JUnit 5

TUTORIAL

Small Codes

Programming Simplified

A SmlCodes.Com Small presentation

In Association with Idleposts.com

For more tutorials & Articles visit SmlCodes.com

Small Codes Programming Simplified

JUnit Tutorial

If you discover any errors on our website or in this tutorial, please notify us at support@smlcodes.com or smlcodes@gmail.com

First published on JAN 2016, Published by **SmlCodes.com**

Author Credits

Name : **Satya Kaveti**

Email : satyakaveti@gmail.com

Website : smlcodes.com, satyajohnny.blogspot.com

Digital Partners

1. Introduction

Testing is the process of checking the functionality of an application to ensure it runs as per requirements. **Unit testing** comes into picture at the developers' level; it is the testing of single entity **(class or method).** Unit testing can be done in two ways –**manual testing & automated testing**

1. Manual Testing: If you execute the test cases manually without any tool support, it is known as manual testing. It is time consuming and less reliable.

2. Automated Testing: If you execute the test cases by tool support, it is known as automated testing. It is fast and more reliable.

XUnit architecture **introduced automated unit testing**. There are many unit testing frame works for different programming. Few of the unit testing frame works are:

- JAVA - **JUnit**,
- C - **CUnit**,
- C++ - **CPPUnit**,
- .NET - .**NUnit** etc..

XUnit architecture was first implemented for java.**It is known as JUnit**

JUnit

It is an open-source testing framework for java programmers. The java programmer can create test cases and test his/her own code.It is one of the unit testing framework. Current version is **junit 4**.you can download it from **JUnit website (github)** or use below maven dependency in your **pom.xml**

```
<dependency>
  <groupId>junit</groupId>
  <artifactId>junit</artifactId>
  <version>4.12</version>
  <scope>test</scope>
</dependency>
```

The Junit 4.x framework is annotation based. Here're some basic JUnit annotations

- **@Test -**Given method is the test method.= `public void`
- **@Test(timeout=1000)** -method will be failed if it takes more then 1000 milliseconds (1 sec).
- **@BeforeClass** - method will be invoked only once, before starting all the tests. `public static void`
- **@AfterClass** -method will be invoked only once, after finishing all the tests `public static void`
- **@Before** -method will be invoked before each test. Run before @Test, `public void`
- **@After** - method will be invoked after each test. Run after @Test, `public void`

The most important package in JUnit is **junit.framework**, which contains all the core classes. Some of the most important classes are given below

1.Assert - set of assert methods.

2.TestCase - test case defines the fixture to run multiple tests.

3.TestResult - TestResult collects the results of executing a test case.

4.TestSuite - TestSuite is a composite of tests.

Example 1 : Testing Annotations Working

```
package basic;
import org.junit.*;
public class AnnotationsTest {
        // Run once, e.g. Database connection, connection pool
    @BeforeClass
    public static void runOnceBeforeClass() {
        System.out.println("@BeforeClass - runOnceBeforeClass");
    }

    // Run once, e.g close connection, cleanup
    @AfterClass
    public static void runOnceAfterClass() {
        System.out.println("@AfterClass - runOnceAfterClass");
    }

    // Should rename to @BeforeTestMethod
    // e.g. Creating an similar object and share for all @Test
    @Before
    public void runBeforeTestMethod() {
        System.out.println("@Before - runBeforeTestMethod");
    }

    // Should rename to @AfterTestMethod
    @After
    public void runAfterTestMethod() {
        System.out.println("@After - runAfterTestMethod");
    }

    @Test
    public void TestMethod1() {
        System.out.println("@Test - TestMethod1");
    }

    @Test
    public void TestMethod2() {
        System.out.println("@Test - TestMethod2");
    }
}
```

```
@BeforeClass – runOnceBeforeClass

@Before - runBeforeTestMethod
@Test - TestMethod1
@After – runAfterTestMethod

@Before - runBeforeTestMethod
@Test - TestMethod2
@After – runAfterTestMethod

@AfterClass - runOnceAfterClass
```

Note: All sources of production code commonly reside in the `src/main/java` directory, while all test source files are kept at `src/test/java`

2. JUnit Hello World!

To write testcases we must figute out below points

1. ***Class to be tested***
2. ***Write Testcases for selected class***
3. ***Run the Test (Commandline / TestRunner class)***

1. Class to be tested

```
package junit;
public class Calculator {
public int square(int x){
        return x*x;
}
}
```

2. Write Testcases for selected class

```
package junit;
import static org.junit.Assert.*;
import org.junit.Test;
public class CalculatorTest {
        @Test
          public void squareTest() {
            Calculator calculator = new Calculator();
            int sqr = calculator.square(2);
            //Checking for 2
            assertEquals("2*2=4 Passed",4, sqr);//pass
            assertEquals("2*2=4 Passed",6, sqr); //Fail
          }
}
```

3. Run the Test (Commandline / TestRunner class)

Using command line

```
java -cp .;junit-4.XX.jar;hamcrest-core-1.3.jar org.junit.runner.JUnitCore CalculatorTest
```

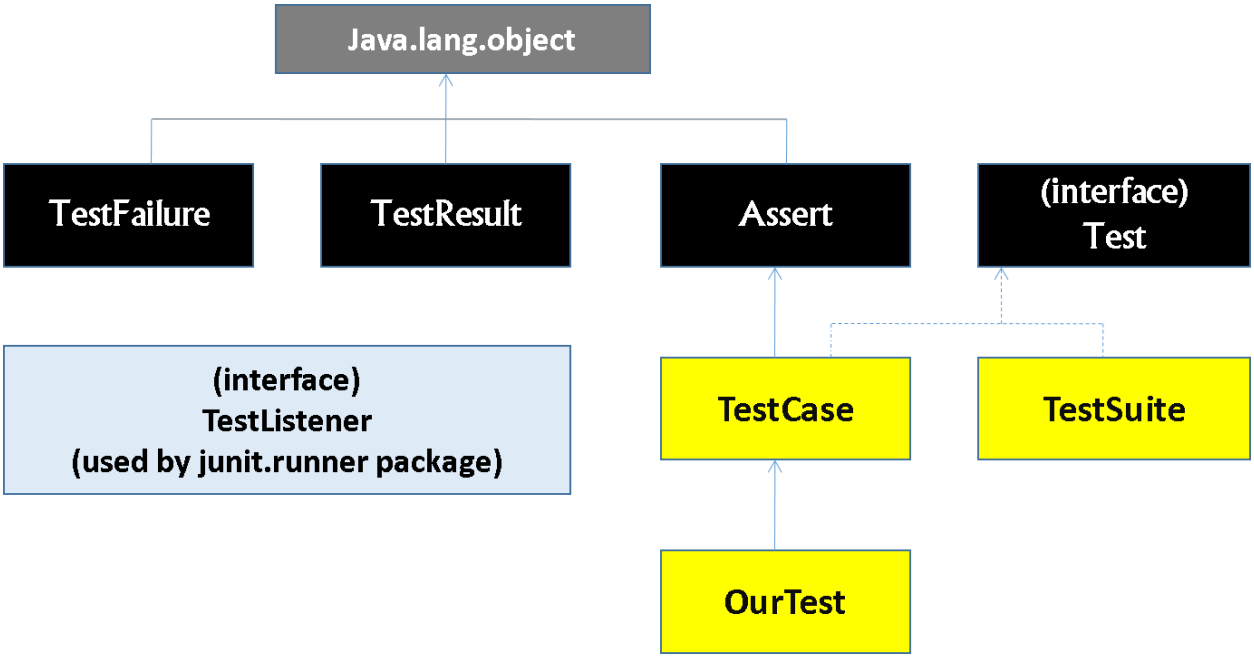
Using TestRunner class

```
package junit;
import org.junit.runner.*;
public class TestRunner {
        public static void main(String[] args) {
                Result result = JUnitCore.runClasses(CalculatorTest.class);

                for (Failure failure : result.getFailures()) {
                        System.out.println("Failure : " + failure.toString());
                }
                System.out.println("Success : " + result.wasSuccessful());
        }
}
```

```
Failure : squareTest(junit.CalculatorTest): 2*2=4 Passed expected:<6> but
was:<4>
Success : false  //for assertEquals("2*2=4 Passed",6, sqr); //Fail

Success : true //for assertEquals("2*2=4 Passed",4, sqr);//pass
```

3. JUnit API

This class provides a set of assertion methods useful for writing tests. Only failed assertions are recorded. You need to load **junit4.jar** and **hamcrest-core.jar** files



3.1 Assert Class

The org.junit.Assert class provides methods to assert the program logic. Assert methods are usually used to **compare the actual value with the expected value**. All assert methods are static methods.Return type of all assert methods are void

1. **void assertEquals(boolean expected,boolean actual)**: checks that two primitives/objects are equal. It is overloaded.
2. **void assertTrue(boolean condition)**: checks that a condition is true.
3. **void assertFalse(boolean condition)**: checks that a condition is false.
4. **void assertNull(Object obj)**: checks that object is null.
5. **void assertNotNull(Object obj)**: checks that object is not null.

3.2 TestCase

To define a Test case class it should be a subclass of TestCase. TestCase defines the fixture to run multiple tests. It is meant for defining test cases

```
public class DemoTest extends TestCase {
    //declaration of instance variables
    // Test Case Methods
    public void testAdd() {
       AddClass st = new AddClass();
       int x = st.add(10,20);
       assertEquals(30,x);   //30 is Expected value, x is actual value
} // end of class
```

3.3 TestSuite

A TestSuite is a composite of Tests. TestSuite runs a collection of test cases

```
TestSuite t = new TestSuite();
t.addTest(new DemoTest("testSub"));
t.addTest(new DemoTest("testDivide"));
```

In above example, creating an instance of **TestSuite** Class.Invoking **addTest() method** twice with 2 anonymous instant Objects of DemoTest Class

JUnit supports test hierarchies

- Test Suite-A
  - Test Case1
  - Test Case2
  - Test Suite-B
    - Test Case3
- Test Suite-C(and so on …)

3.4 TestResult

The results of executing a test case are collected by an Object of TestResult.It differentiates between failures and errors.A failure is expected and checked for with assertions.Errors are unexpected problems like an **ArrayIndexOutOfBoundsException, ClassNotFoundException etc**

3.5 TestRunner

TestRunner is a pre-defined class in JUnit package.It is meant for running either **TestCase or TestSuite**.It is a subclass of Base TestRunner and implements TestListener interface.TestRunner class of junit.swingui. Package implements TestRunContext. Below are the types of test runners

Type	Syntax
Text based	Java junit.textui.TestRunner TestCaseClassName / TestSuiteName
Swing based	Java junit.swingui.TestRunner TestCaseClassName / TestSuiteName
Ant	ant

4. JUnit Examples

4.1 Assert all Methods Example

```
import static org.hamcrest.CoreMatchers.*;
import static org.junit.Assert.*;
import java.util.Arrays;
import org.hamcrest.core.CombinableMatcher;
import org.junit.Test;

public class AssertTests {
  @Test
  public void testAssertArrayEquals() {
    byte[] expected = "trial".getBytes();
    byte[] actual = "trial".getBytes();
    assertArrayEquals("failure - byte arrays not same", expected, actual);
  }

  @Test  public void testAssertEquals() {
    assertEquals("failure - strings are not equal", "text", "text");
  }

  @Test  public void testAssertFalse() {
    assertFalse("failure - should be false", false);
  }

  @Test  public void testAssertNotNull() {
    assertNotNull("should not be null", new Object());
  }

  @Test  public void testAssertNotSame() {
    assertNotSame("should not be same Object", new Object(), new Object());
  }

  @Test  public void testAssertNull() {
    assertNull("should be null", null);
  }

  @Test  public void testAssertSame() {
    Integer aNumber = Integer.valueOf(768);
    assertSame("should be same", aNumber, aNumber);
  }

  // JUnit Matchers assertThat
  @Test  public void testAssertThatBothContainsString() {
    assertThat("albumen", both(containsString("a")).and(containsString("b")));
  }

  @Test  public void testAssertThatHasItems() {
    assertThat(Arrays.asList("one", "two", "three"), hasItems("one", "three"));
  }

  @Test  public void testAssertThatEveryItemContainsString() {
    assertThat(Arrays.asList(new String[] { "fun", "ban", "net" }), everyItem(containsString("n")));
  }

  // Core Hamcrest Matchers with assertThat
  @Test  public void testAssertThatHamcrestCoreMatchers() {
    assertThat("good", allOf(equalTo("good"), startsWith("good")));
    assertThat("good", not(allOf(equalTo("bad"), equalTo("good"))));
    assertThat("good", anyOf(equalTo("bad"), equalTo("good")));
    assertThat(7, not(CombinableMatcher.<Integer> either(equalTo(3)).or(equalTo(4))));
    assertThat(new Object(), not(sameInstance(new Object())));
  }

  @Test  public void testAssertTrue() {
    assertTrue("failure - should be true", true);
  }
}
```

4.2 Test Suite

Test suite is used to bundle a few unit test cases and run them together. **@RunWith and @Suite** annotations are used to run the suite tests.

In below Example we are running Test1 & Test2 together using Test Suite.

1. Class to be tested

```
package testsuite;

public class Calculator {
        public int square(int x) {
                return x * x;
        }

        public int sum(int x, int y) {
                return x + y;
        }
}
```

2. Write Testcases for selected class

```
//1.Test1.java
package testsuite;

import static org.junit.Assert.assertEquals;
import org.junit.Test;

public class Test1 {
        @Test
          public void squareTest() {
            Calculator calculator = new Calculator();
            int sqr = calculator.square(2);
            assertEquals("2*2=4 Passed",4, sqr);
          }
}
-----------------------------------------------------------------------------------------------------------
//2.Test2.java
package testsuite;

import static org.junit.Assert.assertEquals;
import org.junit.Test;

public class Test2 {
        @Test
          public void addTest() {
            Calculator calculator = new Calculator();
            int sum = calculator.sum(8,2);
            assertEquals("8+2=10 Passed",10, sum);
          }
}
```

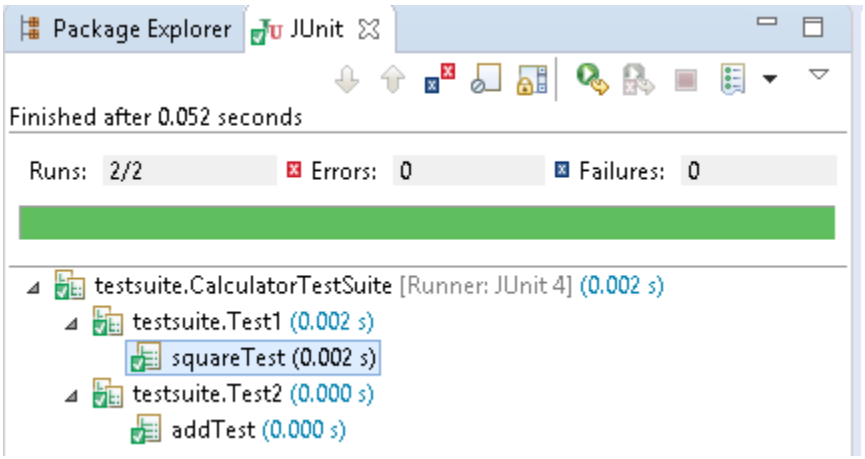
3.Create Test Suite Class

```
package testsuite;
import org.junit.runner.RunWith;
import org.junit.runners.Suite;

@RunWith(Suite.class)
@Suite.SuiteClasses({
   Test1.class,
   Test2.class
})
public class CalculatorTestSuite {
}
```

4. Run the Test (Commandline / TestRunner class)

Remember, TestRunner class is same for all Examples

```
package testsuite;

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

public class TestRunner {
        public static void main(String[] args) {
                Result result = JUnitCore.runClasses(CalculatorTestSuite.class);

                for (Failure failure : result.getFailures()) {
                        System.out.println("Failure : " + failure.toString());
                }
                System.out.println("Success : " + result.wasSuccessful());
        }
}
```



4.3 Ignore Test

@Ignore annotation is used to create Ignore test. We use @ignore in two cases

1. **At Method Level** : if a method annotated with @Ignore, **that method will not be executed.**
2. **At Class Level Level** : if a class annotated with @Ignore**, all its methods will not be executed.**

1. Class to be tested

```
package ignoretest;
public class IgnoreTestClassLevel {
        private String str1;
        private String str2;
        private String str3;

        public IgnoreTestClassLevel(String str1, String str2) {
                this.str1 = str1;
                this.str2 = str2;
        }

        public String addStrings() {
                str3 = str1 + str2;
                System.out.println("addStrings : " + str3);
                return str1 + str2;
```

```
        }

        public String upperCase() {
                str3 = (str1 + str2).toUpperCase();
                System.out.println("upperCase : " + str3);
                return str1 + str2;
        }
}
```

2. Ignore Test at Method Level

```
package ignoretest;
import org.junit.Test;
import org.junit.Ignore;
import static org.junit.Assert.assertEquals;

public class IgnoreTestMethodLevel {
        StringUtil util = new StringUtil("a", "b");
        String res = "";

        @Ignore
        @Test
        public void testAddStrings() {
                System.out.println("Inside testAddStrings()");
                res = "ab";
                assertEquals(res, util.addStrings());
        }

        @Test
        public void testUpperCase() {
                System.out.println("Inside testUpperCase()");
                res = "AB";
                assertEquals(res, util.upperCase());
        }
}
```

```
Inside testUpperCase()
upperCase : AB
Success : true
```

3. Ignore Test at Class Level

```
package ignoretest;
import org.junit.Test;
import org.junit.Ignore;
import static org.junit.Assert.assertEquals;

@Ignore
public class IgnoreTestClassLevel {
        StringUtil util = new StringUtil("a", "b");
        String res = "";

        @Test
        public void testAddStrings() {
                System.out.println("Inside testAddStrings()");
                res = "ab";
                assertEquals(res, util.addStrings());
        }

        @Test
        public void testUpperCase() {
                System.out.println("Inside testUpperCase()");
                res = "AB";
                assertEquals(res, util.upperCase());
        }
}
```

Empty Output, because none of its test methods will be executed.

4.4 Time Test

`@Test(timeout)-` timeout parameter along with @Test annotation as used for Time Test.If a test case takes more time than the specified number of milliseconds, then JUnit will automatically mark it as failed.

Example: Time Test example for above StringUtil.java Class

```
package ignoretest;
import org.junit.Test;
import org.junit.Ignore;
import static org.junit.Assert.assertEquals;

public class StringUtilTimeTest {
        StringUtil util = new StringUtil("a", "b");
        String res = "";

        @Test(timeout = 1000)
        public void testAddStrings() {
                System.out.println("Inside testAddStrings()");
                res = "ab";
                assertEquals(res, util.addStrings());
        }

        @Test
        public void testUpperCase() {
                System.out.println("Inside testUpperCase()");
                res = "AB";
                assertEquals(res, util.upperCase());
        }
}
```

4.5 Exceptions Test

`@Test(expected)-` expected parameter along with @Test annotation as used for Exceptions Test. we can test whether our code throws a expected exception or not

Example: ExceptionsTest

```
package junit;

public class Calculator {
        public int square(int x) {
                return x * x;
        }
        public int div(int a, int b) {
                return a / b;
        }
}
```

```
package junit;
import static org.junit.Assert.*;
import org.junit.Test;

public class CaluculatorExceptionTest {
         @Test(expected = ArithmeticException.class)
          public void divTest() {
            Calculator calculator = new Calculator();
            int res = calculator.div(12,0);      //success
           // int res = calculator.div(12,0);    //error
            assertEquals(4, res);
        }
}
```

4.6 Parameterized Test

Parameterized tests allow a developer to run the same test over and over again using different values.we use **`@RunWith(Parameterized.class)`** to achive this type of tests.

Example

```
public class EvenNumbers {
        public Boolean checkEven(final Integer num) {

                for (int i = 1; i <= num; i++) {
                        if (i % 2 == 0) {
                                return true;
                        }
                }
                return false;
        }
}
```

```
package parameterizedtest;

import java.util.*;
import org.junit.*;
import static org.junit.Assert.assertEquals;

@RunWith(Parameterized.class)
public class PrimeNumberCheckerTest {
   private Integer inum;
   private Boolean res;
   private EvenNumbers evenObj;

   @Before
   public void initialize() {
      evenObj = new EvenNumbers();
   }


   public PrimeNumberCheckerTest(Integer inum, Boolean res) {
      this.inum = inum;
      this.res = res;
   }

   @Parameterized.Parameters
   public static Collection evenNumbers() {
      return Arrays.asList(new Object[][] {
         { 2, true },
         { 6, true },
         { 18, true },
         { 19, false },
         { 48, true }
      });
   }

   @Test
   public void testPrimeNumberChecker() {
      System.out.println("Parameterized Number is : " + inum);
      assertEquals(res, evenObj.checkEven(inum));
   }
}
```

```
Parameterized Number is : 2
Parameterized Number is : 6
Parameterized Number is : 18
Parameterized Number is : 19
Parameterized Number is : 48
```

4.7 JUnit List Example

```
package other;

import org.junit.Test;

import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;
import org.hamcrest.collection.IsEmptyCollection;
import static org.hamcrest.CoreMatchers.*;
import static org.hamcrest.collection.IsCollectionWithSize.hasSize;
import static org.hamcrest.collection.IsIterableContainingInAnyOrder.containsInAnyOrder;
import static org.hamcrest.collection.IsIterableContainingInOrder.contains;
import static org.hamcrest.number.OrderingComparison.greaterThanOrEqualTo;
import static org.hamcrest.number.OrderingComparison.lessThan;
import static org.hamcrest.MatcherAssert.assertThat;

public class ListExample{

    @Test
    public void testAssertList() {

        List<Integer> actual = Arrays.asList(1, 2, 3, 4, 5);
        List<Integer> expected = Arrays.asList(1, 2, 3, 4, 5);

        //All passed / true

        //1. Test equal.
        assertThat(actual, is(expected));

        //2. Check List has this value
        assertThat(actual, hasItems(2));

        //3. Check List Size
        assertThat(actual, hasSize(4));

        assertThat(actual.size(), is(5));

        //4.  List order

        // Ensure Correct order
        assertThat(actual, contains(1, 2, 3, 4, 5));

        // Can be any order
        assertThat(actual, containsInAnyOrder(5, 4, 3, 2, 1));

        //5. check empty list
        assertThat(actual, not(IsEmptyCollection.empty()));

        assertThat(new ArrayList<>(), IsEmptyCollection.empty());

                //6. Test numeric comparisons
        assertThat(actual, everyItem(greaterThanOrEqualTo(1)));

        assertThat(actual, everyItem(lessThan(10)));

    }


}
```

4.8 JUnit Map Example

```
public class MapExample {
        @Test
    public void testAssertMap() {

        Map<String, String> map = new HashMap<>();
        map.put("j", "java");
        map.put("c", "c++");
        map.put("p", "python");
        map.put("n", "node");

        Map<String, String> expected = new HashMap<>();
        expected.put("n", "node");
        expected.put("c", "c++");
        expected.put("j", "java");
        expected.put("p", "python");

        //All passed / true

        //1. Test equal, ignore order
        assertThat(map, is(expected));

        //2. Test size
        assertThat(map.size(), is(4));

        //3. Test map entry, best!
        assertThat(map, IsMapContaining.hasEntry("n", "node"));

        assertThat(map, not(IsMapContaining.hasEntry("r", "ruby")));

        //4. Test map key
        assertThat(map, IsMapContaining.hasKey("j"));

        //5. Test map value
        assertThat(map, IsMapContaining.hasValue("node"));

    }
}
```

4.9 JUnit Tools

Following are the JUnit Tools used for Testing –

1. Cactus
2. JWebUnit
3. XMLUnit
4. MockObject

References

http://junit.org/junit4/

https://www.tutorialspoint.com/junit/

http://www.javatpoint.com/junit-tutorial

http://www.mkyong.com/tutorials/junit-tutorials/