Topics to cover:

1. Unit testing

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Unit Testing

Unit testing involves the testing of each unit or an individual component of the software application. It is the first level of functional testing. The aim behind unit testing is to validate unit components with its performance.

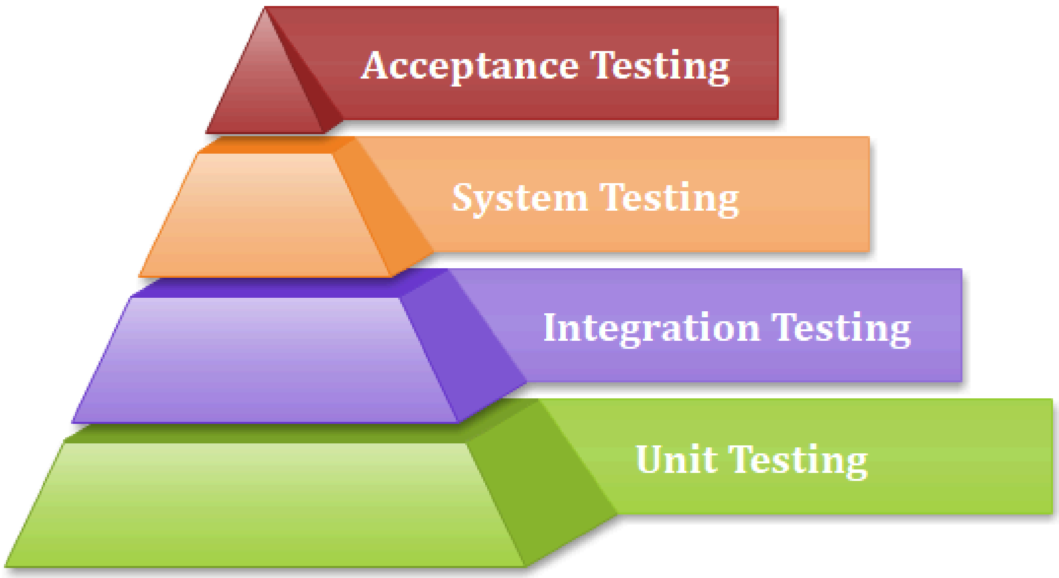
A unit is a single testable part of a software system and tested during the development phase of the application software.

The purpose of unit testing is to test the correctness of isolated code. A unit component is an individual function or code of the application. White box testing approach used for unit testing and usually done by the developers.

Whenever the application is ready and given to the Test engineer, he/she will start checking every component of the module or module of the application independently or one by one, and this process is known as **Unit testing** or **components testing**.

Why Unit Testing?

In a testing level hierarchy, unit testing is the first level of testing done before integration and other remaining levels of the testing. It uses modules for the testing process which reduces the dependency of waiting for Unit testing frameworks, stubs, drivers and mock objects are used for assistance in unit testing.



Generally, **the** software goes under four level of testing: Unit Testing, Integration Testing, System Testing, and Acceptance Testing but sometimes due to time consumption software testers does minimal unit testing but skipping of unit testing may lead to higher defects during Integration Testing, System Testing, and Acceptance Testing or even during Beta Testing which takes place after the completion of software application.

Some crucial reasons are listed below:

- Unit testing helps tester and developers to understand the base of code that makes them able to change defect causing code quickly.
- Unit testing helps in the documentation.
- Unit testing fixes defects very early in the development phase that's why there is a possibility to occur a smaller number of defects in upcoming testing levels.
- It helps with code reusability by migrating code and test cases.

Unit Testing Tools

We have various types of unit testing tools available in the market, which are as follows:

- NUnit
- JUnit
- PHPunit
- Parasoft Jtest
- EMMA

For more information about Unit testing tools, refers to the below link:

https://www.javatpoint.com/unit-testing-tools

How to achieve the best result via Unit testing?

Unit testing can give best results without getting confused and increase complexity by following the steps listed below:

- Test cases must be independent because if there is any change or enhancement in requirement, the test cases will not be affected.
- Naming conventions for unit test cases must be clear and consistent.
- During unit testing, the identified bugs must be fixed before jump on next phase of the SDLC.
- Only one code should be tested at one time.
- Adopt test cases with the writing of the code, if not doing so, the number of execution paths will be increased.
- If there are changes in the code of any module, ensure the corresponding unit test is available or not for that module.

Advantages and disadvantages of unit testing

The pros and cons of unit testing are as follows:

Advantages

- Unit testing uses module approach due to that any part can be tested without waiting for completion of another parts testing.
- The developing team focuses on the provided functionality of the unit and how functionality should look in unit test suits to understand the unit API.
- Unit testing allows the developer to refactor code after a number of days and ensure the module still working without any defect.

Disadvantages

- It cannot identify integration or broad level error as it works on units of the code.
- In the unit testing, evaluation of all execution paths is not possible, so unit testing is not able to catch each and every error in a program.
- It is best suitable for conjunction with other testing activities.

Java Junit testing example:

Important links for setup:

https://stackoverflow.com/questions/8751553/how-to-write-a-unit-test

Program:

SquareUnit.java

```
public class SquareUnit {
        public int square(int n) {
                return n*n;
        }
        public int sum(int a, int b) {
                return a+b;
        }
}
```

JunitProject.java

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

        import org.junit.After;

        import org.junit.Before;

        import org.junit.Test;



public class SquareUnit {
        public int square(int n) {
                return n+n;
        }
}
```

```
public class JunitProject {

    @Test
    public void test_JUnit() {

        SquareUnit su = new SquareUnit();
        int result = su.square(5);
        assertEquals(25,result);

    }
}
```

Output:

```
java.lang.AssertionError: expected:<25> but was:<10>
	at org.junit.Assert.fail(Assert.java:89)
	at org.junit.Assert.failNotEquals(Assert.java:835)
	at org.junit.Assert.assertEquals(Assert.java:647)
	at org.junit.Assert.assertEquals(Assert.java:633)
	at JunitProject.test_JUnit(JunitProject.java:18)
	at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
	at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.java:77)
	at java.base/jdk.internal.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:43)
	at java.base/java.lang.reflect.Method.invoke(Method.java:568)
	at org.junit.runners.model.FrameworkMethod$1.runReflectiveCall(FrameworkMethod.java:59)
	at org.junit.internal.runners.model.ReflectiveCallable.run(ReflectiveCallable.java:12)
	at org.junit.runners.model.FrameworkMethod.invokeExplosively(FrameworkMethod.java:56)
	at org.junit.internal.runners.statements.InvokeMethod.evaluate(InvokeMethod.java:17)
	at org.junit.runners.ParentRunner$3.evaluate(ParentRunner.java:306)
	at org.junit.runners.BlockJUnit4ClassRunner$1.evaluate(BlockJUnit4ClassRunner.java:100)
	at org.junit.runners.ParentRunner.runLeaf(ParentRunner.java:366)
	at org.junit.runners.BlockJUnit4ClassRunner.runChild(BlockJUnit4ClassRunner.java:103)
	at org.junit.runners.BlockJUnit4ClassRunner.runChild(BlockJUnit4ClassRunner.java:63)
	at org.junit.runners.ParentRunner$4.run(ParentRunner.java:331)
	at org.junit.runners.ParentRunner$1.schedule(ParentRunner.java:79)
	at org.junit.runners.ParentRunner.runChildren(ParentRunner.java:329)
	at org.junit.runners.ParentRunner.access$100(ParentRunner.java:66)
	at org.junit.runners.ParentRunner$2.evaluate(ParentRunner.java:293)
	at org.junit.runners.ParentRunner$3.evaluate(ParentRunner.java:306)
	at org.junit.runners.ParentRunner.run(ParentRunner.java:413)
	at org.eclipse.jdt.internal.junit4.runner.JUnit4TestReference.run(JUnit4TestReference.java:93)
	at org.eclipse.jdt.internal.junit.runner.TestExecution.run(TestExecution.java:40)
	at org.eclipse.jdt.internal.junit.runner.RemoteTestRunner.runTests(RemoteTestRunner.java:529)
	at org.eclipse.jdt.internal.junit.runner.RemoteTestRunner.runTests(RemoteTestRunner.java:756)
	at org.eclipse.jdt.internal.junit.runner.RemoteTestRunner.run(RemoteTestRunner.java:452)
```

```
        at 
org.eclipse.jdt.internal.junit.runner.RemoteTestRunner.main(RemoteTestRunner.java:21
0)
```

In the above program, the output was expected to be 25 but since our implementation of the square method in the program was wrong, this gives 10 as output.

Now, let us consider we write the following

```
 int result = su.square(2);
 assertEquals(4,result);
```

In the above cast, our program will match with the expected output and there will be no error because **2+2** and **2*2** both give us **4**. Therefore this single test case is not enough for unit testing. We must implement multiple test cases to make our unit testing process much stronger.

Since the output is big, you can write the following as the output

```
java.lang.AssertionError: expected:<25> but was:<10>
        at org.junit.Assert.fail(Assert.java:89)
…..
…..
…..
```