Unit Testing with JUNIT

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Outline

1. Testing
2. JUnit
3. Practice

Testing

Testing

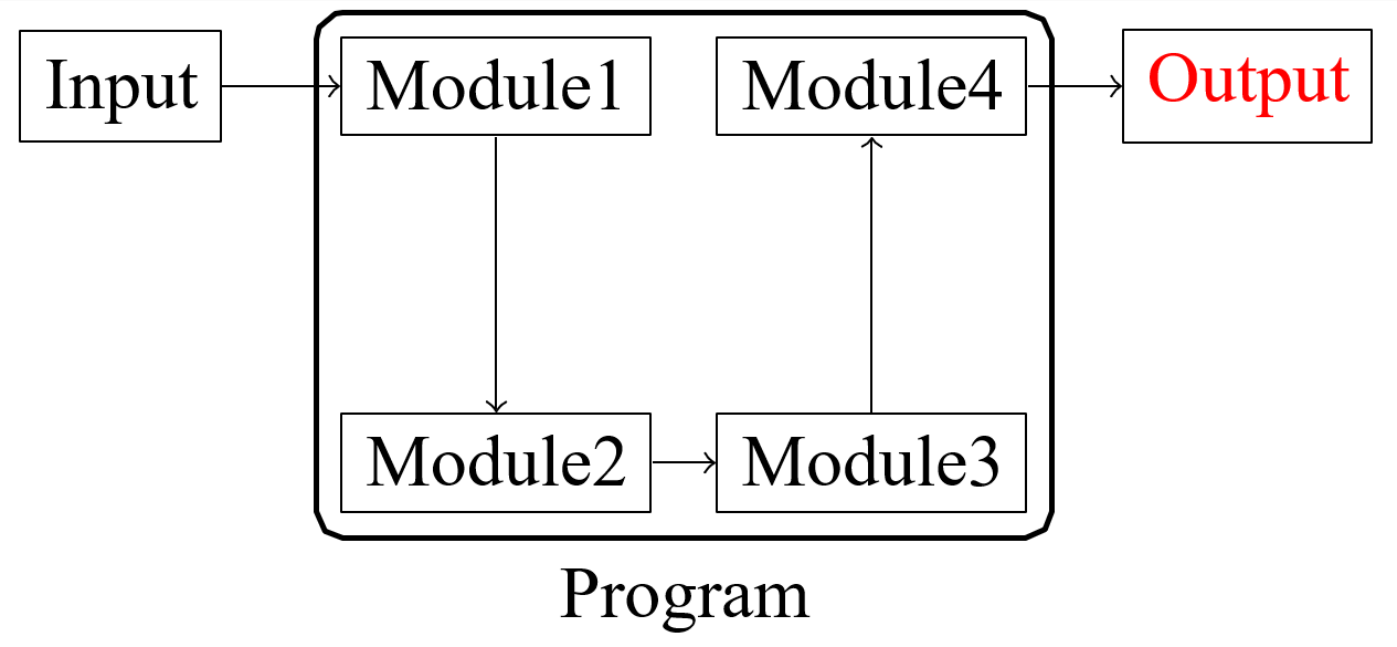
- An empiric method for verifying the correctness of a software
- An automated process aimed at showing the behavior of a software on a given input

Two categories:

- Black Box
- White Box

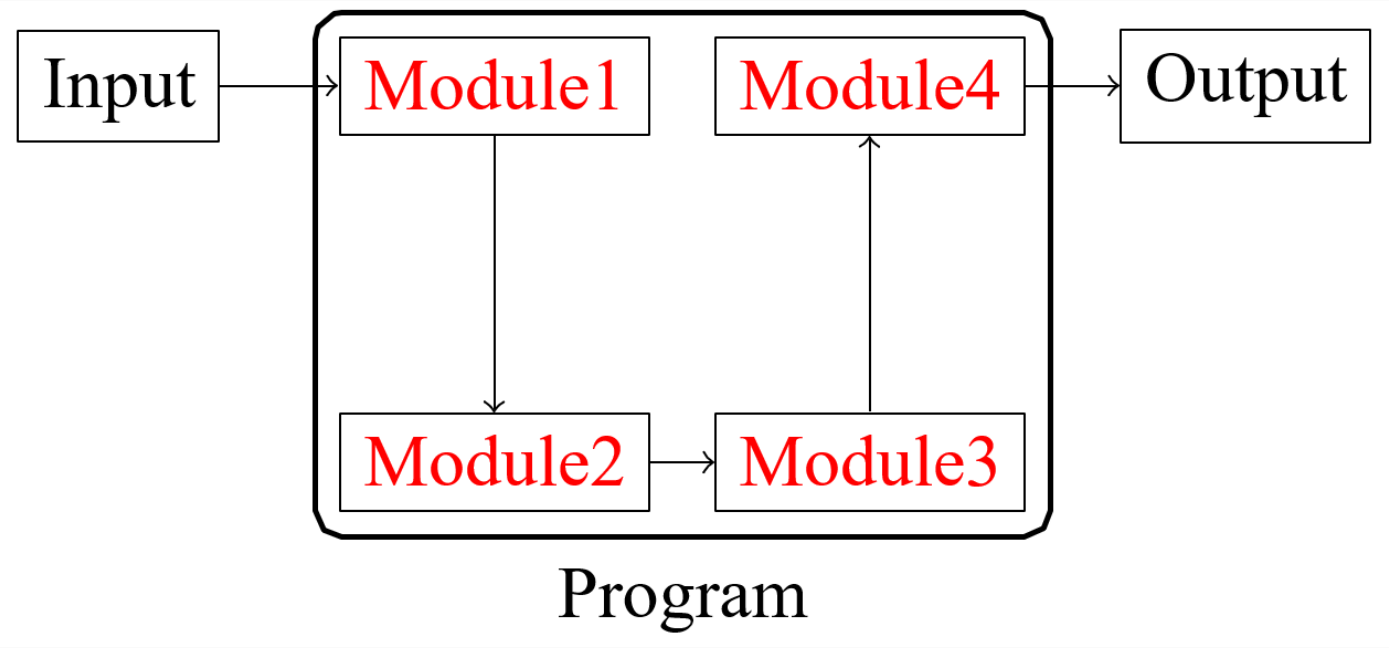
Black Box Testing

Given an input, tests whether the software outputs the expected result, ignoring how the software really works



White Box Testing

Single portions of source code are tested



Unit Testing

- **Unit Testing** is a white box testing methodology that tests the unit of a source code
- A unit is the smallest portion of code that may be tested
  - In procedural programming it may be a single program, or a function
  - In Java it may be a class, an interface, or even a method
- Unit Testing is the testing of a specific unit

Why Unit Testing?

- A source code cannot be considered correct without being verified
- Divide-et-impera approach
  - Subdivide the system into unit
  - Each unit is debugged separately
  - Reduce the probability of presenting bugs
  - Errors are not propagated among units
- Support regression testing
  - Verify that the application works as specified even after the changes/additions/modifications were made to it
  - The original functionality continues to work as specified even after changes/additions/modifications to the software application
  - The changes/additions/modifications to the software application have not introduced any new bug

JUnit

What it is?

- Unit testing can be performed by a software
- JUnit is a Java Unit Testing framework
  - API for easily creating tests
  - Comprehensive assertion facilities (expected vs actual result)
  - Test runner for running tests
  - Test aggregation facilities

Basic Concepts

- Test Case:
  - a method that verifies a specific functionality of a unit
- Test Suite:
  - a collection of Unit Tests

Conventions

- The name of a test case method should indicate the expected behavior
  - good: sqrtWorks, getAllInvoicesWorks, createPersonFailsOnSameCF, etc.
  - bad: test1, myTest, etc.
- Test classes usually end their name with **"Test"**
  - good: MathTest, PersistenceTest, InvoiceServiceTest, etc.
  - bad: MyClass, Test1, etc.

Test Cases

- JUnit is annotation-driven
- There is no need to extend any special class
- Test cases are annotated with @Test
  - Test methods are Void and take no parameters
  - Extra infos suggests specific behaviors
    - @Test(timeout = 10): test succeeds if terminate within 10 seconds
    - @Test(expected = IllegalArgumentException.class): test succeeds if IllegalArgumentException is thrown
  - @Ignore("reason") ignore a test

Annotations

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- @After (@AfterEach in JUnit 5): marks a method for being invoked after each test case

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- @Before and @After are meant to prepare/release the test fixture for each test case
- @BeforeClass @AfterClass are static methods and must appear at most once in each test

Parametrized Tests

Using @RunWith(Parameterized.class) and a parameter marked with @Parameters, we can execute a test over multiple values of the parameter

```
@RunWith(value=Parameterized.class)
public class FactorialTest {
   private long expected; private int value;
   @Parameters
   public static Collection<Object[]> data() {
      return
      Arrays.asList(new Object[][]{{1,0},{1,1},{2,2},{120,5}});
   }
   public FactorialTest(long expected, int value) {
      this.value = value;
   }
   @Test
   public void factorial() {
      assertEquals(expected, new Calculator().factorial(value));
   }
}
```

Test Suite

Test Suites group tests into hierarchies

```
@RunWith(value=Suite.class)
@SuiteClasses(value={MyProgramTest.class, AnotherTest.class})
public class AllTests{
    ...
}
```

Asserts

- **assertEquals**(expected, actual)
  - Works with object, int, long, byte, string, . . ., etc.
  - Object: it invokes object.equals(object) to check for equality
- **assertEquals**(expected, actual, epsilon)
  - For float and double
- **assertTrue / assertFalse**(bool)
- **assertNull / assertNotNull**(object)
- **assertSame / assertNotSame**(object, object)
- **assertArrayEquals**(object[], object[])

Other libraries

- NodeJS
  - Mocha
  - Jest
  - Jasmine
- Python
  - PyUnit
  - PyTest
- C++
  - UnitTest++
  - Unit++
- Many Others ...

Practice