

OBJECT ORIENTED PROGRAMMING (JAVA) (CST8284)

LAB 4

UNIT TEST FRAMEWORK (Java Unit Test – JUnit 4)

Marks: 5%





Important Information

To be successful in this lab:

- Ensure that you review the hybrid tasks for Week #4 first before starting off with this lab exercise.
- Review the helpful video included in the Hybrid for Week #4 in Brightspace page to enrich your learning experience.



Some Introduction

The essence of this lab is to learn about, and use a **unit testing** framework.

- Unit testing frameworks are used to execute and evaluate test suites, as well as make it easy to add test cases.
- In this lab we will use the JUnit 4
- Available at: https://junit.org/junit4/

You do not need to install JUnit if using Eclipse



Some Introduction (2)

- In **JUnit** testing, you design a **test case** for **each class** you develop.
- A method is provided for each of the test cases you wish to run.
- Test methods are annotated. **Annotations** are used to **mark** the test methods (advanced Java features that place markers in the code, which is interpreted by another tool).
- In JUnit, @Test annotation is used to mark methods. Other methods may exist in the text class without @Test (e.g. methods performing steps to be shared among test methods).



Some Introductions (3)

- For each test case, conditions can be computed to check if **true**.
- Result is passed to a method (assertEquals method) that sends it to the framework.
- The assertEquals method takes the **expected** and **actual** values as **arguments** (for floating point numbers it takes a **tolerance** value). Method fails if the two given values are unequal.
- It is **good practice** to end the name of the test class with "**Test**", for example: CovidTest



Some Introductions (4) - Assertions and their definitions

From your Hybrid tasks for this week, what assertions can you identify that are used in JUnit testing methods? What are their descriptions?

Hint: assertNull(...), assertNotNull(...), assertTrue(test), assertFalse(test), assertSame(...), etc.



PART 1

YOUR TASKS USING THE CODE PROVIDED





You are Required to...

- Inspect the code files that you received and load them into eclipse (Lab 4)
- Check to ensure that you have JUnit 4 appropriately set up in your eclipse.
- Do the following if you need to correctly set up JUnit 4 in eclipse:
 - Go to Package Explorer at the top bar of your eclipse editor

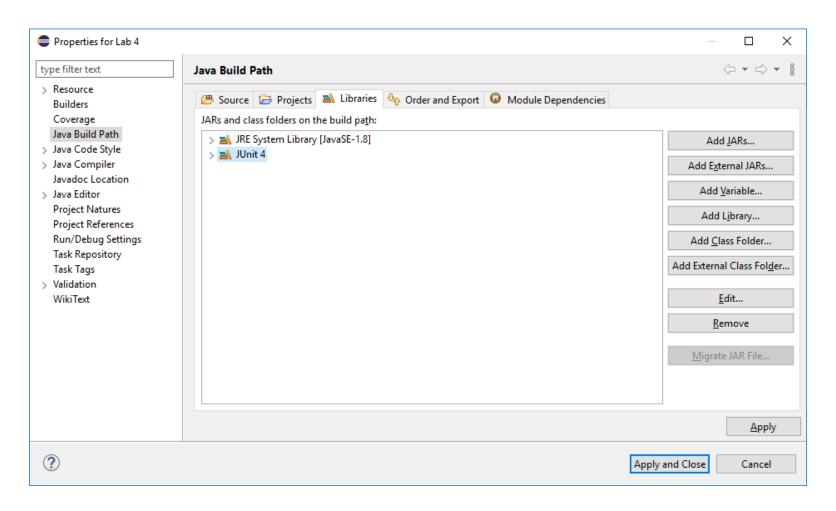


You are Required to... Ensure Correct set up of JUnit 4

- Click on Project
- Scroll down to Properties on the menu
- Scroll down to Java Build Path on the menu and click on it.
- From Libraries, Select Add Library (from the list on the right-hand side of that page)
- Select Junit (and then JUnit 4 from menu)
- Click Apply and Close



You are Required to... Ensure Correct set up of JUnit 4 (2)



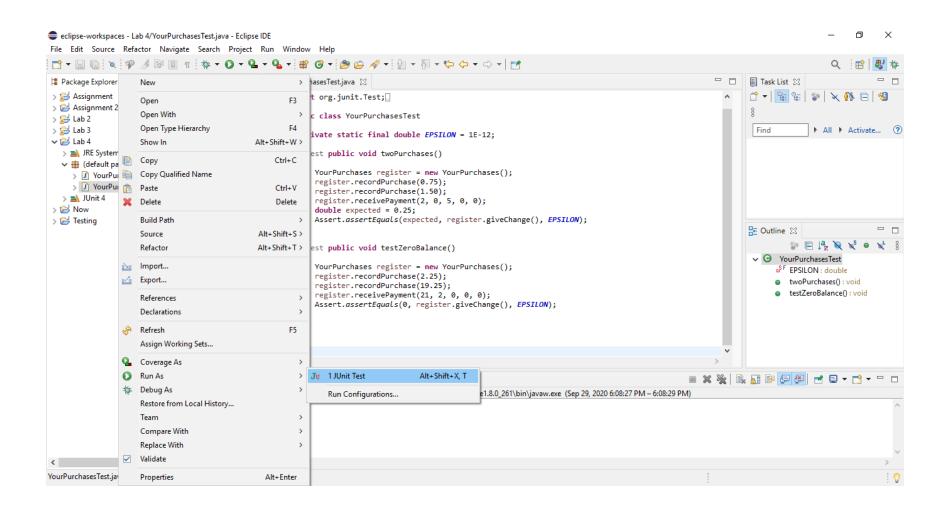


Execute your Code as Junit Test

- To execute, right click on the YourPurchasesTest and select Run As, and then JUnit Test (as shown in slide 13)
- When your execution is successful, a green bar shows in the panel in eclipse, cataloging Runs, Errors and Failures (see slide 14)
- When unsuccessful, a red bar shows in the panel and the catalog of Runs, Errors and Failures (see slide 15)



Execute as JUnit Test





When your run is successful...

```
🚭 eclipse-workspaces - Lab 4/YourPurchasesTest.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help

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🖺 Package Explorer 🚽 🗗 JUnit 🛭
                                                                                                                                                                                                                                                                                       ■ Task List XX

▼ YourPurchasesTest.java 

※
                    2⊕ import org.junit.Test; ...
Finished after 0.05 seconds
                                                                                               public class YourPurchasesTest

    Errors: 0
                                                                                                                                                                                                                                                                                                                 ▶ All ▶ Activate... ②
                                                                                                     private static final double EPSILON = 1E-12;
                                                                                                    @Test public void twoPurchases()
 ▼ YourPurchasesTest [Runner: JUnit 4] (0.019 s)
                                                                                        11
                                                                                                         YourPurchases register = new YourPurchases();
        testZeroBalance (0.017 s)
                                                                                                         register.recordPurchase(0.75);
        twoPurchases (0.002 s)
                                                                                                         register.recordPurchase(1.50);
                                                                                                          register.receivePayment(2, 0, 5, 0, 0);
                                                                                                          double expected = 0.25;
                                                                                                          Assert.assertEquals(expected, register.giveChange(), EPSILON);
                                                                                                                                                                                                                                                                                       ₽ Outline ⊠
                                                                                        18
                                                                                        19⊝
                                                                                                    @Test public void testZeroBalance()
                                                                                        20

    YourPurchasesTest

                                                                                        21
                                                                                                         YourPurchases register = new YourPurchases();
                                                                                                                                                                                                                                                                                                  22
                                                                                                         register.recordPurchase(2.25);
                                                                                                                                                                                                                                                                                                  twoPurchases(): void
                                                                                        23
                                                                                                         register.recordPurchase(19.25);
                                                                                                                                                                                                                                                                                                  testZeroBalance(): void
                                                                                                         register.receivePayment(21, 2, 0, 0, 0);
                                                                                                         Assert.assertEquals(0, register.giveChange(), EPSILON);
                                                                   园 泽 部
Failure Trace
                                                                                        29
                                                                                      🥋 Problems @ Javadoc 🖳 Declaration 📮 Console 🔀
                                                                                      <terminated> YourPurchasesTest [JUnit] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Sep 29, 2020 6:08:27 PM - 6:08:29 PM)
```



Error is encountered: unsuccessful run

```
☑ YourPurchasesTest2.java ×
b Project Explorer d

□ JUnit ×
nished after 0.017 seconds
                                                                       > $\rightarrow$ Lab4 > $\mathcal{B}$ src > $\mathcal{B}$ fall22lab4 > $\text{O}$ YourPurchasesTest2 >
                                                                         1 package fall22lab4;
                                                                         2⊕import static org.junit.Assert.*;
fall22lab4.YourPurchasesTest2 [Runner: JUnit 4] (0.000 s)
                                                                           public class YourPurchasesTest2 {
   testGiveChange2 (0.000 s)
                                                                        9
                                                                                 private static final double EPSILON = 1E-12;
                                                                       10
                                                                       11
                                                                                 //THIS TEST WOULD FAIL.
                                                                      @12
                                                                                 // TODO: WRITE ONE OR MORE TESTS TO SYSTEMATICALLY FIND THE SOURCE OF THE TEST FAILURE
                                                                       13⊝
                                                                                 public void testGiveChange2() {
                                                                       15
                                                                                       YourPurchases aPurchase = new YourPurchases();
                                                                       16
                                                                                       aPurchase.recordPurchase(1.5);
                                                                       17
                                                                                       aPurchase.receivePayment(5, 0, 0, 0, 0);
                                                                       18
                                                                                       double changeResult = aPurchase.CalculateChange();
                                                                       19
                                                                                       double expected = 0.25;
                                                                        20
                                                                                       Assert.assertEquals(expected, changeResult, EPSILON);
                                                                                       assertTrue(true);
                                                              21
Failure Trace
                                                                        22
1 java.lang.AssertionError: expected: <0.25 > but was: <6.5 >
                                                                        23
at fall22lab4.YourPurchasesTest2.testGiveChange2(YourPurchasesTest2.java:20)
                                                                        24
                                                                       📳 Problems @ Javadoc 🚇 Declaration 🔗 Search 🖳 Console 🗡 🗫 Breakpoints 🍰 Call Hierarchy 🚳 Palette
                                                                      <terminated> YourPurchasesTest2 (1) [JUnit] C:\Users\saadawh\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_11.0.13.v20211116-1829\jre\bin\javaw.exe (Sep. 27, 20 openjdk.hotspot.jre.full.win32.x86_64_11.0.13.v20211116-1829\jre\bin\javaw.exe
```

Demo: Part 1

- Run the code provided to you (YourPurchases.java and YourPurchasesTest.java) to show GREEN BAR
 - > Explain the output on your eclipse screen to your professor
- Run the code provided to you (YourPurchases.java and YourPurchasesTest2.java) to show RED BAR



PART 2

CREATING A NEW TEST CASE



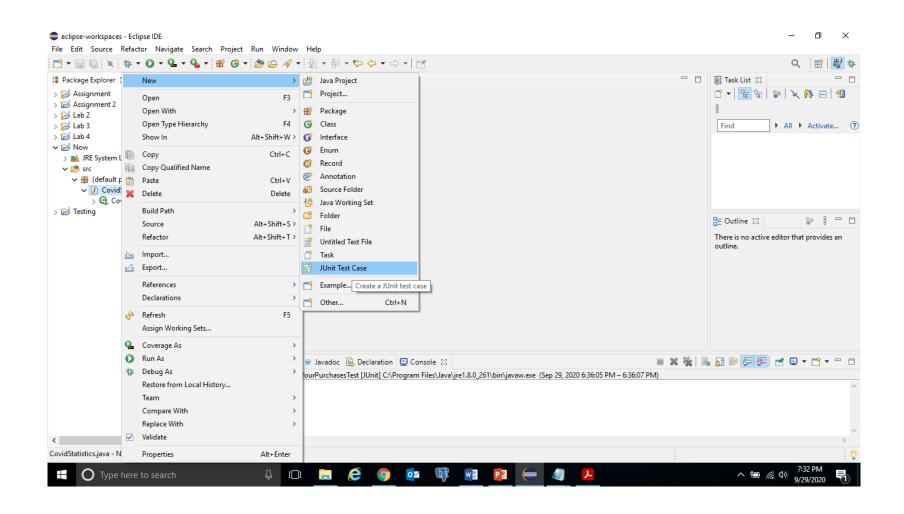


Create a New Test Case

- In your eclipse editor, select the source code for which the Test case is required (use YourPurchases.java)
- Make a right click on the source code file to display a long menu window (as shown in next slide).
- At the top of the menu, select New, and then scroll down to select Junit Test Case



Creating a New Test Case (2)





Creating a New Test Case (3)

- In the New JUnit test case window, ensure to select the New Junit 4 Test
- Select the Package (default packages are discouraged – always name your package
- Enter the Name (ending with "Test")
- Click Next to select the methods for which your test cases are required (see picture slide below) and then click Finish



Creating a New Test Case (4) - Example

New JUnit Test Case				×		
JUnit Test Case The use of the default package is discouraged.			E			
○ New JUnit 3 test New JUnit 4 test New JUnit 1 upiter test						
Source fol <u>d</u> er:	Now/src		Br <u>o</u> wse.			
Pac <u>k</u> age:	(default)		Bro <u>w</u> se.			
Na <u>m</u> e:	CovidStatisticsTest					
<u>Superclass:</u>	java.lang.Object		Brows <u>e</u> .			
Which method stubs would you like to create? ✓ setUpBeforeClass() ✓ tearDownAfterClass() ✓ setUp() ✓ tearDown() ✓ constructor Do you want to add comments? (Configure templates and default value here) ✓ Generate comments						
Class under test: CovidStatistics Browse						
?	< <u>B</u> ack <u>N</u> ext > <u>F</u> inish		Cancel			

Creating a New Test Case (5) - Example

New JUnit Test Case	_		×
Test Methods Select methods for which test method stubs should be created.		E	
Available <u>m</u> ethods:			
	^	<u>S</u> elect <u>D</u> eselec	
? < <u>B</u> ack <u>N</u> ext > <u>F</u> inish		Canc	el

Demo for Part 2 – Create Example Test Case

Using what you learned in slides 18 – 22:

- Demonstrate to your Professor how you will create a new Test Case still using (YourPurchases.java)
- ❖ Use JUnit test cases to find the source of the test failure. You may do this systematically by creating a test testing one method, then add another test for two methods (the previous successful one and another method). Do this until you get a test failure. Then, last added method is the reason for the failure.



Grading Rubrics

- Successfully configuring your Junit 4 test environment and running the provided code to show GREEN BAR – 0.5%
- Successfully introducing an error/failure into the code provided to show RED BAR – 0.5%
- Successfully writing your own tests into the YourPurchasesTest code file (see instructions in the code) – 1.5%
- Successfully creating a new test suite and answering relevant questions 2%
- Correctly including Javadoc comments into the test file provided to you 0.5%



References

- Java How to Program, Early Objects Plus MyProgrammingLab with Pearson eText -- Access Card Package, 11/E. Author: Deitel ISBN: 9780134800271
- ❖ Big Java Early Objects, 7/E. Author: Horstmann, C. Wiley. ISBN: eText: 978-1-119-49909-1 or loose-leaf paper: 978-1-119-74020-9.

