.add("z");
    }

    @Test
    public void withoutHamcrest() {
        assertTrue(values.contains("one")
        || values.contains("two")
        || values.contains("three"));
        }
    }
```

```
@Test
public void withHamcrest() {
    assertThat(values, hasItem(anyOf(equalTo("one"), equalTo("two"),
    equalTo("three"))));
}
```

References

- Professional Java JDK 5 Edition
  - *Richardson et. al.*, Wrox Publications 2006
- xUnit Test Patterns
  - *G. Meszaros*, Addison Wesley 2006
- Next Generation Java Testing
  - *Beust, Suleiman*, Addison Wesley 2007
- JUnit in Action, 2nd Ed.
  - *Massol et al.* , Manning Pubs 2009