495

Free tutorial, donate to support

Donate

by Lars Vogel

Java File APIs
Manipulate files from your code:
XLS, DOC, PDF HTML, PPT, MSG Barcodes
and many more!
.NET Java SSRS SharePoint JasperReports
DOC PPT XLS PDF MSG
Free 30 Day Trial
ASPOSE
Your File Format Experts

JUnit - Tutorial

Lars Vogel

Version 2.3

06.12.2012

Revision History

Revision 0.1-0.5	03.09.2007	Lars Vogel	JUnit description
Revision 0.6 - 2.3	10.05.2008 - 06.12.2012	Lars Vogel	bugfixes and enhancements

Unit testing with JUnit

This tutorial explains unit testing with JUnit 4.x. It explains the creation of JUnit tests and how to run them in Eclipse or via own code.

Table of Contents

1. Introduction to unit testing

This tutori
Kindle boo

1.1. Unit tests and unit testing

A *unit test* is a piece of code written by a developer that executes a specific functionality in the code which is tested. The percentage of code which is tested by unit tests is typically called *test coverage*.

Unit tests target small units of code, e.g. a method or a class, (local tests) whereas *component and integration tests* targeting to test the behavior of a component or the integration between a set of components or a complete application consisting of several components.

Unit tests ensure that code works as intended. They are also very helpful to ensure that the code still works as intended in case you need to modify code for fixing a bug or extending functionality. Having a high test coverage of your code allows you to continue developing features without having to perform lots of manual tests.

Typically unit tests are created in their own project or their own source folder to avoid that the normal code and the test code is mixed.

1.2. Unit testing with JUnit

JUnit unit test in version 4.x is a test framework which uses annotations to identify methods that specify a test. Typically these test methods are contained in a class which is only used for testing. It is typically called a *Test class*.

The following code shows a JUnit test method which can be created via *File → New → JUnit → JUnit Test case*.

```
@Test
public void testMultiply() {

   // MyClass is tested
   MyClass tester = new MyClass();

   // Check if multiply(10,5) returns 50
   assertEquals("10 x 5 must be 50", 50, tester.multiply(10, 5));
 }
```

xecuted in an arbitrary order. Therefore tests should not

.

To write a test with JUnit you annotate a method with the `@org.junit.Test` annotation and use a method provided by JUnit to check the expected result of the code execution versus the actual result.

You can use the Eclipse user interface to run the test, via right-click on the test class and selecting *Run → Run As → JUnit Test*. Outside of Eclipse you can use `org.junit.runner.JUnitCore` class to run the test.

1.3. Available JUnit annotations

The following table gives an overview of the available annotations in JUnit 4.x.

Table 1. Annotations

Annotation	Description
@Test public void method()	The annotation @Test identifies that a method is a test method.
@Before public void method()	This method is executed before each test. This method can prepare the test environment (e.g. read input data, initialize the class).
@After public void method()	This method is executed after each test. This method can cleanup the test environment (e.g. delete temporary data, restore defaults). It can also save memory by cleaning up expensive memory structures.
@BeforeClass public static void method()	This method is executed once, before the start of all tests. This can be used to perform time intensive activities, for example to connect to a database. Methods annotated with this annotation need to be defined as `static` to work with JUnit.
@AfterClass	This method is executed once, after all tests have been finished. This can be used to

public static void method()	perform clean-up activities, for example to disconnect from a database. Methods annotated with this annotation need to be defined as `static` to work with JUnit.
@Ignore	Ignores the test method. This is useful when the underlying code has been changed and the test case has not yet been adapted. Or if the execution time of this test is too long to be included.
@Test (expected = Exception.class)	Fails, if the method does not throw the named exception.
@Test(timeout=100)	Fails, if the method takes longer than 100 milliseconds.

BACK TO TOP

1.4. Assert statements

JUnit provides static methods in the `Assert` class to test for certain conditions. These methods typically start with `asserts` and allow you to specify the error message, the expected and the actual result. The following table gives an overview of these methods. Parameters in [] brackets are optional.

Table 2. Test methods

Statement	Description
fail(String)	Let the method fail. Might be used to check that a certain part of the code is not reached. Or to have a failing test before the test code is implemented.
assertTrue([message], boolean condition)	Checks that the boolean condition is true.
assertsEquals([String message], expected, actual)	Tests that two values are the same. Note: for arrays the reference is checked not the content of the arrays.
assertsEquals([String message], expected, actual, tolerance)	Test that float or double values match. The tolerance is the number of decimals which must be the same.
assertNull([message], object)	Checks that the object is null.
assertNotNull([message], object)	Checks that the object is not null.
assertSame([String], expected, actual)	Checks that both variables refer to the same object.
assertNotSame([String], expected, actual)	Checks that both variables refer to different objects.

Note

You should provide meaningful messages in assertions so that it is easier for the developer to identify the problem. This help in fixing the issue, especially if someone looks at the problem, which did not write the code under test or the test code.

1.5. Create a JUnit test suite

If you have several test classes you can combine them into a *test suite*. Running a test suite will execute all test classes in that suite.

The following example code shows a test suite which defines that two test classes should be executed. If you want to add another test class you can add it to `@Suite.SuiteClasses` statement.

```
package com.vogella.junit.first;

import org.junit.runner.RunWith;
import org.junit.runners.Suite;
import org.junit.runners.Suite.SuiteClasses;

@RunWith(Suite.class)
@SuiteClasses({ MyClassTest.class, MySecondClassTest.class })
```

```
public class AllTests {

}
```

1.6. Run your test outside Eclipse

Eclipse provides support for running your test interactively in the Eclipse IDE. You can also run your JUnit tests outside Eclipse via standard Java code. The `org.junit.runner.JUnitCore` class provides the `runClasses()` method which allows you to run one or several tests classes. As a return parameter you receive an object of the type `org.junit.runner.Result`. This object can be used to retrieve information about the tests.

In your *`test`* folder create a new class `MyTestRunner` with the following code. This class will execute your test class and write potential failures to the console.

```
package de.vogella.junit.first;

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());
    }
  }
}
```

To run your JUnit tests outside Eclipse you need to add the JUnit library jar to the classpath of your program. Typically build frameworks like Apache Ant or Apache Maven are used to execute tests automatically on a regular basis.

2. Installation of JUnit

2.1. Using JUnit integrated into Eclipse

Eclipse allows you to use the version of JUnit which is integrated in Eclipse. If you use Eclipse no additional setup is required. In this case you can skip the following section.

2.2. Downloading the JUnit library

If you want to control the used JUnit library explicitly, download JUnit4.x.jar from the following JUnit website. The download contains the *`junit-4.*.jar`* which is the JUnit library. Add this library to your Java project and add it to the classpath.

```
http://junit.org/
```

3. Eclipse support for JUnit

3.1. Creating JUnit tests

You can write the JUnit tests manually but Eclipse supports the creation of JUnit tests via wizards.

For example to create a JUnit test or a test class for an existing class, right-click on your new class, select this class in the *Package Explorer view*, right-click on it and select *New* → *JUnit Test Case*.

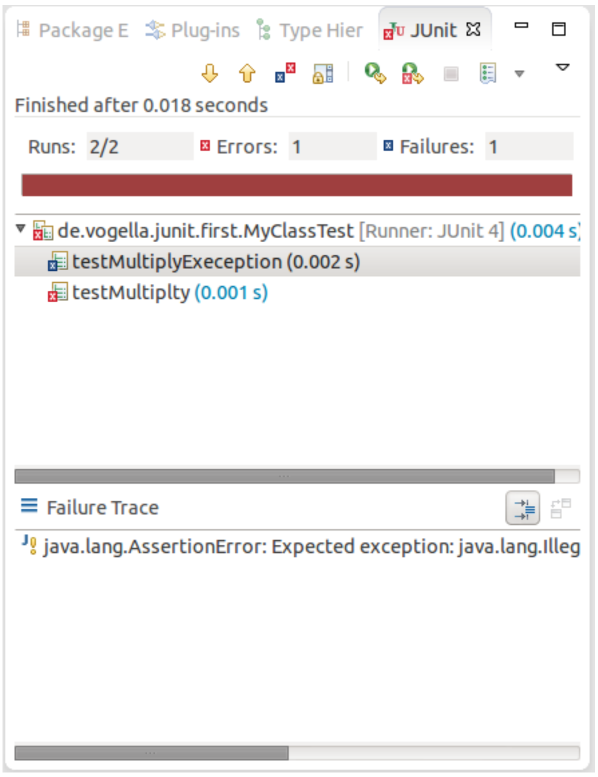
Alternatively you can also use the JUnit wizards available under *File* → *New* → *Other...* → *Java* → *JUnit*.

3.2. Running JUnit tests

To run a test, select the class which contains the tests, right-click on it and select *Run-as* → *JUnit Test*. This starts JUnit and executes all test methods in this class.

Eclipse provides the **Alt**+**Shift**+**X, ,T** shortcut to run the test in the selected class. If you position the cursor on one method name, this shortcut runs only the selected test method.

To see the result of an JUnit test, Eclipse uses the *JUnit view* which shows the results of the tests. You can also select individual unit test in this view , right-click them and select *Run* to execute them again.



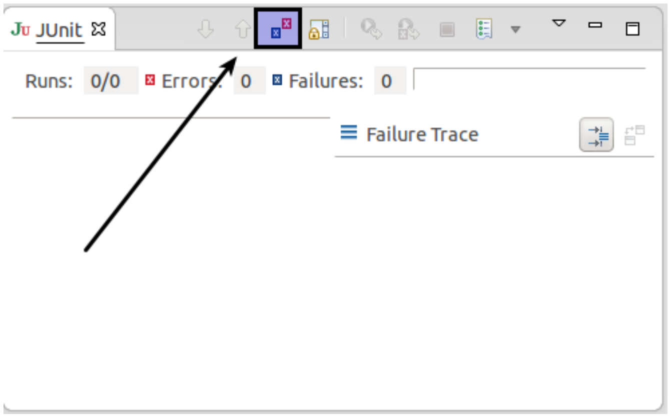
Finished after 0.018 seconds

Runs: 2/2 Errors: 1 Failures: 1

de.vogella.junit.first.MyClassTest [Runner: JUnit 4] (0.004 s)
testMultiplyExeception (0.002 s)
testMultiplty (0.001 s)

Failure Trace
java.lang.AssertionError: Expected exception: java.lang.Illeg

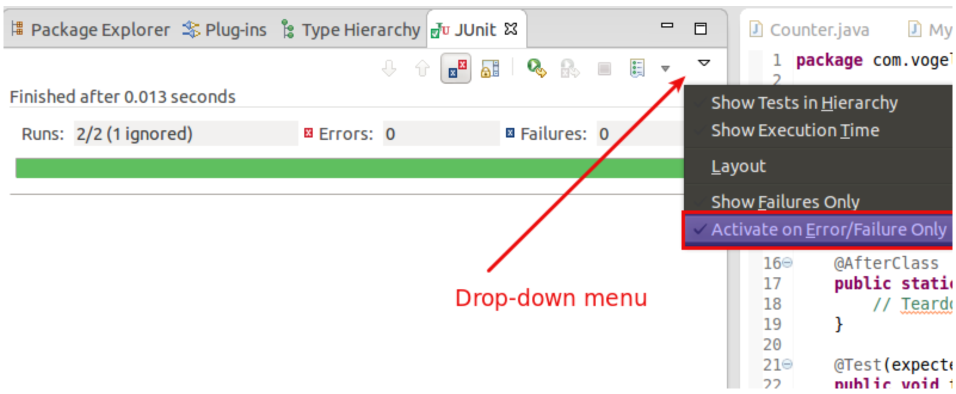
By default this view shows all tests you can also configure, that it shows only failing tests.



Runs: 0/0 Errors: 0 Failures: 0

Failure Trace

You can also define that the view is only activated if you have a failing test.



Finished after 0.013 seconds

Runs: 2/2 (1 ignored) Errors: 0 Failures: 0

Show Tests in Hierarchy
Show Execution Time
Layout
Show Failures Only
✓ Activate on Error/Failure Only

Note

Eclipse creates run configurations for tests. You can see and modify these via the *Run → Run Configurations...* menu.

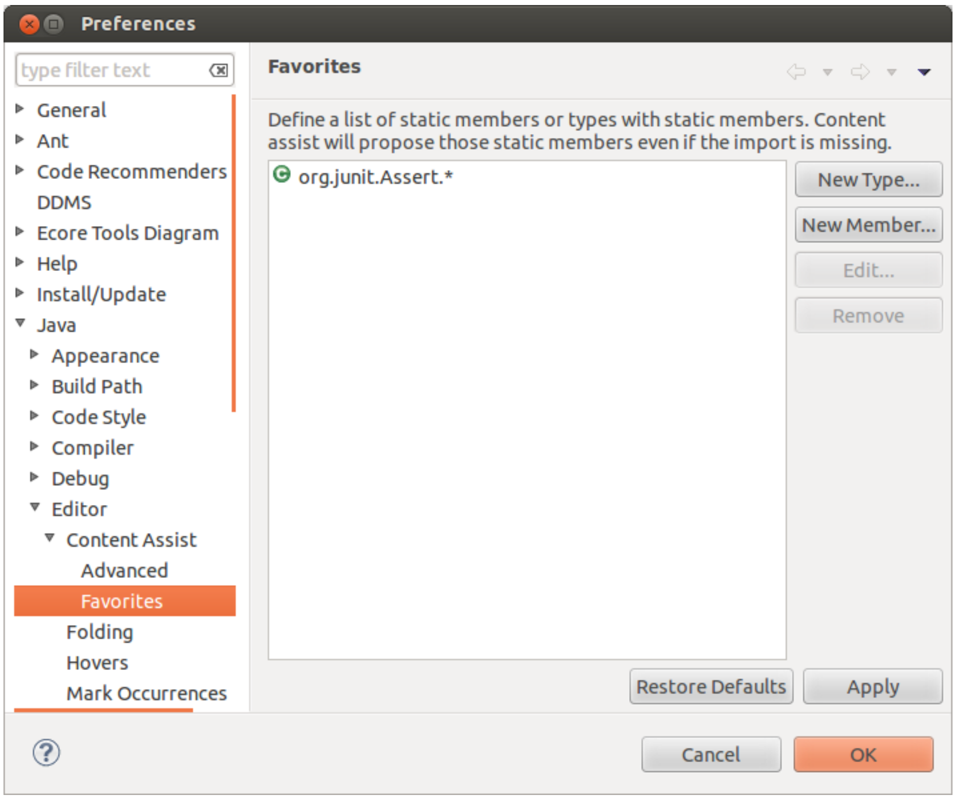
3.3. JUnit static imports

JUnit uses static methods and Eclipse cannot always create the corresponding `static import` statements automatically.

You can make the JUnit test methods available via the content assists.

Open the Preferences via *Window → Preferences* and select *Java → Editor → Content Assist → Favorites*.

Use the new *New Type* button to add the `org.junit.Assert` type. This makes for example the `assertTrue`, `assertFalse` and `assertEquals` methods directly available in the content assists.



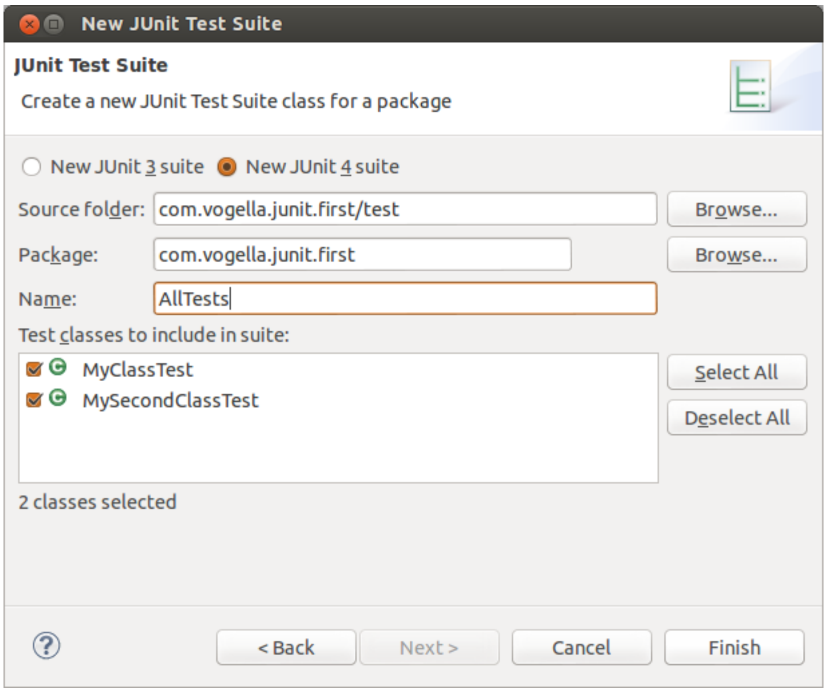
Define a list of static members or types with static members. Content assist will propose those static members even if the import is missing.

org.junit.Assert.*

You can now use Content Assist (Ctrl+Space) to add the method and the import.

3.4. Wizard for creating test suites

To create a test suite in Eclipse you select the test classes which should be included into this in the *Package Explorer view*, right-click on them and select *New → Other... → JUnit → JUnit Test Suite*.



New JUnit Test Suite

JUnit Test Suite

Create a new JUnit Test Suite class for a package

[ ] New JUnit 3 suite [✓ New JUnit 4 suite]

Source folder: com.vogella.junit.first/test

Package: com.vogella.junit.first

Name: AllTests

Test classes to include in suite:

- [✓] MyClassTest
- [✓] MySecondClassTest

2 classes selected

3.5. Testing exception

The @Test (expected = Exception.class) annotation is limited as it can only test for one exception. To test exceptions you can use the following test pattern.

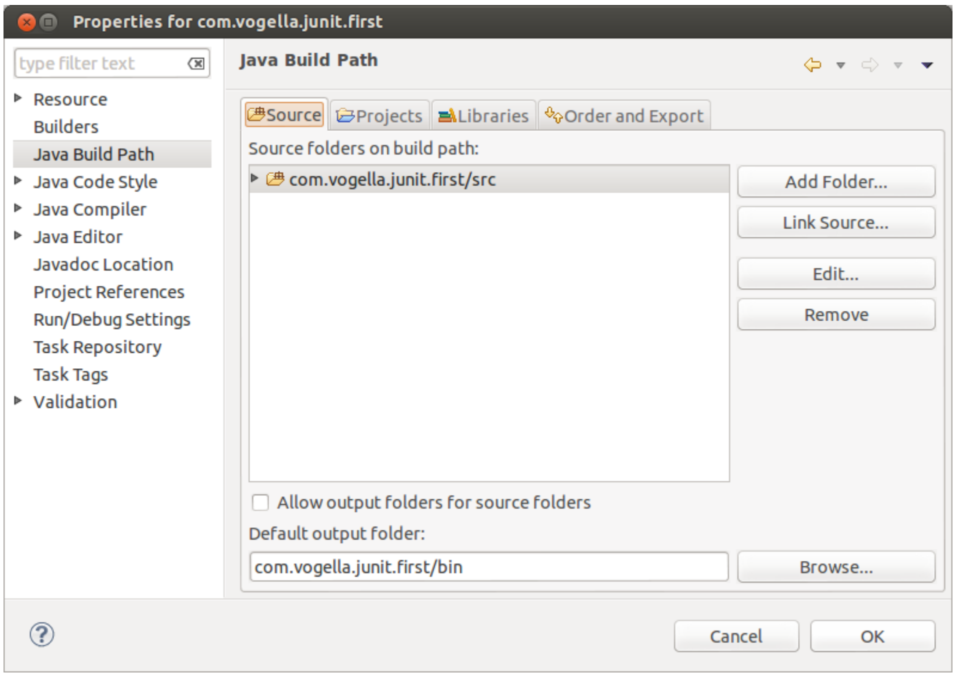
```
try {
   mustThrowException();
   fail();
} catch (Exception e) {
   // expected
   // could also check for message of exception, etc.
}
```

4. Exercise: Using JUnit

4.1. Project preparation

Create a new project called *com.vogella.junit.first*.

Create a new source folder test. For this right-click on your project, select *Properties* and choose the *Java Build Path* . Select the *Source* tab.


Properties for com.vogella.junit.first

Java Build Path

Source folders on build path:

com.vogella.junit.first/src

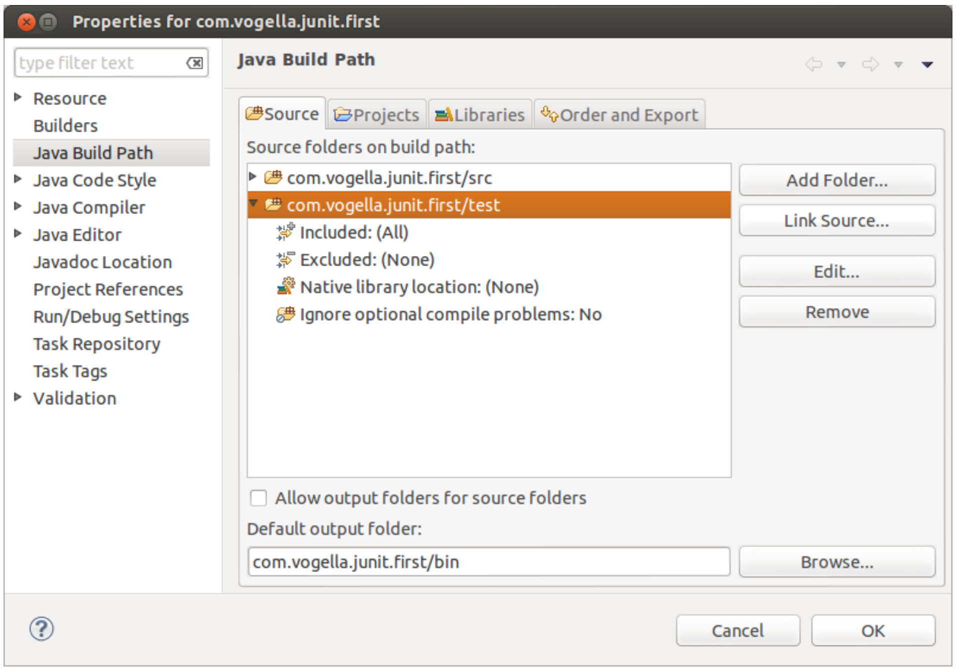
☐ Allow output folders for source folders

Default output folder:

com.vogella.junit.first/bin

Press the *Add Folder* button, afterwards press the *Create New Folder* button. Create the `test` folder.

The result is depicted in the following sceenshot.


Properties for com.vogella.junit.first

Java Build Path

Source folders on build path:

com.vogella.junit.first/src
com.vogella.junit.first/test
Included: (All)
Excluded: (None)
Native library location: (None)
Ignore optional compile problems: No

☐ Allow output folders for source folders

Default output folder:

com.vogella.junit.first/bin

Alternatively you can add a new source folder by right-clicking on a project and selecting *New → Source Folder*.

4.2. Create a Java class

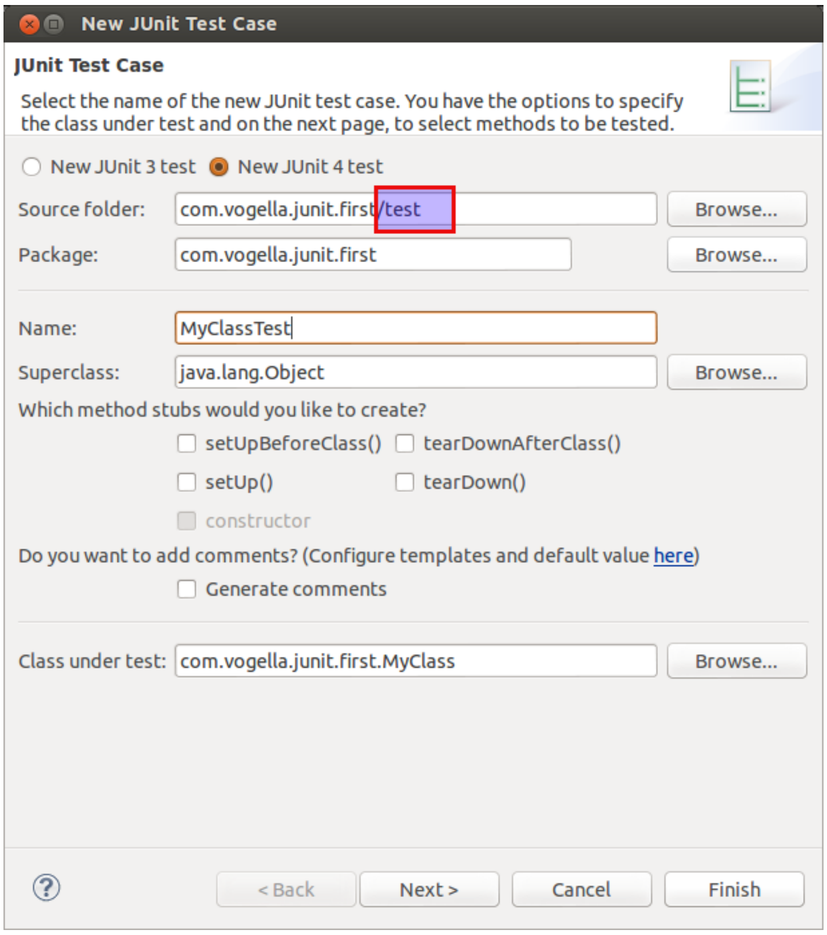
In the *src* folder, create the `com.vogella.junit.first` package and the following class.

```
package com.vogella.junit.first;

public class MyClass {
  public int multiply(int x, int y) {
    // the following is just an example
    if (x > 999) {
      throw new IllegalArgumentException("X should be less than 1000");
    }
    return x / y;
    }
}
```

4.3. Create a JUnit test

Right-click on your new class in the *Package Explorer view* and select *New → JUnit Test Case*.

In the following wizard ensure that the *New JUnit 4 test* flag is selected and set the source folder to `test`, so that your test class gets created in this folder.



New JUnit Test Case

JUnit Test Case

Select the name of the new JUnit test case. You have the options to specify the class under test and on the next page, to select methods to be tested.

○ New JUnit 3 test ● New JUnit 4 test

Source folder: com.vogella.junit.first/test

Package: com.vogella.junit.first

Name: MyClassTest

Superclass: java.lang.Object

Which method stubs would you like to create?

☐ setUpBeforeClass() ☐ tearDownAfterClass()

☐ setUp() ☐ tearDown()

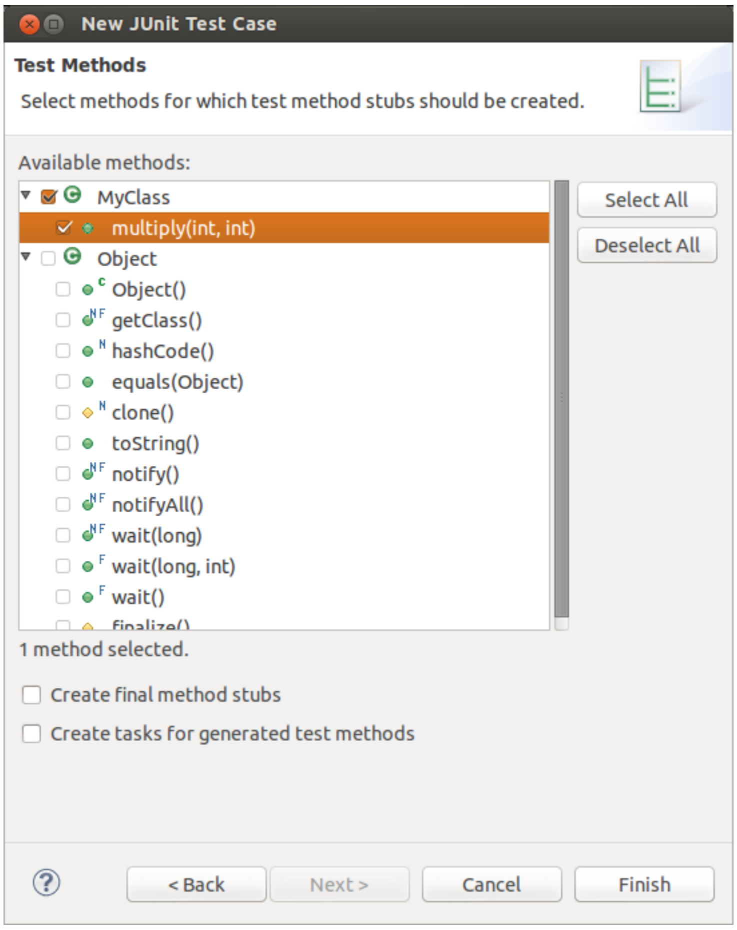
☐ constructor

Do you want to add comments? (Configure templates and default value here)

☐ Generate comments

Class under test: com.vogella.junit.first.MyClass

Press the *Next* button and select the methods that you want to test.



New JUnit Test Case

Test Methods

Select methods for which test method stubs should be created.

Available methods:

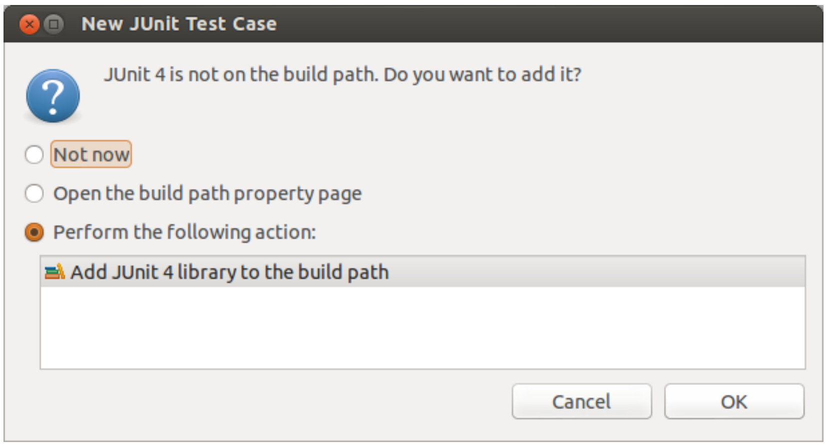
- [✓] MyClass
  - [✓] multiply(int, int)
- [ ] Object
  - [ ] Object()
  - [ ] getClass()
  - [ ] hashCode()
  - [ ] equals(Object)
  - [ ] clone()
  - [ ] toString()
  - [ ] notify()
  - [ ] notifyAll()
  - [ ] wait(long)
  - [ ] wait(long, int)
  - [ ] wait()
  - [ ] finalize()

1 method selected.

[ ] Create final method stubs

[ ] Create tasks for generated test methods

If the JUnit library is not part of the classpath of your project, Eclipse will prompt you to add it. Use this to add JUnit to your project.



New JUnit Test Case

JUnit 4 is not on the build path. Do you want to add it?

Not now Open the build path property page [✓ Perform the following action:]

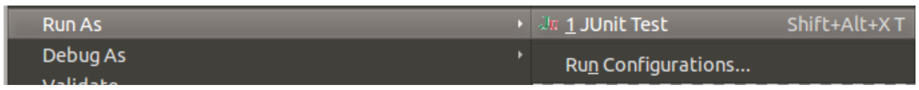
Add JUnit 4 library to the build path

Create a test with the following code.

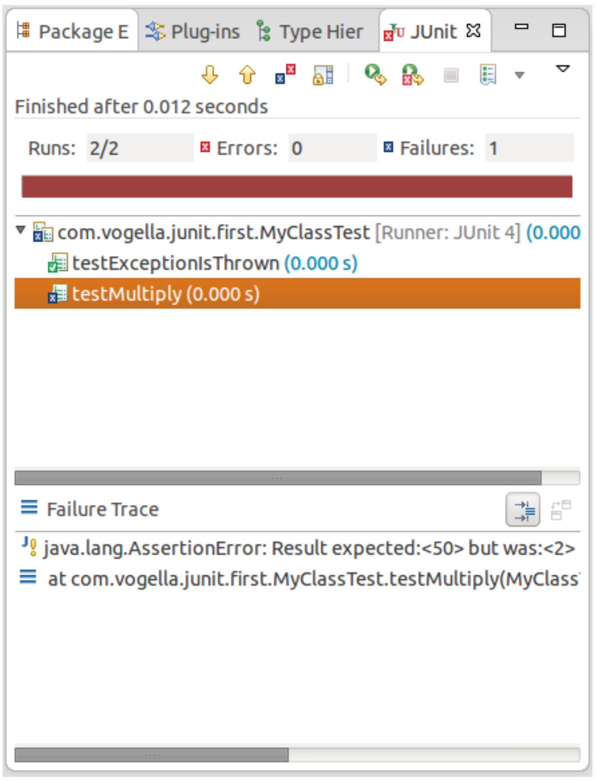
```
package com.vogella.junit.first;

import static org.junit.Assert.assertEquals;

import org.junit.AfterClass;
import org.junit.BeforeClass;
import org.junit.Test;

public class MyClassTest {

  @BeforeClass
  public static void testSetup() {
  }

  @AfterClass
  public static void testCleanup() {
    // Teardown for data used by the unit tests
  }

  @Test(expected = IllegalArgumentException.class)
  public void testExceptionIsThrown() {
    MyClass tester = new MyClass();
    tester.multiply(1000, 5);
  }

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

4.4. Run your test in Eclipse

Right-click on your new test class and select *Run-As → JUnit Test*.



The result of the tests will be displayed in the JUnit *view*. In our example one test should be succesful and one test should show an error. This error is indicated by a red bar.



Finished after 0.012 seconds

Runs: 2/2 Errors: 0 Failures: 1

com.vogella.junit.first.MyClassTest [Runner: JUnit 4] (0.000
testExceptionIsThrown (0.000 s)
testMultiply (0.000 s)

Failure Trace
java.lang.AssertionError: Result expected:<50> but was:<2>
at com.vogella.junit.first.MyClassTest.testMultiply(MyClass

The test is failing because our multiplier class is currently not working correctly. It does a division instead of multiplication. Fix the bug and re-run test to get a green bar.

5. Advanced JUnit options

5.1. Parameterized test

JUnit allows you to use parameters in a tests class. This class can contain one test method and this method is executed with the different parameters provided.

You mark a test class as a parameterized test with the `@RunWith(Parameterized.class)` annotation.

Such a test class must contain a static method annotated with `@Parameters` that generates and returns a Collection of Arrays. Each item in this collection is used as the parameters for the test method.

You need also to create a constructor in which you store the values for each test. The number of elements in each array provided by the method annotated with `@Parameters` must correspond to the number of parameters in the constructor of the class. The class is created for each parameter and the test values are passed via the constructor to the class.

The following code shows an example for a parameterized test. It assume that you test the `multiply()` method of the `MyClass` class which was used in an example earlier.

```
package de.vogella.junit.first;

import static org.junit.Assert.assertEquals;

import java.util.Arrays;
import java.util.Collection;

import org.junit.Test;
import org.junit.runner.RunWith;
import org.junit.runners.Parameterized;
import org.junit.runners.Parameterized.Parameters;

@RunWith(Parameterized.class)
public class MyParameterizedClassTest {

  private int multiplier;

  public MyParameterizedClassTest(int testParameter) {
    this.multiplier = number;
  }

  // Creates the test data
  @Parameters
  public static Collection<Object[]> data() {
    Object[][] data = new Object[][] { { 1 }, { 5 }, { 121 } };
    return Arrays.asList(data);
  }

  @Test
  public void testMultiplyException() {
    MyClass tester = new MyClass();
    assertEquals("Result", multiplier * multiplier,
        tester.multiply(multiplier, multiplier));
  }

}
```

If you run this test class, the test method is executed with each defined parameter. In the above example the test method is executed three times.

5.2. Rules

Via the `@Rule` annotation you can create objects which can be used and configured in your test methods. This adds more flexibility to your tests. You could for example specify which exception message your expect during execution of your test code.

```
package de.vogella.junit.first;

import org.junit.Rule;
import org.junit.Test;
import org.junit.rules.ExpectedException;

public class RuleExceptionTesterExample {

  @Rule
  public ExpectedException exception = ExpectedException.none();

  @Test
  public void throwsIllegalArgumentExceptionIfIconIsNull() {
    exception.expect(IllegalArgumentException.class);
    exception.expectMessage("Negative value not allowed");
    ClassToBeTested t = new ClassToBeTested();
    t.methodToBeTest(-1);
  }
}
```

JUnit provides already several useful implementations of rules. For example the `TemporaryFolder` class allows to setup files and folders which are automatically removed after a test.

The following code shows an example for the usage of the `TemporaryFolder` implementation.

```
package de.vogella.junit.first;

import static org.junit.Assert.assertTrue;

import java.io.File;
import java.io.IOException;

import org.junit.Rule;
import org.junit.Test;
import org.junit.rules.TemporaryFolder;

public class RuleTester {

  @Rule
  public TemporaryFolder folder = new TemporaryFolder();

  @Test
  public void testUsingTempFolder() throws IOException {
    File createdFolder = folder.newFolder("newfolder");
    File createdFile = folder.newFile("myfilefile.txt");
    assertTrue(createdFile.exists());
  }
}
```

To write your own rule you need to implement the `TestRule` interface.

6. Mocking with EasyMock

Unit testing uses also mocking of objects. In this case the real object is replaced by a replacement which has a predefined behavior the test. There are several frameworks available for mocking. To learn more about mock frameworks please see **EasyMock Tutorial**

7. Thank you

Please help me to support this article:

Flattr this!	Donate

8. Questions and Discussion

Before posting questions, please see the **vogella FAQ**. If you have questions or find an error in this article please use the **www.vogella.com Google Group**. I have created a short list **how to create good questions** which might also help you.

9. Links and Literature

9.1. JUnit Resources

http://www.junit.org/ JUnit Homepage

9.2. vogella Resources

vogella Training Android and Eclipse Training from the vogella team

Android Tutorial Introduction to Android Programming

GWT Tutorial Program in Java and compile to JavaScript and HTML

Eclipse RCP Tutorial Create native applications in Java

JUnit Tutorial Test your application

Git Tutorial Put everything you have under distributed version control system