

Test-Driven Development

JUnit

EECS 2311 - Software Development Project

Click to edit Master text styles

Second level

Third level

Fourth level

Fifth level

Tuesday, February 2, 2021

Unit Testing

- Testing the internals of a class
- Black box testing
 - Test public methods
- Classes are tested in isolation
 - One test class for each application class

Test – Driven Development

- TDD is a software development approach whereby you write your test cases **before** you write any implementation code
- Tests drive or dictate the code that is developed
- An indication of “intent”
 - Tests provide a specification of “what” a piece of code actually does
 - Tests are documentation

TDD Stages

1. Write a single test.
2. Compile it. It should not compile because you have not written the implementation code
3. Implement **just enough** code to get the test to compile
4. Run the test and see it **fail**
5. Implement **just enough** code to get the test to pass
6. Run the test and see it **pass**
7. Refactor
8. Repeat

JUnit

- JUnit is a framework for writing and running tests
 - Created by Erich Gamma (of Design Patterns fame) and Kent Beck (creator of XP methodology)
 - Uses Java features such as annotations and static imports
 - We will discuss JUnit 5 (the latest version)
 - Lots of JUnit 4 code out there, JUnit 5 is backwards compatible
 - Include junit-vintage in your build path to run JUnit 4 code

Terminology

- A **test fixture** sets up the data (both objects and primitives) that are needed for every test
 - Example: If you are testing code that updates an employee record, you need an employee record to test it on
- A **unit test** is a test of a *single* class
- A **test case** tests the response of a single method to a particular set of inputs
- A **test suite** is a collection of test cases
- A **test runner** is software that runs tests and reports results

Structure of a JUnit test class

- To test a class named **Fraction**
- Create a test class **FractionTest**

```
import org.junit.jupiter.api.*;
import static
org.junit.jupiter.api.Assertions.*;
public class FractionTest
{
    ...
}
```

Test fixtures

- Methods annotated with `@BeforeEach` will execute before each test case
- Methods annotated with `@AfterEach` will execute after each test case

```
@BeforeEach
public void setUp() {...}
@AfterEach
public void tearDown() {...}
```


Class Test fixtures

- Methods annotated with `@BeforeAll` will execute once *before* all test cases
- Methods annotated with `@AfterAll` will execute once *after* all test cases
- These are useful if you need to allocate and release expensive resources once

Test cases

- Methods annotated with `@Test` are considered to be test cases

```
@Test  
public void testadd() {...}  
@Test  
public void testToString() {...}
```

What JUnit does

- For *each* test case **t**:
 - JUnit executes all `@BeforeEach` methods
 - Their order of execution is not specified
 - JUnit executes **t**
 - Any exceptions during its execution are logged
 - JUnit executes all `@AfterEach` methods
 - Their order of execution is not specified
- A report for all test cases is presented

Within a test case

- Call the methods of the class being tested
- Assert what the correct result should be with one of the provided **assert methods**
- These steps can be repeated as many times as necessary
- An assert method is a JUnit method that performs a test, and throws an **AssertionError** if the test fails
 - JUnit catches these exceptions and shows you the results

List of assert methods 1

- `assertTrue(boolean b)`
`assertTrue(boolean b, String s)`
 - Throws an `AssertionError` if *b* is False
 - The optional message *s* is included in the Error
- `assertFalse(boolean b)`
`assertFalse(boolean b, String s)`
 - Throws an `AssertionError` if *b* is True
 - All assert methods have an optional message

List of assert methods 2

- `assertEquals(Object expected, Object actual)`
- Uses the `equals` method to compare the two objects
- Primitives can be passed as arguments thanks to autoboxing
- Casting may be required for primitives
- There is also a version to compare arrays

Example: Counter class

- Consider a trivial “counter” class
- The constructor creates a counter and sets it to zero
- The **increment** method adds one to the counter and returns the new value
- The **decrement** method subtracts one from the counter and returns the new value
- An example and the corresponding JUnit test class can be found on the course website

List of assert methods 3

- `assertSame(Object expected, Object actual)`
 - Asserts that two references are attached to the same object (using `==`)
- `assertNotSame(Object expected, Object actual)`
 - Asserts that two references are not attached to the same object

List of assert methods 4

- `assertNull(Object object)`
Asserts that a reference is null
- `assertNotNull(Object object)`
Asserts that a reference is not null
- `fail()`
Causes the test to fail and throw an `AssertionError`
 - Useful as a result of a complex test, or when testing for exceptions

Parameterized Tests

- Useful when repeating the same test case but with different input parameters

```
@ParameterizedTest
@ValueSource(ints = { 1, 2, 3 })
void testWithValueSource
           (int argument) {
    assertTrue(argument > 0 &&
               argument < 4);
}
```

Testing for exceptions

- If a test case is expected to raise an exception, it can be noted as follows

```
@Test
void testExpectedException() {
    assertThrows(
        NumberFormatException.class,
        () -> {Integer.parseInt("One");}
    );
}
```

Ignoring test cases

- Test cases that are not finished yet can be annotated with `@Disabled`
- JUnit will not execute the test case but will report how many test cases are disabled

JUnit in Eclipse

- JUnit can be downloaded from github
- If you use Eclipse, as in this course, you do not need to download anything
- Eclipse contains wizards to help with the development of test suites with JUnit
- JUnit results are presented in an Eclipse window

JUnit 4 vs. JUnit 5

- Some annotations have been updated
 - @BeforeClass → @BeforeAll
 - @Before → @BeforeEach
 - @AfterClass → @AfterAll
 - @After → @AfterEach
 - @Ignore → @Disabled
- **assertThrows** was introduced in JUnit 5

JUnit 5 other new features

- **assertAll()** – tests a number of assertions together
- **assertTimeout()** – tests that a piece of code will finish within a particular timeframe
- Assumptions – Running the test case only if the assumption holds
- Many more! See link to documentation on course website