Unit tests with Mockito - Tutorial

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This tutorial explains testing with the Mockito framework for writing software tests.

1. Prerequisites

The following tutorial is based on an understanding of unit testing with the JUnit framework.

In case your are not familiar with JUnit please check the following JUnit Tutorial (http://www.vogella.com/tutorials/JUnit/article.html).

2. Testing with mock objects

2.1. Target and challenge of unit testing

A unit test should test functionality in isolation. Side effects from other classes or the system should be eliminated for a unit test, if possible.

This can be done via using test replacements (*test doubles*) for the real dependencies. Test doubles can be classified like the following:

- A *dummy object* is passed around but never used, i.e., its methods are never called. Such an object can for example be used to fill the parameter list of a method.
- *Fake* objects have working implementations, but are usually simplified. For example, they use an in memory database and not a real database.
- A *stub* class is an partial implementation for an interface or class with the purpose of using an instance of this stub class during testing. Stubs usually don't respond to anything outside what's programmed in for the test. Stubs may also record information about calls.
- A *mock object* is a dummy implementation for an interface or a class in which you define the output of certain method calls. Mock objects are configured to perform a certain behavior during a test. They typical record the interaction with the system and test can validate that.

Test doubles can be passed to other objects which are tested. Your tests can validate that the class reacts correctly during tests. For example, you can validate if certain methods on the mock object were called. This helps to ensure that you only test the class while running tests and that your tests are not affected by any side effects.

Mock objects typically require less code to configure and should therefore be preferred.

2.2. Mock object generation

You can create mock objects manually (via code) or use a mock framework to simulate these classes. Mock frameworks allow you to create mock objects at runtime and define their behavior.

The classical example for a mock object is a data provider. In production an implementation to connect to the real data source is used. But for testing a mock object simulates the data source and ensures that the test conditions are always the same.

These mock objects can be provided to the class which is tested. Therefore, the class to be tested should avoid any hard dependency on external data.

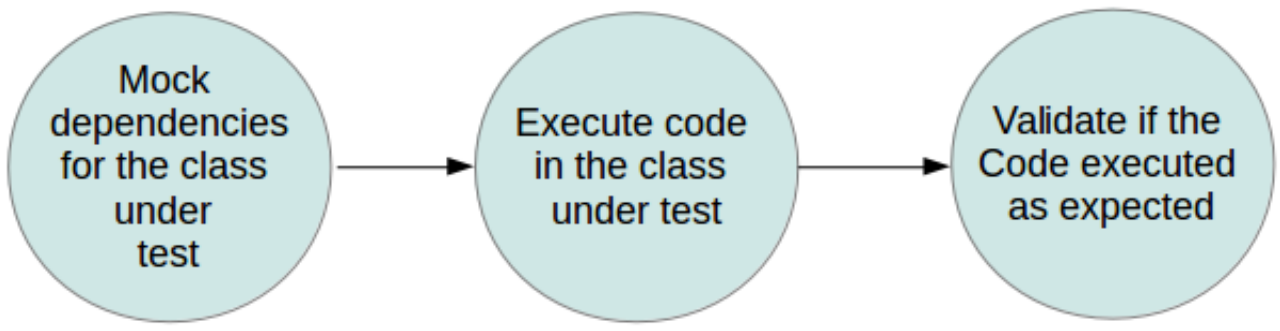
Mocking or mock frameworks allows testing the expected interaction with the mock object. You can, for example, validate that only certain methods have been called on the mock object.

2.3. Using Mockito for mocking objects

Mockito is a popular mock framework which can be used in conjunction with JUnit. Mockito allows you to create and configure mock objects. Using Mockito simplifies the development of tests for classes with external dependencies significantly.

If you use Mockito in tests you typically:

- Mock away external dependencies and insert the mocks into the code under test
- Execute the code under test
- Validate that the code executed correctly



3. Adding Mockito as dependencies to a project

3.1. Using Gradle for a Java project

If you use Gradle in a Java project, add the following dependency to the Gradle build file.

```groovy
repositories { jcenter() }
dependencies { testCompile 'org.mockito:mockito-core:2.7.22'
}
```

3.2. Using Gradle for an Android project

Add the following dependency to the Gradle build file:

```groovy
dependencies {
    // ... more entries
    testCompile 'junit:junit:4.12'

    // required if you want to use Mockito for unit tests
    testCompile 'org.mockito:mockito-core:2.7.22'
    // required if you want to use Mockito for Android tests
    androidTestCompile 'org.mockito:mockito-android:2.7.22'
}
```

3.3. Using Maven

Maven users can declare a dependency. Search for g:"org.mockito", a:"mockito-core" via the http://search.maven.org website to find the correct pom entry.

3.4. Using the Eclipse IDE

The Eclipse IDE supports the Gradle as well as the Maven build system. These build system allow to manage your software dependencies. Therefore, you are advised to use either the Gradle or Maven tooling in Eclipse.

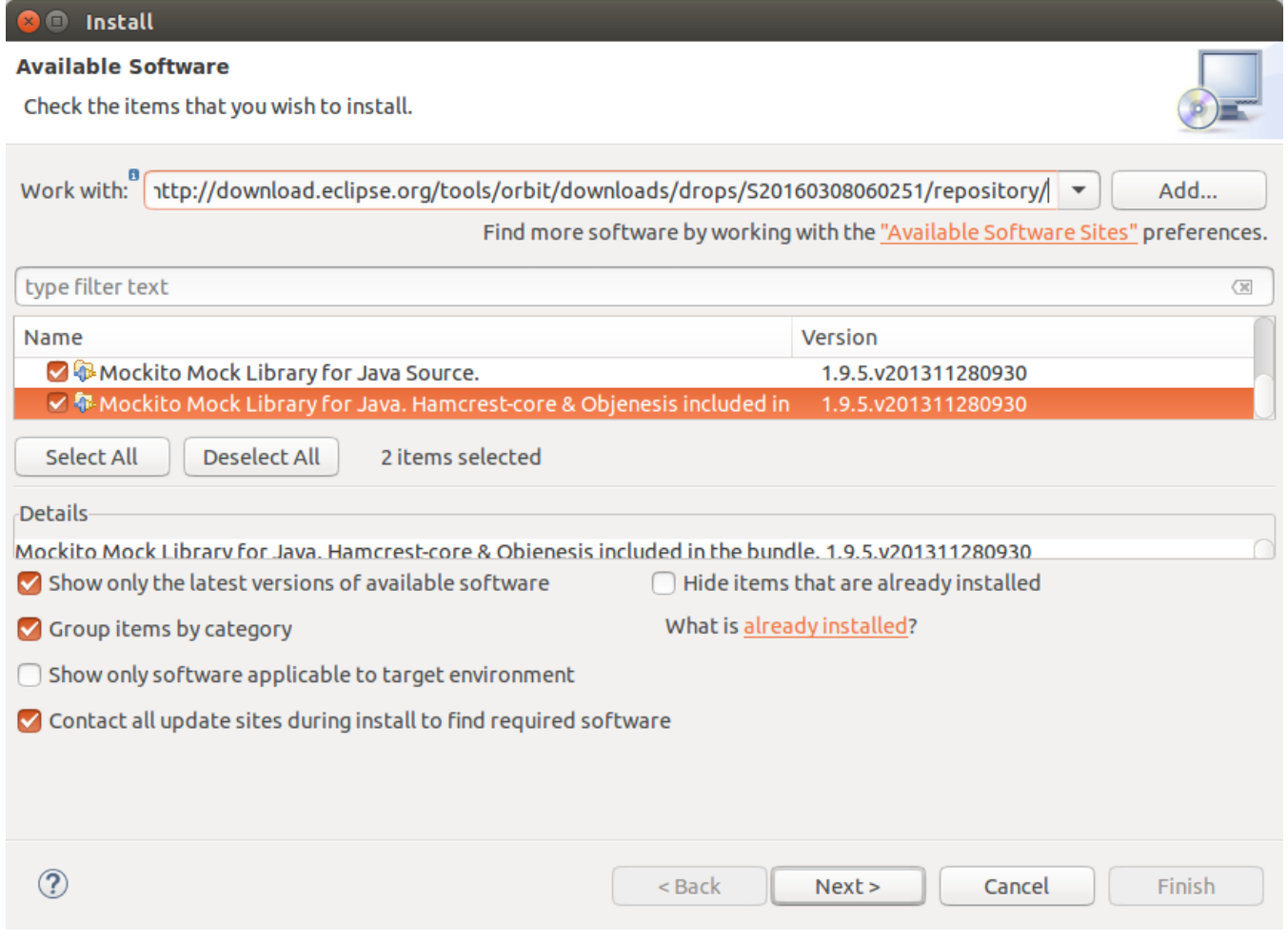
3.5. Using IntelliJ

If you are using IntelliJ, you should use either Gradle or Maven to manage your dependencies to Mockito.

3.6. OSGi or Eclipse plug-in development

In Eclipse RCP applications dependencies are usually obtained from p2 update sites. The Orbit repositories are a good source for third party libraries, which can be used in Eclipse based applications or plug-ins.

The Orbit repositories can be found here http://download.eclipse.org/tools/orbit/downloads



4. Using the Mockito API

4.1. Creating mock objects with Mockito

Mockito provides several methods to create mock objects:

- Using the static `mock()` method.
- Using the `@Mock` annotation.

If you use the `@Mock` annotation, you must trigger the creation of annotated objects. The `MockitoRule` allows this. It invokes the static method `MockitoAnnotations.initMocks(this)` to populate the annotated fields. Alternatively you can use `@RunWith(MockitoJUnitRunner.class)`.

The usage of the `@Mock` annotation and the `MockitoRule` rule is demonstrated by the following example.

```java
import static org.mockito.Mockito.*;

public class MockitoTest  {

    @Mock
    MyDatabase databaseMock;                                    (1)

    @Rule public MockitoRule mockitoRule =
MockitoJUnit.rule();                                            (2)

    @Test
    public void testQuery()  {
        ClassToTest t  = new ClassToTest(databaseMock);         (3)
        boolean check = t.query("* from t");                    (4)
        assertTrue(check);                                      (5)
        verify(databaseMock).query("* from t");                 (6)
    }
}
```

1. Tells Mockito to mock the databaseMock instance
2. Tells Mockito to create the mocks based on the @Mock annotation
3. Instantiates the class under test using the created mock
4. Executes some code of the class under test
5. Asserts that the method call returned true
6. Verify that the query method was called on the `MyDatabase` mock

Static imports

By adding the `org.mockito.Mockito.*;` static import, you can use methods like `mock()` directly in your tests. Static imports allow you to call static members, i.e., methods and fields of a class directly without specifying the class.

Using static imports greatly improves the readability of your test code, you should use it.

4.2. Configuring mocks

Mockito allows to configure the return values of its mocks via a fluent API. Unspecified method calls return "empty" values:

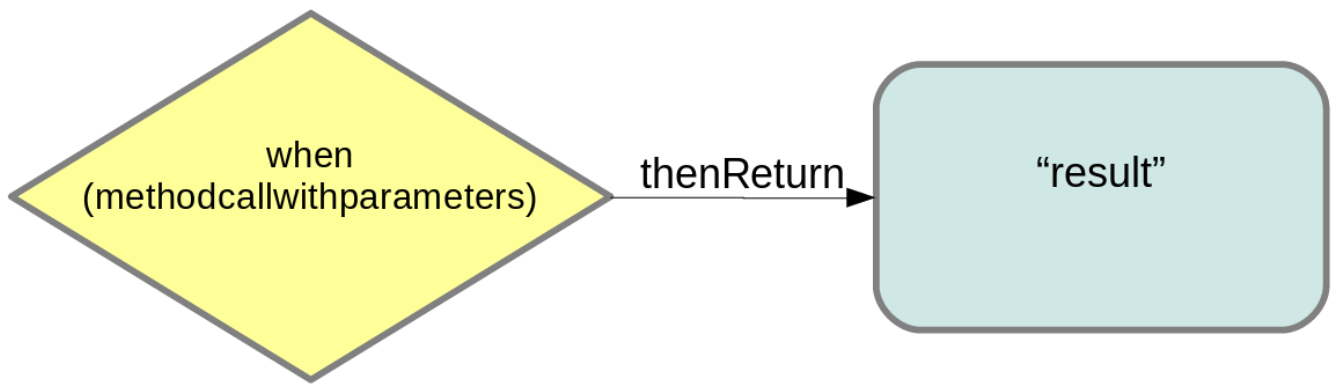
- null for objects
- 0 for numbers
- false for boolean
- empty collections for collections

- ...

The following assert statements are only for demonstration purposes, a real test would use the mocks to unit test another functionality.

4.2.1. "when thenReturn" and "when thenThrow

Mocks can return different values depending on arguments passed into a method. The `when(….).thenReturn(….)` method chain is used to specify a a return value for a method call with pre-defined parameters.



You also can use methods like `anyString` or `anyInt` to define that dependent on the input type a certain value should be returned.

If you specify more than one value, they are returned in the order of specification, until the last one is used. Afterwards the last specified value is returned.

The following demonstrates the usage of `when(….).thenReturn(….)`.

JAVA

```java
import static org.mockito.Mockito.*;
import static org.junit.Assert.*;

@Test
public void test1()  {
        //  create mock
        MyClass test = mock(MyClass.class);

        // define return value for method getUniqueId()
        when(test.getUniqueId()).thenReturn(43);

        // use mock in test....
        assertEquals(test.getUniqueId(), 43);
}


// demonstrates the return of multiple values
@Test
public void testMoreThanOneReturnValue()  {
        Iterator<String> i= mock(Iterator.class);
when(i.next()).thenReturn("Mockito").thenReturn("rocks");
        String result= i.next()+" "+i.next();
        //assert
        assertEquals("Mockito rocks", result);
}

// this test demonstrates how to return values based on the
input
@Test
public void testReturnValueDependentOnMethodParameter()  {
        Comparable<String> c= mock(Comparable.class);
        when(c.compareTo("Mockito")).thenReturn(1);
        when(c.compareTo("Eclipse")).thenReturn(2);
        //assert
        assertEquals(1, c.compareTo("Mockito"));
}

// this test demonstrates how to return values independent of
the input value

@Test
public void testReturnValueInDependentOnMethodParameter()
{
        Comparable<Integer> c= mock(Comparable.class);
        when(c.compareTo(anyInt())).thenReturn(-1);
        //assert
        assertEquals(-1, c.compareTo(9));
}

// return a value based on the type of the provide parameter

@Test
public void testReturnValueInDependentOnMethodParameter2()
{
        Comparable<Todo> c= mock(Comparable.class);
        when(c.compareTo(isA(Todo.class))).thenReturn(0);
        //assert
        assertEquals(0, c.compareTo(new Todo(1)));
}
```

The `when(….).thenReturn(….)` method chain can be used to throw an exception.

```java
Properties properties = mock(Properties.class);

when(properties.get("Anddroid")).thenThrow(new
IllegalArgumentException(...));

try {
    properties.get("Anddroid");
    fail("Anddroid is misspelled");
} catch (IllegalArgumentException ex) {
    // good!
}
```

4.2.2. "doReturn when" and "doThrow when"

The `doReturn(…).when(…).methodCall` call chain works similar to `when(….).thenReturn(….)`. It is useful for mocking methods which give an exception during a call, e.g., if you use use functionality like Wrapping Java objects with Spy.

```java
doReturnWhen.java
```

The `doThrow` variant can be used for methods which return `void` to throw an exception. This usage is demonstrated by the following code snippet.

```java
Properties properties = new Properties();

Properties spyProperties = spy(properties);

doReturn("42").when(spyProperties).get("shoeSize");

String value = spyProperties.get("shoeSize");

assertEquals("42", value);
```

4.3. Wrapping Java objects with Spy

@Spy or the `spy()` method can be used to wrap a real object. Every call, unless specified otherwise, is delegated to the object.

```java
import static org.mockito.Mockito.*;

@Test
public void testLinkedListSpyWrong() {
    // Lets mock a LinkedList
    List<String> list = new LinkedList<>();
    List<String> spy = spy(list);

    // this does not work
    // real method is called so spy.get(0)
    // throws IndexOutOfBoundsException (list is still empty)
    when(spy.get(0)).thenReturn("foo");

    assertEquals("foo", spy.get(0));
}

@Test
public void testLinkedListSpyCorrect() {
    // Lets mock a LinkedList
    List<String> list = new LinkedList<>();
    List<String> spy = spy(list);

    // You have to use doReturn() for stubbing
    doReturn("foo").when(spy).get(0);

    assertEquals("foo", spy.get(0));
}
```

4.4. Verify the calls on the mock objects

Mockito keeps track of all the method calls and their parameters to the mock object. You can use the `verify()` method on the mock object to verify that the specified conditions are met. For example, you can verify that a method has been called with certain parameters. This kind of testing is sometimes called *behavior testing*. Behavior testing does not check the result of a method call, but it checks that a method is called with the right parameters.

```java
import static org.mockito.Mockito.*;

@Test
public void testVerify()  {
    // create and configure mock
    MyClass test = Mockito.mock(MyClass.class);
    when(test.getUniqueId()).thenReturn(43);


    // call method testing on the mock with parameter 12
    test.testing(12);
    test.getUniqueId();
    test.getUniqueId();


    // now check if method testing was called with the
parameter 12
    verify(test).testing(ArgumentMatchers.eq(12));

    // was the method called twice?
    verify(test, times(2)).getUniqueId();

    // other alternatives for verifiying the number of method
calls for a method
    verify(test, never()).someMethod("never called");
    verify(test, atLeastOnce()).someMethod("called at least
once");
    verify(test, atLeast(2)).someMethod("called at least
twice");
    verify(test, times(5)).someMethod("called five times");
    verify(test, atMost(3)).someMethod("called at most 3
times");
    // This let's you check that no other methods where
called on this object.
    // You call it after you have verified the expected
method calls.
    verifyNoMoreInteractions(test);
}
```

In case you do not care about the value, use the `anyX`, e.g., `anyInt`, `anyString()`, or `any(YourClass.class)` methods.

4.5. Using @InjectMocks for dependency injection via Mockito

You also have the `@InjectMocks` annotation which tries to do constructor, method or field dependency injection based on the type. For example, assume that you have the following class.

```java
public class ArticleManager {
    private User user;
    private ArticleDatabase database;

    public ArticleManager(User user, ArticleDatabase
database) {
        super();
        this.user = user;
        this.database = database;
    }

    public void initialize() {
        database.addListener(new ArticleListener());
    }
}
```

This class can be constructed via Mockito and its dependencies can be fulfilled with mock objects as demonstrated by the following code snippet.

```java
@RunWith(MockitoJUnitRunner.class)
public class ArticleManagerTest  {

       @Mock ArticleCalculator calculator;
       @Mock ArticleDatabase database;
       @Mock User user;

       @Spy private UserProvider userProvider = new
ConsumerUserProvider();

       @InjectMocks private ArticleManager manager;

       @Test public void shouldDoSomething() {
           // calls addListener with an instance of
ArticleListener
           manager.initialize();

           // validate that addListener was called
verify(database).addListener(any(ArticleListener.class));
       }
}
```

(1) creates an instance of `ArticleManager` and injects the mocks into it

Mockito can inject mocks either via constructor injection, setter injection, or property injection and in this order. So if `ArticleManager` would have a constructor that would only take `User` and setters for both fields, only the mock for `User` would be injected.

4.6. Capturing the arguments

The `ArgumentCaptor` class allows to access the arguments of

method calls during the verification. This allows to capture these arguments of method calls and to use them for tests.

To run this example you need to add hamcrest-library (https://mvnrepository.com/artifact/org.hamcrest/hamcrest-library) to your project.

```java
import static org.hamcrest.Matchers.hasItem;
import static org.junit.Assert.assertThat;
import static org.mockito.Mockito.mock;
import static org.mockito.Mockito.verify;

import java.util.Arrays;
import java.util.List;

import org.junit.Rule;
import org.junit.Test;
import org.mockito.ArgumentCaptor;
import org.mockito.Captor;
import org.mockito.junit.MockitoJUnit;
import org.mockito.junit.MockitoRule;


public class MockitoTests {

    @Rule
    public MockitoRule rule = MockitoJUnit.rule();

    @Captor
    private ArgumentCaptor<List<String>> captor;


    @Test
    public final void shouldContainCertainListItem() {
        List<String> asList =
Arrays.asList("someElement_test", "someElement");
        final List<String> mockedList = mock(List.class);
        mockedList.addAll(asList);

        verify(mockedList).addAll(captor.capture());
        final List<String> capturedArgument =
captor.getValue();
        assertThat(capturedArgument, hasItem("someElement"));
    }
}
```

4.7. Using Answers for complex mocks

It is possible to define a `Answer` object for complex results. While `thenReturn` returns a predefined value every time, with answers you can calculate a response based on the arguments given to your stubbed method. This can be useful if your stubbed method is supposed to call a function on one of the arguments or if your

method is supposed to return the first argument to allow method chaining. There exists a static method for the latter. Also note that there a different ways to configure an answer:

```java
import static org.mockito.AdditionalAnswers.returnsFirstArg;

@Test
public final void answerTest() {
    // with doAnswer():
    doAnswer(returnsFirstArg()).when(list).add(anyString());
    // with thenAnswer():

when(list.add(anyString())).thenAnswer(returnsFirstArg());
    // with then() alias:
    when(list.add(anyString())).then(returnsFirstArg());
}
```

Or if you need to do a callback on your argument:

```java
@Test
public final void callbackTest() {
    ApiService service = mock(ApiService.class);
    when(service.login(any(Callback.class))).thenAnswer(i ->
{
        Callback callback = i.getArgument(0);
        callback.notify("Success");
        return null;
    });
}
```

It is even possible to mock a persistence service like an DAO, but you should consider creating a fake class instead of a mock if your Answers become too complex.

```java
List<User> userMap = new ArrayList<>();
UserDao dao = mock(UserDao.class);
when(dao.save(any(User.class))).thenAnswer(i -> {
    User user = i.getArgument(0);
    userMap.add(user.getId(), user);
    return null;
});
when(dao.find(any(Integer.class))).thenAnswer(i -> {
    int id = i.getArgument(0);
    return userMap.get(id);
});
```

4.8. Mocking final classes

Since Mockito v2 it is possible to mock final classes. This feature is incubating and is deactivated by default. To activate the mocking of final classes create the file `org.mockito.plugins.MockMaker`

in either `src/test/resources/mockito-extensions/` or `src/mockito-extensions/`. Add this line to the file: *mock-maker-inline*. With this modification we now can mock a final class.

```java
final class FinalClass {
    public final String finalMethod() { return
"something"; }
}

@Test
public final void mockFinalClassTest() {
     FinalClass instance = new FinalClass();

     FinalClass mock = mock(FinalClass.class);
     when(mock.finalMethod()).thenReturn("that other thing");

     assertNotEquals(mock.finalMethod(),
instance.finalMethod());
}
```

4.9. Clean test code with the help of the strict stubs rule

The strict stubs rule helps you to keep your test code clean and checks for common oversights. It adds the following:

- test fails early when a stubbed method gets called with different arguments than what it was configured for (with `PotentialStubbingProblem` exception).
- test fails when a stubbed method isn't called (with `UnnecessaryStubbingException` exception).
- org.mockito.Mockito.verifyNoMoreInteractions(Object) also verifies that all stubbed methods have been called during the test

```java
@Test
public void withoutStrictStubsTest() throws Exception {
    DeepThought deepThought = mock(DeepThought.class);

    when(deepThought.getAnswerFor("Ultimate Question of Life,
The Universe, and Everything")).thenReturn(42);
    when(deepThought.otherMethod("some mundane
thing")).thenReturn(null);

    System.out.println(deepThought.getAnswerFor("Six by
nine"));

    assertEquals(42, deepThought.getAnswerFor("Ultimate
Question of Life, The Universe, and Everything"));
    verify(deepThought, times(1)).getAnswerFor("Ultimate
Question of Life, The Universe, and Everything");
}
```

```java
// activate the strict subs rule
@Rule public MockitoRule rule =
MockitoJUnit.rule().strictness(Strictness.STRICT_STUBS);

@Test
public void withStrictStubsTest() throws Exception {
    DeepThought deepThought = mock(DeepThought.class);

    when(deepThought.getAnswerFor("Ultimate Question of Life,
The Universe, and Everything")).thenReturn(42);
    // this fails now with an UnnecessaryStubbingException
since it is never called in the test
    when(deepThought.otherMethod("some mundane
thing")).thenReturn(null);

    // this will now throw a PotentialStubbingProblem
Exception since we usually don't want to call methods on
mocks without configured behavior
    deepThought.someMethod();

    assertEquals(42, deepThought.getAnswerFor("Ultimate
Question of Life, The Universe, and Everything"));
    // verifyNoMoreInteractions now automatically verifies
that all stubbed methods have been called as well
    verifyNoMoreInteractions(deepThought);
}
```

4.10. Limitations

Mockito has certain limitations. For example, you cannot mock static methods and private methods (https://github.com/mockito/mockito/wiki/Mockito-And-Private-Methods).

See FAQ for Mockito limitations for the details (https://github.com/mockito/mockito/wiki/FAQ#what-are-the-limitations-of-mockito)

4.11. Behavior testing vrs. state testing

Mockito puts a focus on behavior testing, vrs. result testing. This is not always correct, for example, if you are testing a sort algorithm, you should test the result not the internal behavior.

```java
// state testing
testSort() {
    testList = [1, 7, 3, 8, 2]
    MySorter.sort(testList)

    assert testList equals [1, 2, 3, 7, 8]
}


// incorrect would be behavior testing
// the following tests internal of the implementation
testSort() {
    testList = [1, 7, 3, 8, 2]
    MySorter.sort(testList)

    assert that compare(1, 2) was called once
    assert that compare(1, 3) was not called
    assert that compare(2, 3) was called once
    ....
}
```


5. Exercise: Write an instrumented unit test using Mockito

5.1. Create Application under tests on Android

Create an Android application with the package name `com.vogella.android.testing.mockito.contextmock`. Add a `Util` class with a static method which allows to create an intent with certain parameters as in the following example.

```java
package com.vogella.android.testing.mockito.contextmock;

import android.content.Context;
import android.content.Intent;

public class Util {

    public static Intent createQuery(Context context,
String query, String value) {
        // Reuse MainActivity for simplification
        Intent i = new Intent(context, MainActivity.class);
        i.putExtra("QUERY", query);
        i.putExtra("VALUE", value);
        return i;
    }
}
```

5.2. Add the Mockito dependency to the app/build.gradle file

```groovy
dependencies {
    // ... more entries
    testCompile 'junit:junit:4.12'

    // required if you want to use Mockito for unit tests
    testCompile 'org.mockito:mockito-core:2.7.22'
    // required if you want to use Mockito for Android tests
    androidTestCompile 'org.mockito:mockito-android:2.7.22'
}
```

5.3. Create test

Create a new unit test running on Android using Mockito in the `androidTest` folder. This test should check if the intent contains the correct extras. For this you mock the `Context` object with Mockito.

```java
package com.vogella.android.testing.mockito.contextmock;

import android.content.Context;
import android.content.Intent;
import android.os.Bundle;
import android.support.test.runner.AndroidJUnit4;

import org.junit.Test;
import org.junit.runner.RunWith;

import static org.junit.Assert.assertEquals;
import static org.junit.Assert.assertNotNull;
import static org.mockito.Mockito.mock;

@RunWith(AndroidJUnit4.class)
public class UtilTest2 {

    @Test
    public void shouldContainTheCorrectExtras()  throws
Exception {
        Context context = mock(Context.class);
        Intent intent = Util.createQuery(context, "query",
"value");
        assertNotNull(intent);
        Bundle extras = intent.getExtras();
        assertNotNull(extras);
        assertEquals("query", extras.getString("QUERY"));
        assertEquals("value", extras.getString("VALUE"));
    }
}
```

6. Exercise: Creating mock objects using Mockito

6.1. Target

Create an API, which can be mocked and use Mockito to do the job.

6.2. Create a sample Twitter API

Implement a `TwitterClient`, which works with `ITweet` instances. But imagine these `ITweet` instances are pretty cumbersome to get, e.g., by using a complex service, which would have to be started.

```java
public interface ITweet {

    String getMessage();
}
```

```java
public class TwitterClient {

    public void sendTweet(ITweet tweet) {
        String message = tweet.getMessage();

        // send the message to Twitter
    }
}
```

6.3. Mocking ITweet instances

In order to avoid starting up a complex service to get `ITweet` instances, they can also be mocked by Mockito.

```java
@Test
public void testSendingTweet() {
    TwitterClient twitterClient = new TwitterClient();

    ITweet iTweet = mock(ITweet.class);

    when(iTweet.getMessage()).thenReturn("Using mockito is
great");

    twitterClient.sendTweet(iTweet);
}
```

Now the `TwitterClient` can make use of a mocked `ITweet` instance and will get "Using Mockito is great" as message when calling `getMessage()` on the mocked `ITweet`.

6.4. Verify method invocation

Ensure that getMessage() is at least called once.

```java
@Test
public void testSendingTweet() {
    TwitterClient twitterClient = new TwitterClient();

    ITweet iTweet = mock(ITweet.class);

    when(iTweet.getMessage()).thenReturn("Using mockito is
great");

    twitterClient.sendTweet(iTweet);

    verify(iTweet, atLeastOnce()).getMessage();
}
```

6.5. Validate

Run the test and validate that it is successful.

7. Using PowerMock with Mockito

7.1. Powermock for mocking static methods

Mockito cannot mock static methods. For this you can use `Powermock`. PowerMock provides a class called "PowerMockito" for creating mock/object/class and initiating verification, and expectations, everything else you can still use Mockito to setup and verify expectation (e.g. times(), anyInt()).

```java
import java.net.InetAddress;
import java.net.UnknownHostException;

public final class NetworkReader {
    public static String getLocalHostname() {
        String hostname = "";
        try {
            InetAddress addr = InetAddress.getLocalHost();
            // Get hostname
            hostname = addr.getHostName();
        } catch ( UnknownHostException e ) {
        }
        return hostname;
    }
}
```

To write a test which mocks away the NetworkReader as dependency you can use the following snippet.

```java
import org.junit.runner.RunWith;
import
org.powermock.core.classloader.annotations.PrepareForTest;

@RunWith( PowerMockRunner.class )
@PrepareForTest( NetworkReader.class )
public class MyTest {

// Find the tests here

 @Test
public void testSomething() {
    mockStatic( NetworkUtil.class );
    when( NetworkReader.getLocalHostname() ).andReturn(
"localhost" );

    // now test the class which uses NetworkReader
}
```

8. Using a wrapper instead of Powermock

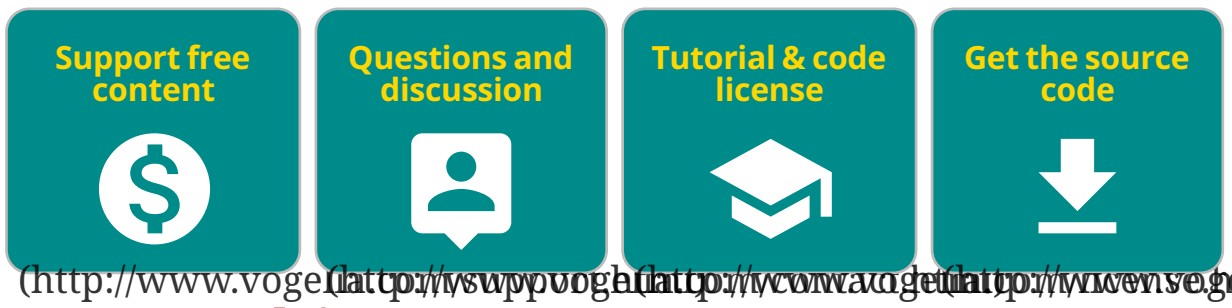
Sometimes you can also use a wrapper around a static method, which can be mocked with Mockito.

```java
class FooWraper {
   void someMethod() {
     Foo.someStaticMethod()
   }
}
```

8.1. Learn more about Powermock

See Using PowerMock with Mockito (https://github.com/jayway/powermock/wiki/MockitoUsage) for more information

9. About this website



(http://www.vogella.com/code/index.html)

10. Mockito resources

Mockito home page (http://site.mockito.org)

Dzone reference card (https://dzone.com/refcardz/mockito)

Mockito project hosting page (https://github.com/mockito/mockito)

Mockito release notes (https://github.com/mockito/mockito/blob/master/doc/release-notes/official.md)

Martin Fowler about Mocks, Stubs etc. (http://martinfowler.com/articles/mocksArentStubs.html)

Chiu-Ki Chan Advanced Android Espresso presentation (http://chiuki.github.io/advanced-android-espresso/)

10.1. vogella GmbH training and consulting support

TRAINING (http://www.vogella.com/training/)	**SERVICE & SUPPORT (http://www.vogella.com/consulting/)**
The vogella company provides comprehensive training and education services	The vogella company offers expert consulting (http://www.vogella.com/consulting/) services, development

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from experts in the areas of Eclipse RCP, Android, Git, Java, Gradle and Spring. We offer both public and inhouse training. Whichever course you decide to take, you are guaranteed to experience what many before you refer to as "The best IT class I have ever attended" (http://www.vogella.com/training/).

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Appendix A: Copyright and License

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