SWE 434
Software Testing and Validation

Testing Methods using JUnit

Agenda

- Introduction to IDE (Eclipse)
- Introduction to Software Testing Framework (JUnit)
- **Quiz-1**

Java Program

```
1. package lab1;

2. public class MyMath
3. {
4.     public static void main( String[] args )
5.     {
6.             int result = MyMath.div( 6, 2 );
7.             System.out.println( result );
8.     }

9.     public static int div( int a, int b )
10.    {
11.            return a / b;
12.    }
13.}
```

Where can I Find Eclipse (IDE)

- **Eclipse downloads are available on**
  https://www.eclipse.org/downloads/

- **Where else can I find an IDE with Junit**
  IBM Rational Software Architect: Comes with Junit

Java Runtime Environment(JRE 7)

- If **JRE** is not installed in system, then download it from
  - http://www.oracle.com/technetwork/java/javase/downloads/jre7-downloads-1880261.html

Java SE Runtime Environment 7u13

You must accept the Oracle Binary Code License Agreement for Java SE to download this software.

○ Accept License Agreement ◉ Decline License Agreement

Product / File Description	File Size	Download
Linux x86	54.7 MB	jre-7u13-linux-i586.rpm
Linux x86	45.9 MB	jre-7u13-linux-i586.tar.gz
Linux x64	52.84 MB	jre-7u13-linux-x64.rpm
Linux x64	44.63 MB	jre-7u13-linux-x64.tar.gz
Mac OS X x64	50.32 MB	jre-7u13-macosx-x64.dmg
Mac OS X x64	46.66 MB	jre-7u13-macosx-x64.tar.gz
Solaris x86	45.41 MB	jre-7u13-solaris-i586.tar.gz
Solaris x64	14.8 MB	jre-7u13-solaris-x64.tar.gz
Solaris SPARC	48.7 MB	jre-7u13-solaris-sparc.tar.gz
Solaris SPARC 64-bit	17.4 MB	jre-7u13-solaris-sparcv9.tar.gz
Windows x86 Online	0.86 MB	jre-7u13-windows-i586-iftw.exe
Windows x86 Offline	30.05 MB	jre-7u13-windows-i586.exe
Windows x86	39.77 MB	jre-7u13-windows-i586.tar.gz
Windows x64	31.47 MB	jre-7u13-windows-x64.exe
Windows x64	41.49 MB	jre-7u13-windows-x64.tar.gz

- **Download** the relevant installation package, and
- Do the JRE 7 **installation**!

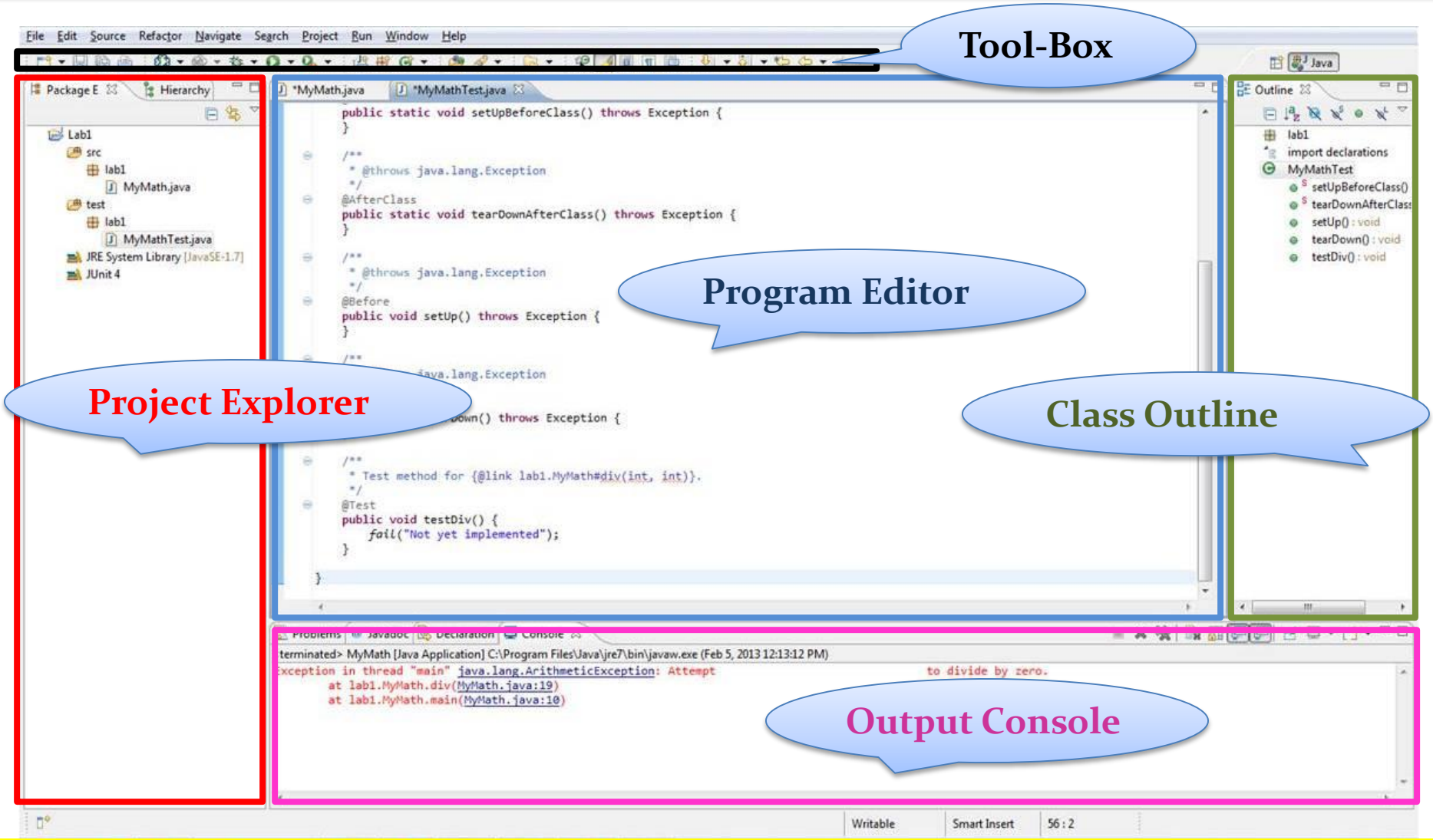
Integrated Development Environment (IDE)

- **Eclipse**
  - It should be in following folder **eclipse-SDK-3.7.2-win32**

Name	Date modified	Type	Size
configuration	2/19/2011 12:09 AM	File folder	
features	10/10/2012 7:45 PM	File folder	
plugins	10/10/2012 7:45 PM	File folder	
readme	10/13/2010 5:44 AM	File folder	
workspace	2/19/2011 12:15 AM	File folder	
.eclipseproduct	10/23/2007 8:43 PM	ECLIPSEPRODUCT...	1 KB
eclipse	10/23/2007 8:43 PM	Application	56 KB
eclipse	10/22/2012 6:11 PM	Configuration sett...	1 KB
eclipsec	10/23/2007 8:43 PM	Application	28 KB
epl-v10	10/23/2007 8:43 PM	Chrome HTML Do...	17 KB

  - Please open the **eclipse.exe**

Integrated Development Environment (IDE)



Software Testing

The **process** of executing a **program** with the intent of finding errors.

Myers, 1979

Unit Testing

- The process of validating a piece of code (*function* or *method*) with required input and expected output.

Test Case and Test Execution System

- Requirements for automated testing?

1. <u>Test Case</u>

   "A test case is a small unit of code that tests a specific method"

   - **INPUT:** Actions send to System Under Test (**SUT**).
   - **OUTPUT:** Responses expected from **SUT**.
   - **VALIDATION:** To Check the *Test*, was successful or not?

2. <u>Test Execution System</u>

   - Mechanism to read test scripts, and connect test cases to **System Under Test,** for example **<u>JUNIT</u>**.
   - Keeps track of test results.

Software Testing Process

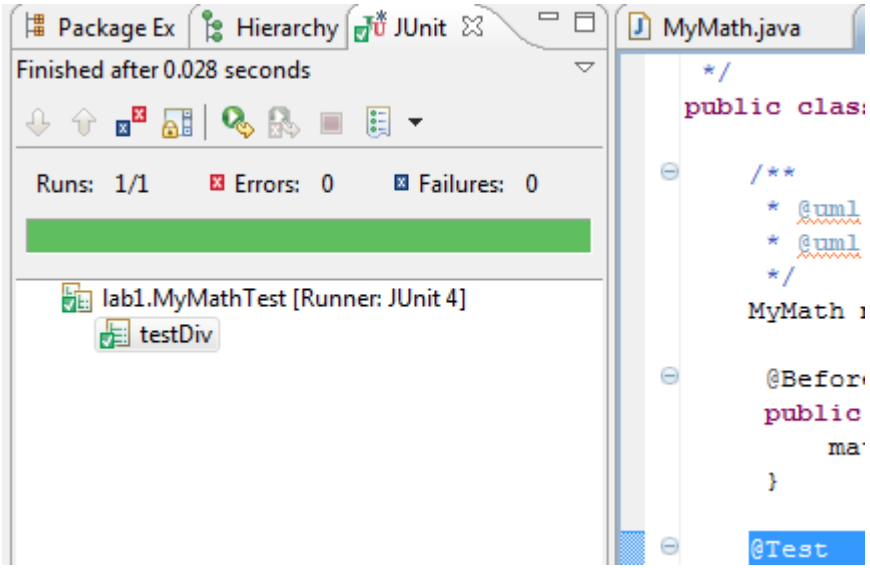
System Under Test (SUT)

```
public class MyMath
{
    public static void main( String[] args )
    {}

    public int div( int a, int b )
    {}
}
```

UNIT

Test Execution System (JUNIT)



Test Case

```
@Test
public void testDiv() {
    int actual=MyMath.div(6, 2);
    int expected=3;
    Assert.assertEquals(expected, actual);
}
```

Actions send to system under test (SUT).

Responses expected from SUT.

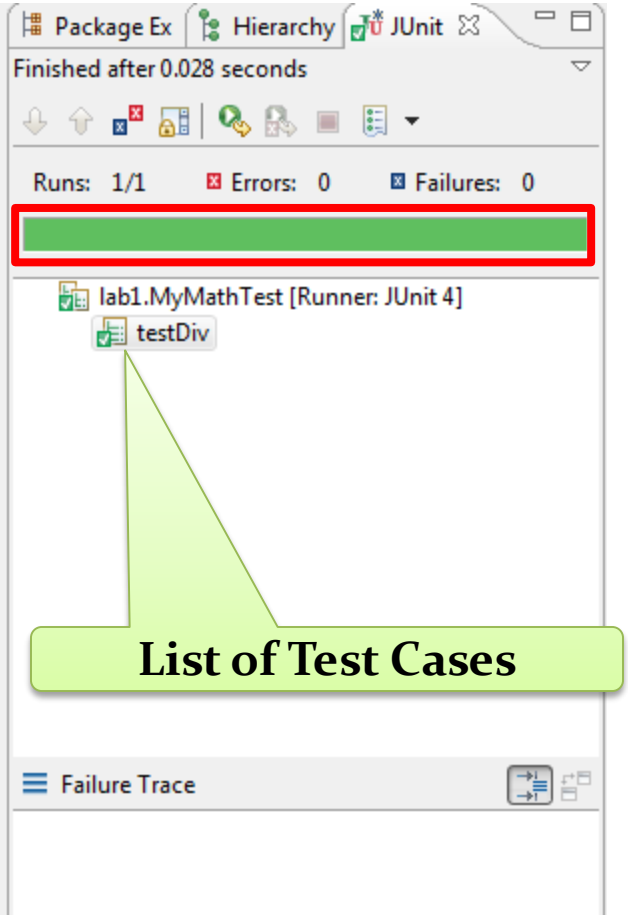
Determine whether a test was successful or not?

Test case verdicts

- A **verdict** is the declared result of executing a single test.
  - We can get the verdict after the assertion statement
- **Pass**: the test case achieved its intended purpose, and the software under test performed as expected.
- **Fail**: the test case achieved its intended purpose, but the software under test did not perform as expected.
- **Error**: the test case did not achieve its intended purpose.
  - Potential reasons:
    - An unexpected event occurred during the test case.
    - The test case could not be set up properly

JUnit

- **A Unit Testing Framework for Java**
  - It helps us to test the specific method of class
  - **Authors:** Erich Gamma, Kent Beck
  - http://www.junit.org or
  - http://sourceforge.net/projects/junit/
  - Plug-in is already installed in **Eclipse**.
  - **Recommended Version: 4.3.1+**



Failure console of JUnit

Practical Lab (Example-1)

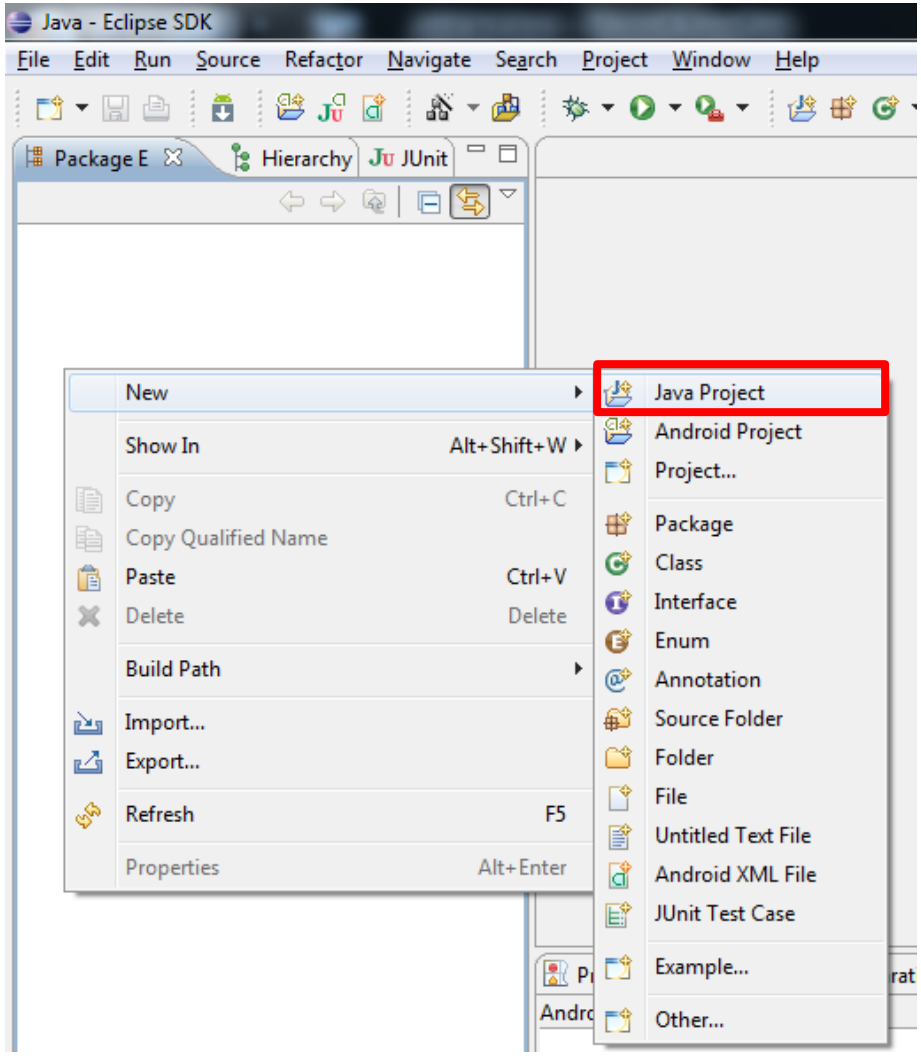
- <u>Problem Description:</u>
  1. Implement the method "**div(a, b)**" for division of two integer numbers.
  2. Implement the *Test Case* by using the JUnit framework.

- <u>Objective:</u>
  - Creating the new java project in Eclipse through wizard
  - Creating the new class (SUT) and its implementation
  - Creating the test case class in JUnit through wizard
  - Implementing the test case method

- Create a new Java project in **Eclipse**.
  - *When creating the project, be sure the following is set up in the new project wizard:*

Create a New Java Project

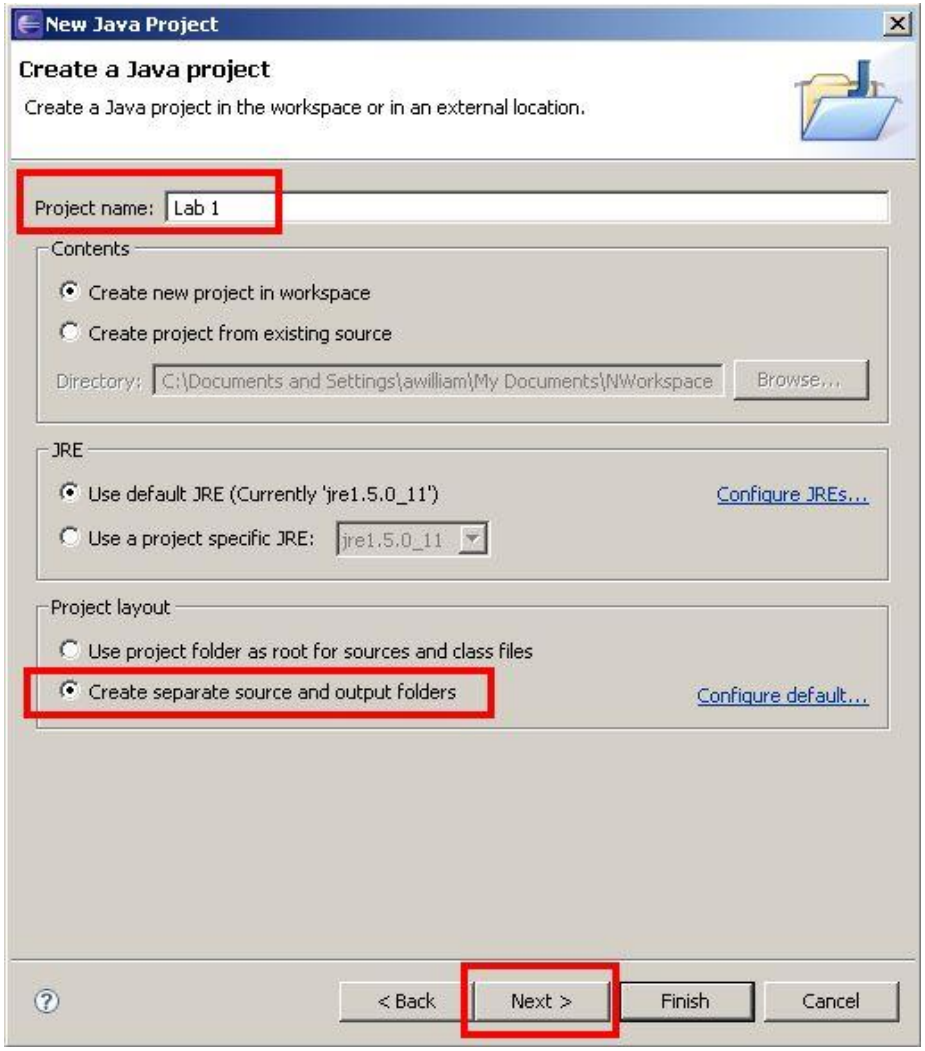
- Right click anywhere in package explorer, or go to in File menu.



Step-1

Create a Java Project

- On the "Create a Java Project" screen
  - Enter a project name,
  - Select the option "Create separate source and output folders."
  - The exact version of the JRE is not important, but it should be version 1.5.0 or greater.
  - Then, click Next.



Step-1.1

Java Settings

- On the "Java Settings" screen, click on "Create a new source folder".

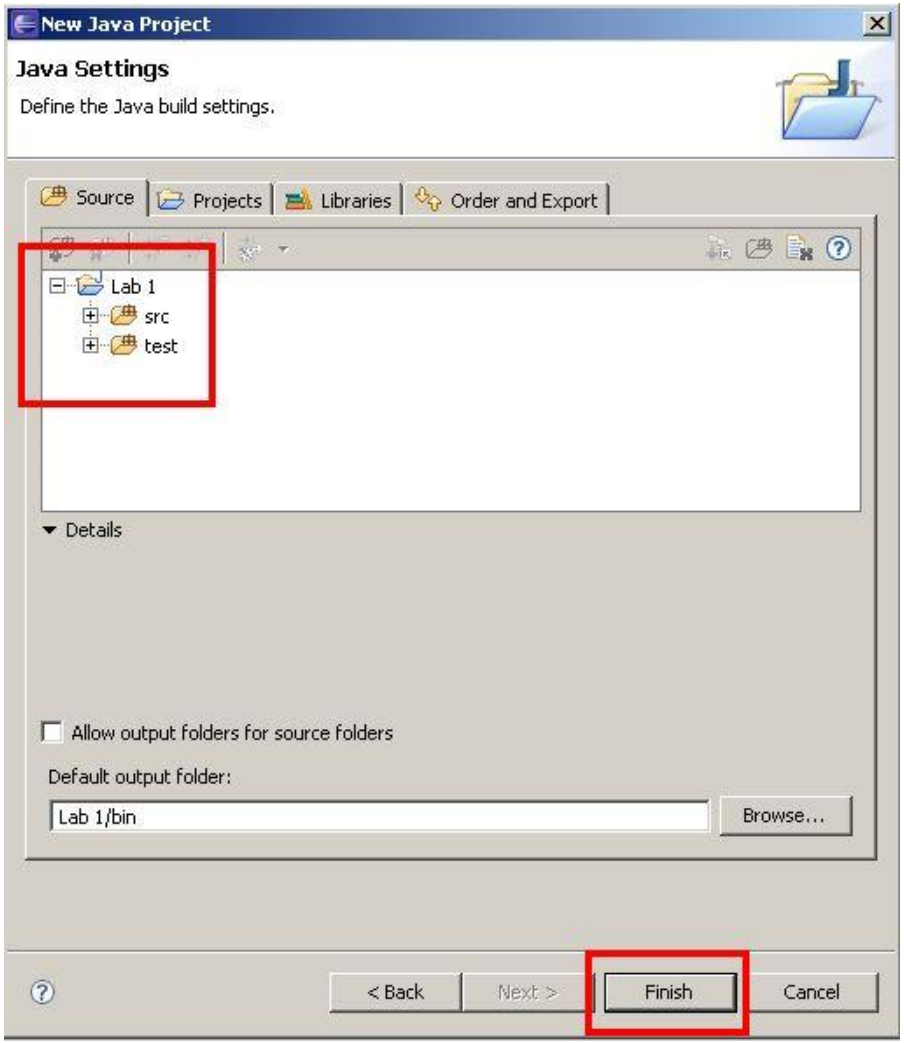
Step-1.2

New Source Folder

- Name the new source folder **test**. Click Finish.

Step-1 Completed

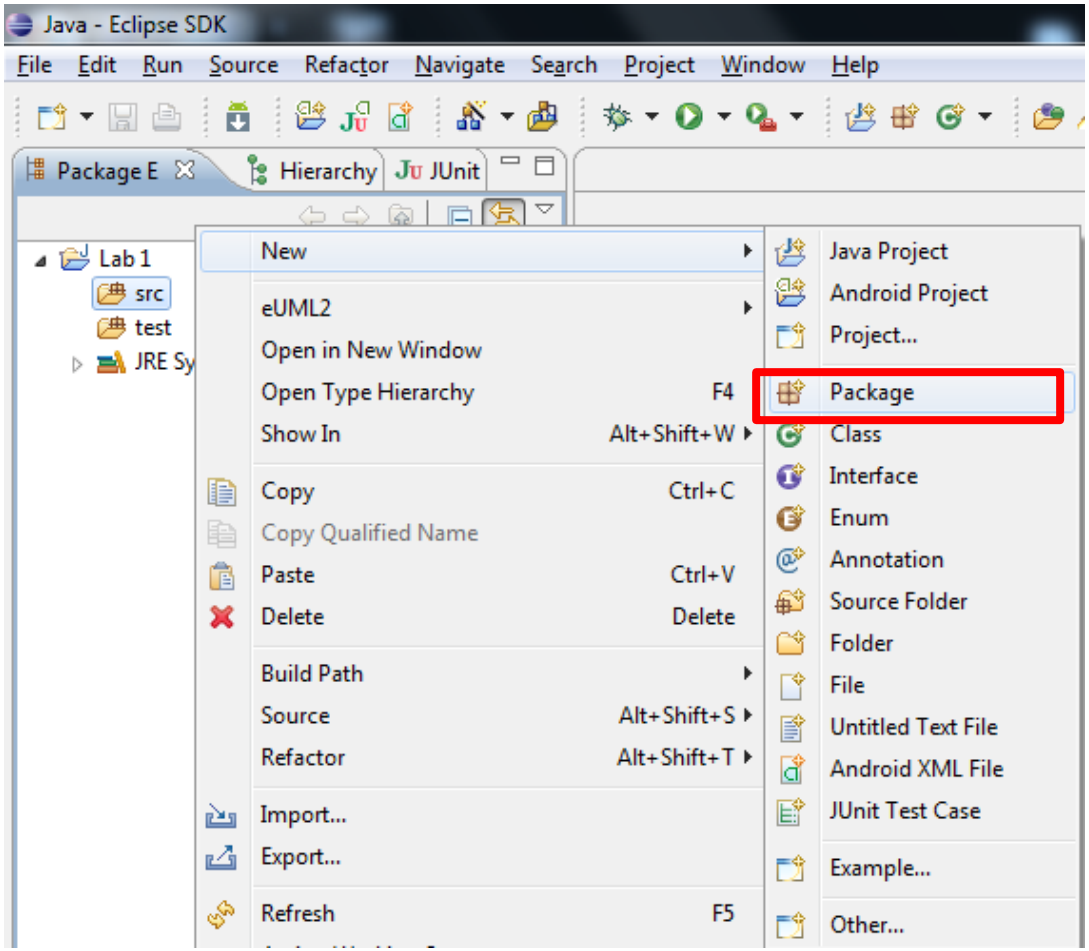
- The result should be two source folders, **src** and **test**.
- We are going to store the code to be tested in the **src** folder,
- and the test cases in the **test** folder.



Step-2

Create a Package in src

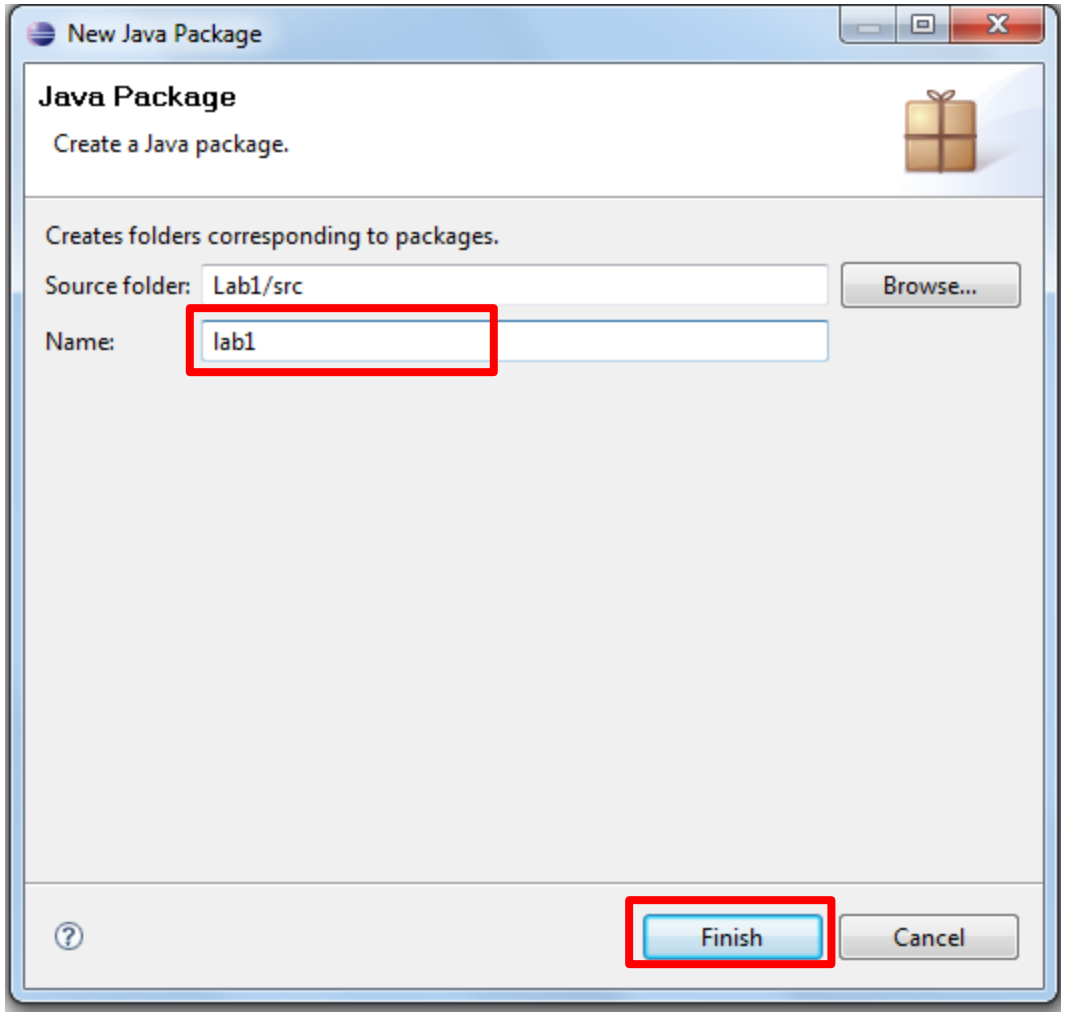
- Create package **lab1** in **src** folder,
- Right Click on **src**,
- see the steps in this figure,



Step-2

Create a Package in src

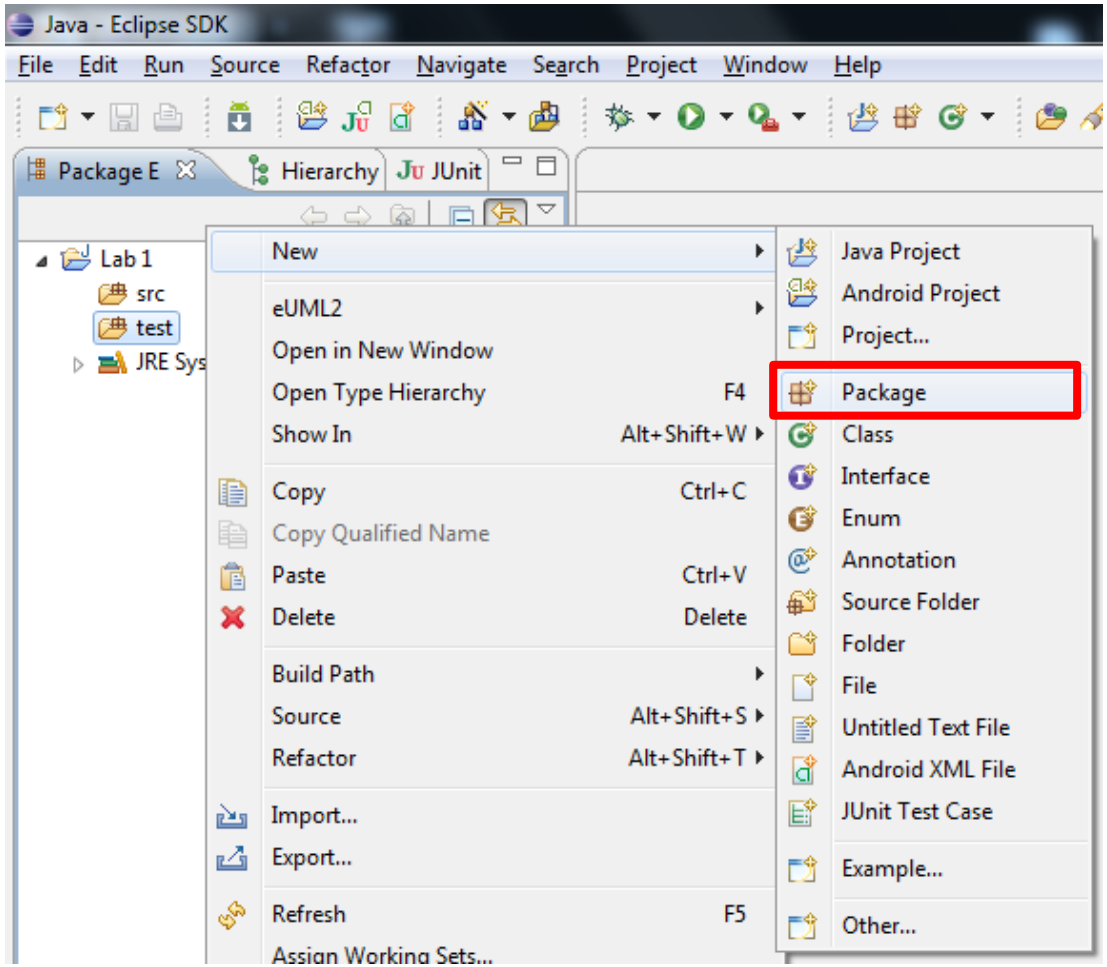
- Enter **lab1** in Name field.
- Press **Finish** Button



Step-2

Create a Package in test

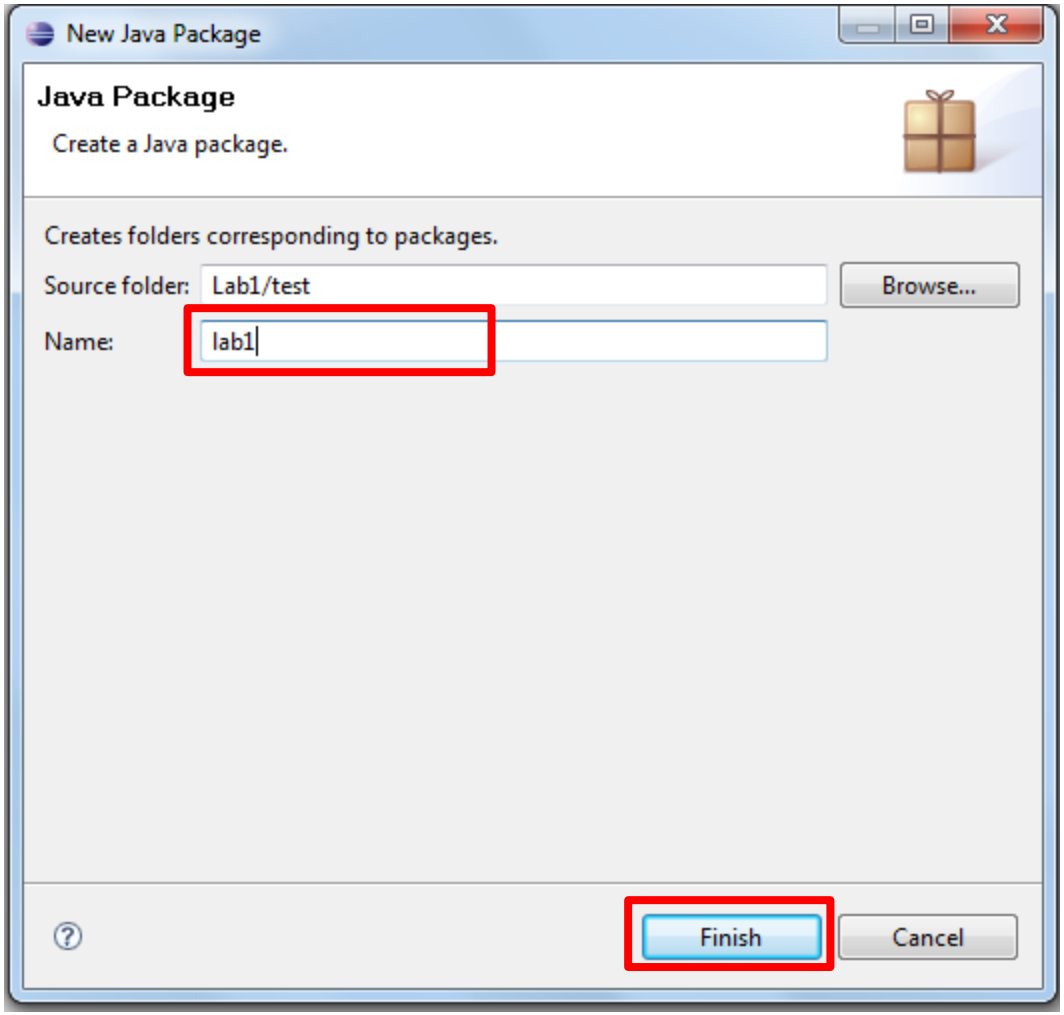
- Create package **lab1** in **test** folder,
- Right Click on **test**,
- see the steps in this figure,



Step-2

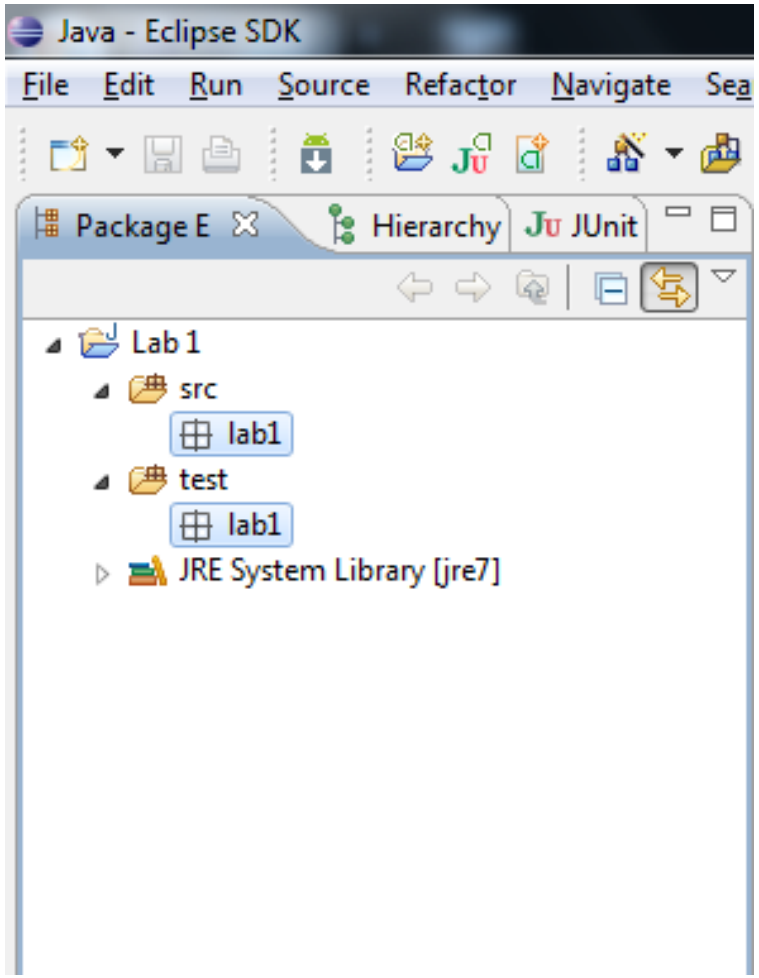
Create a Package in test

- Enter **lab1** in Name field.
- Press **Finish** Button



Package View

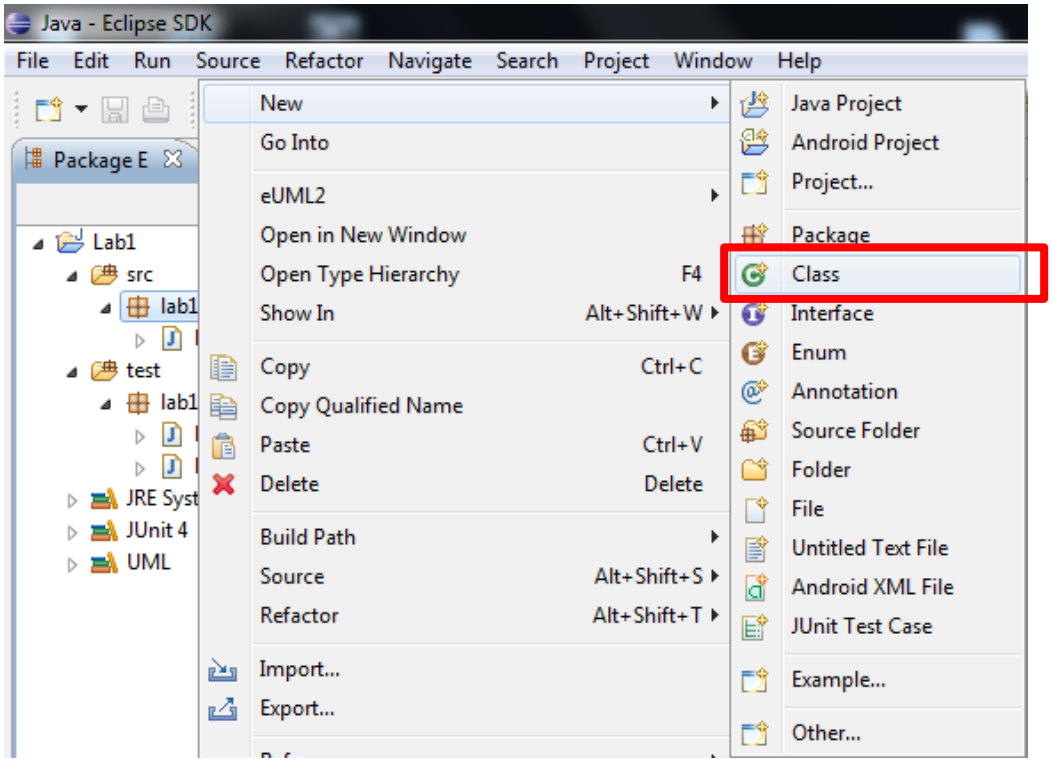
- Now, we already created the package **lab1** in both **src** and **test** folders.



Step-3

Create a Class to Test

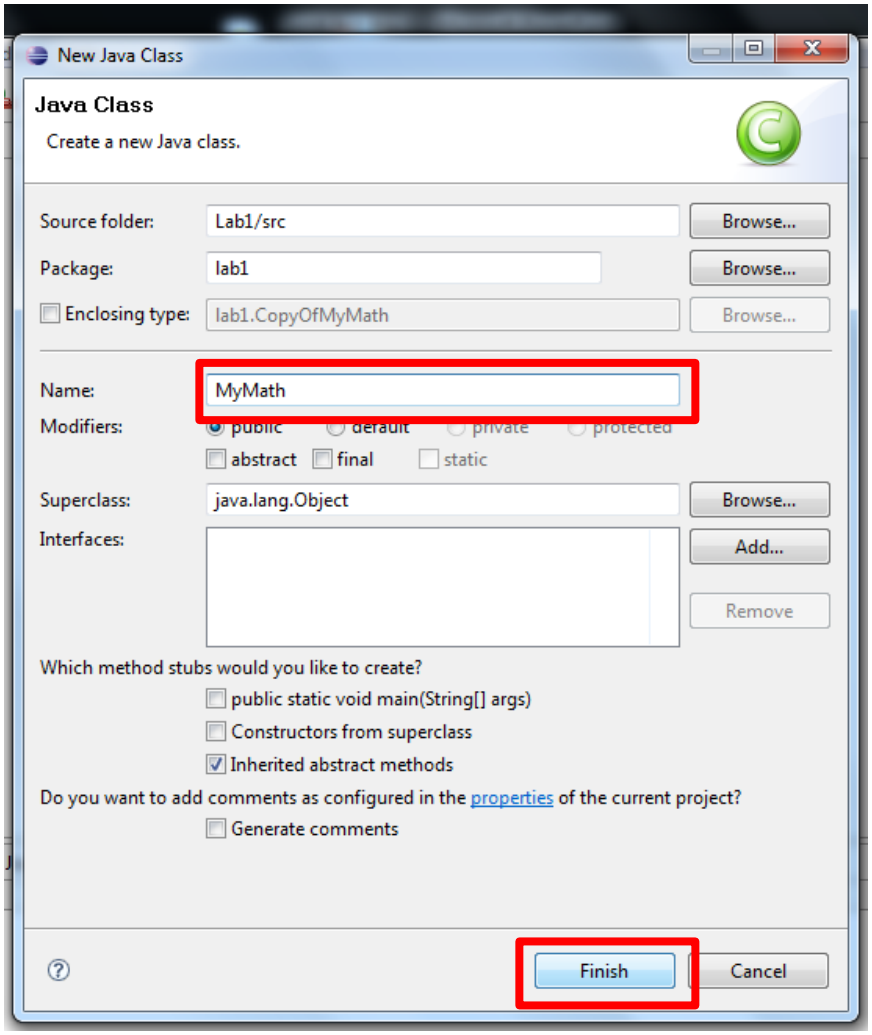
- *Right click* on **lab1** under **src** folder, and
- Click the **Class**



Step-3

Create a Class to Test

- Enter class name **MyMath**
- Press **Finish**



Step-3

Create a Class to Test

- Add the following code in class **MyMath** within the **lab1** package of the **src** folder.

```
1.package lab1;

2.public class MyMath
3.{
4.    public int div( int a, int b )
5.    {
6.          return a / b;
7.    }
8. }
```

- The class has one method, **div(int, int)**, which performs some computation.

Class View (SUT)

Java - Lab1/src/lab1/MyMath.java - Eclipse SDK

File Edit Run Source Refactor Navigate Search Project Window Help

Pa Hi J

- Lab1
  - src
    - lab1
      - MyMath.java
  - test
    - lab1
      - MyMathTest.java
  - JRE System Library [jre7]
  - JUnit 4
  - UML

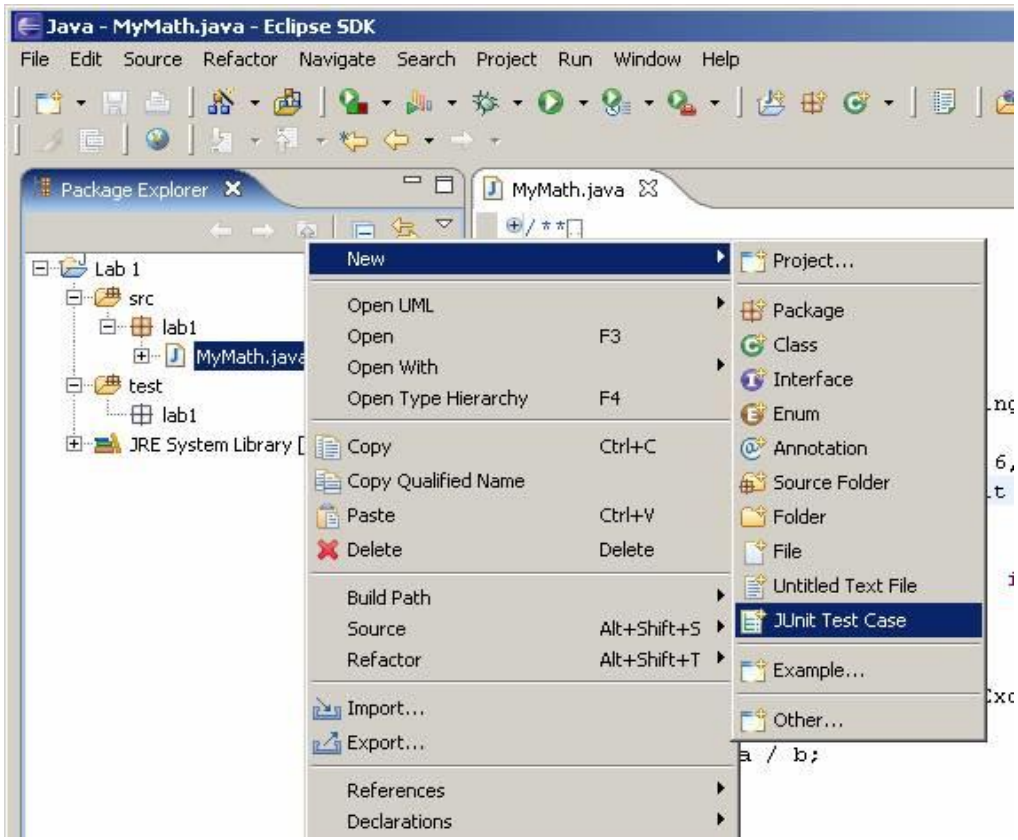
MyMathTest.java | MyMath.java

```
1  package lab1;
2
3  public class MyMath
4  {
5      /**
6       * perform division of two integer numbers
7       *
8       *
9       * @param a, must be integer
10      * @param b, must be integer
11      * @return, division result of a and b
12      */
13     public int div( int a, int b )
14     {
15         return a / b;
16     }
17 }
```

Step-4

Create a Test Case Class

- Select the class **MyMath**, and
- Right-click to get the popup menu.
- Select **New** > **JUnit Test Case**.



Step-5

New (JUnit Test Case)

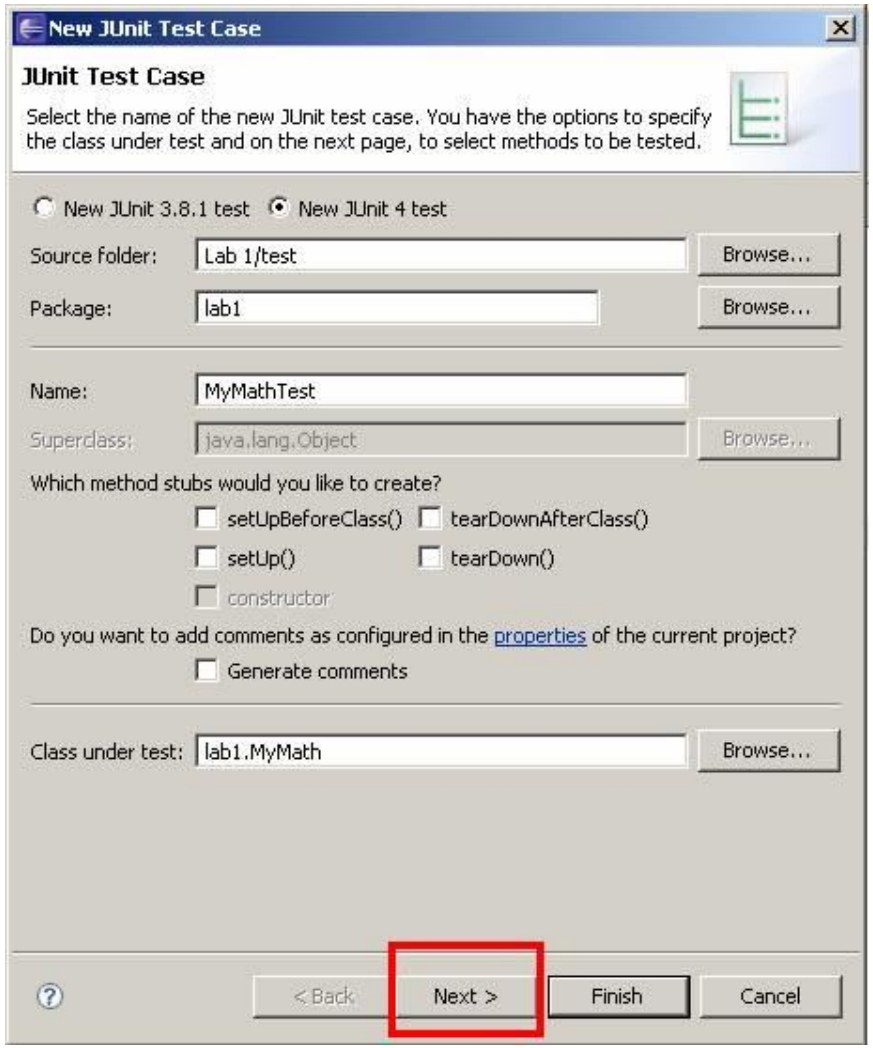
1. Select JUnit 4

2. Select the source folder of the test case to be **lab1/test**. To do this, click on the Browse… button on the same line and select the **test** folder.

3. **[Optional]** In the section "Which method stubs would you like to create?" check all of **setUpBeforeClass()**, **tearDownAfterClass()**, **setUp()**, and **tearDown()**. This will create methods with the annotations **@BeforeClass**, **@AfterClass**, **@Before**, and **@After**, respectively.

4. If you would like automatically generated comments, check the "Generate comments" box.

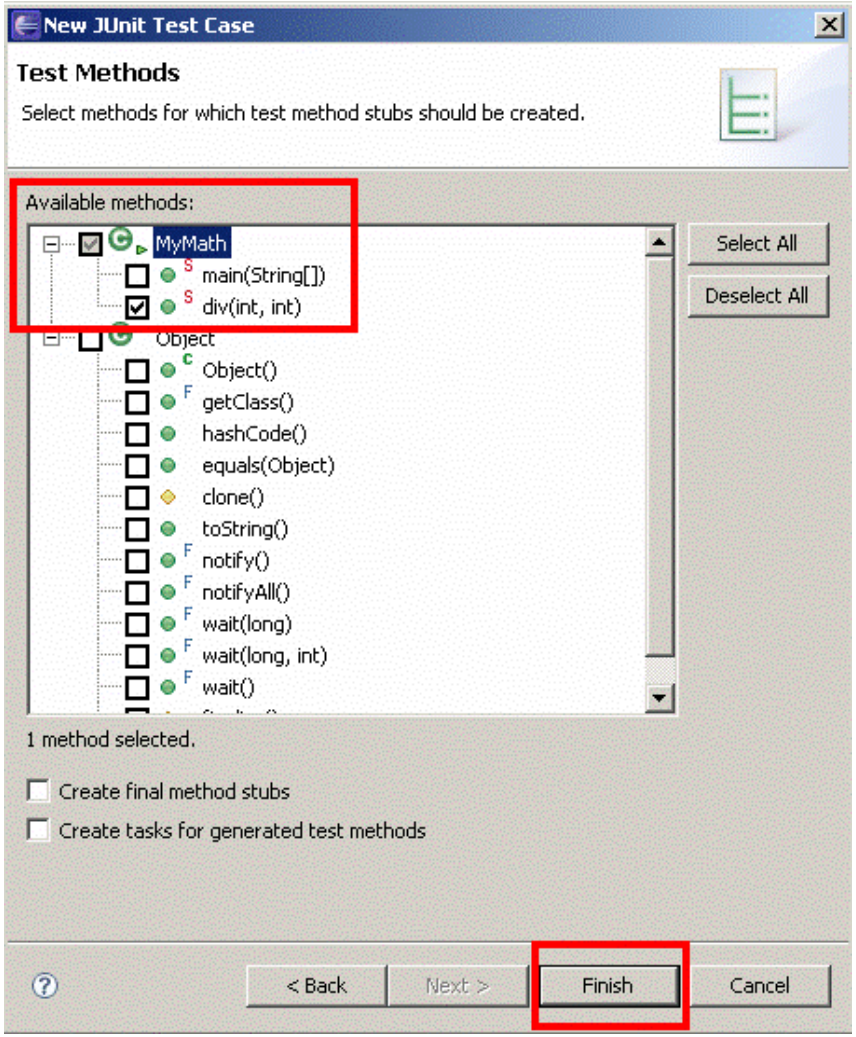
5. Click **NEXT**



Test Methods

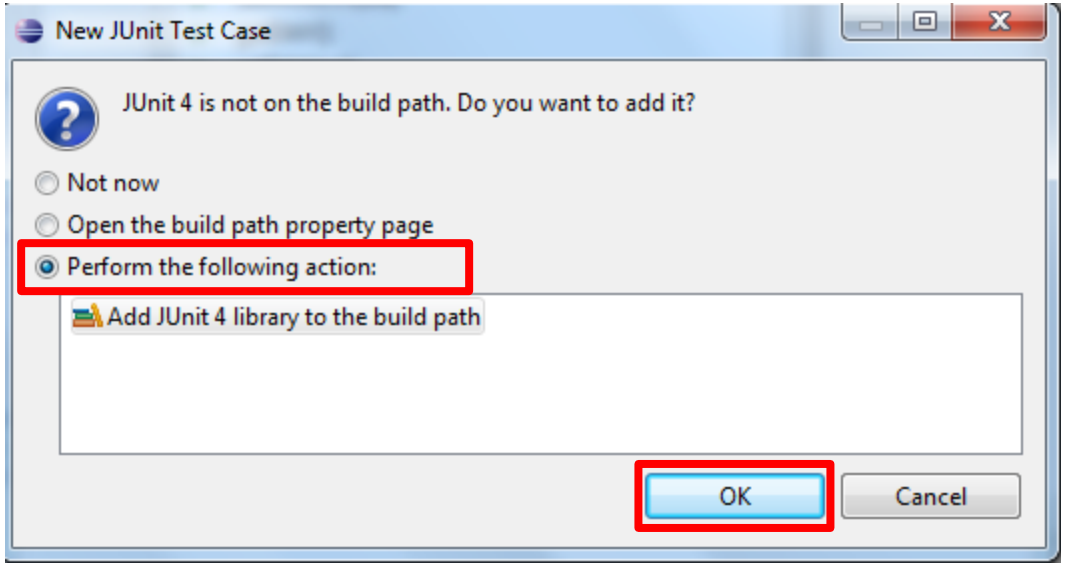
Step-5.3

- Select the method **div(int,int)** for testing, and then click Finish.



Choosing JUnit-4 Library [Optional]

- Select the highlighted option
  - Click on **OK**



Step-6

Test Case Class

A new file **MyMathTest.java** will be created with a new class **MyMathTest**. The file will be opened in a new editor window, and the contents should resemble the following code:

```
package lab1;

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

public class MyMathTest {

        @Test
        public void testDiv() {
            fail("Not yet implemented");
        }
}
```

Remove this line

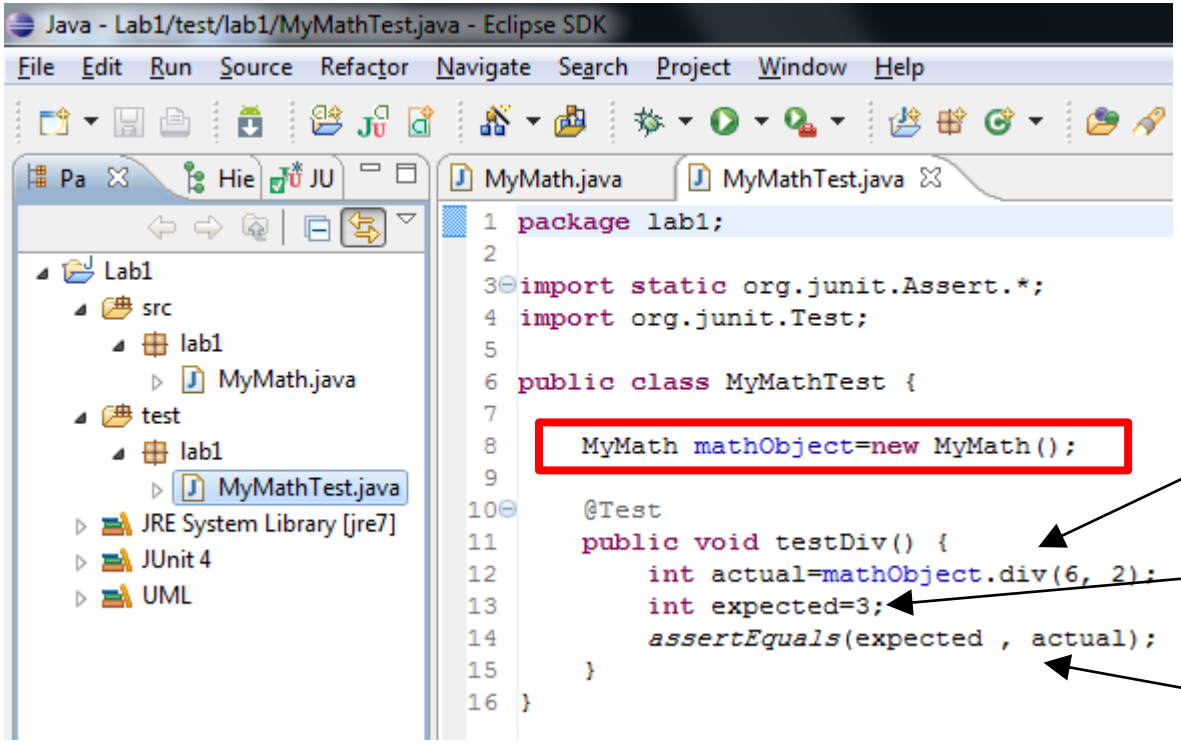
Proposed Test Case

- **Test Case for System Under Test (SUT)**
  - **MyMath.div**(int, int)
  - This method has two integer parameters and it will return the division of two input numbers (e.g. **6** and **2**).

TEST CASE	INPUT		EXPECTED OUTPUT
	INTEGER-A	INTEGER-B	INTEGER-A/INTEGER-B = ?
TC-1	6	2	3

Implementation of Test Case

- Implementation of **TC-1** in **testDiv()**
  - *Add the required code in **MyMathTest***

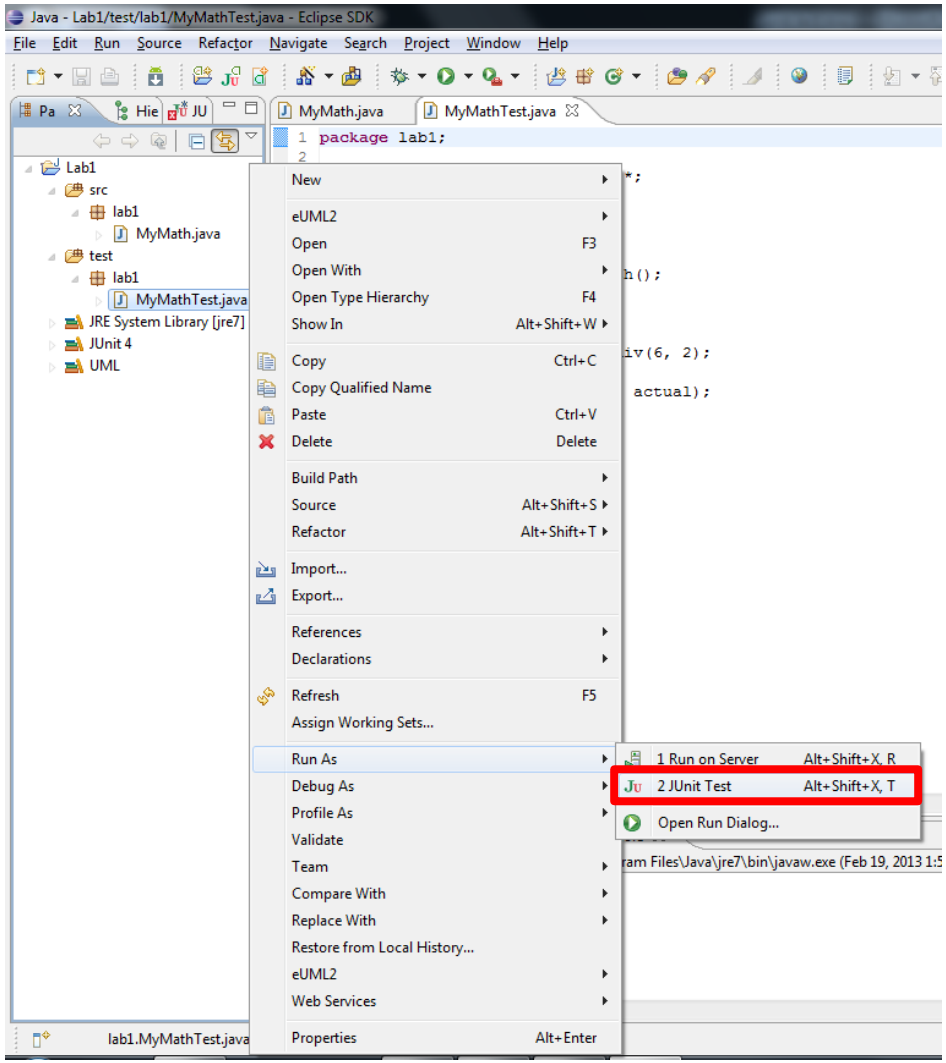


Actions send to **System Under Test** (SUT).

Responses expected from **SUT**.

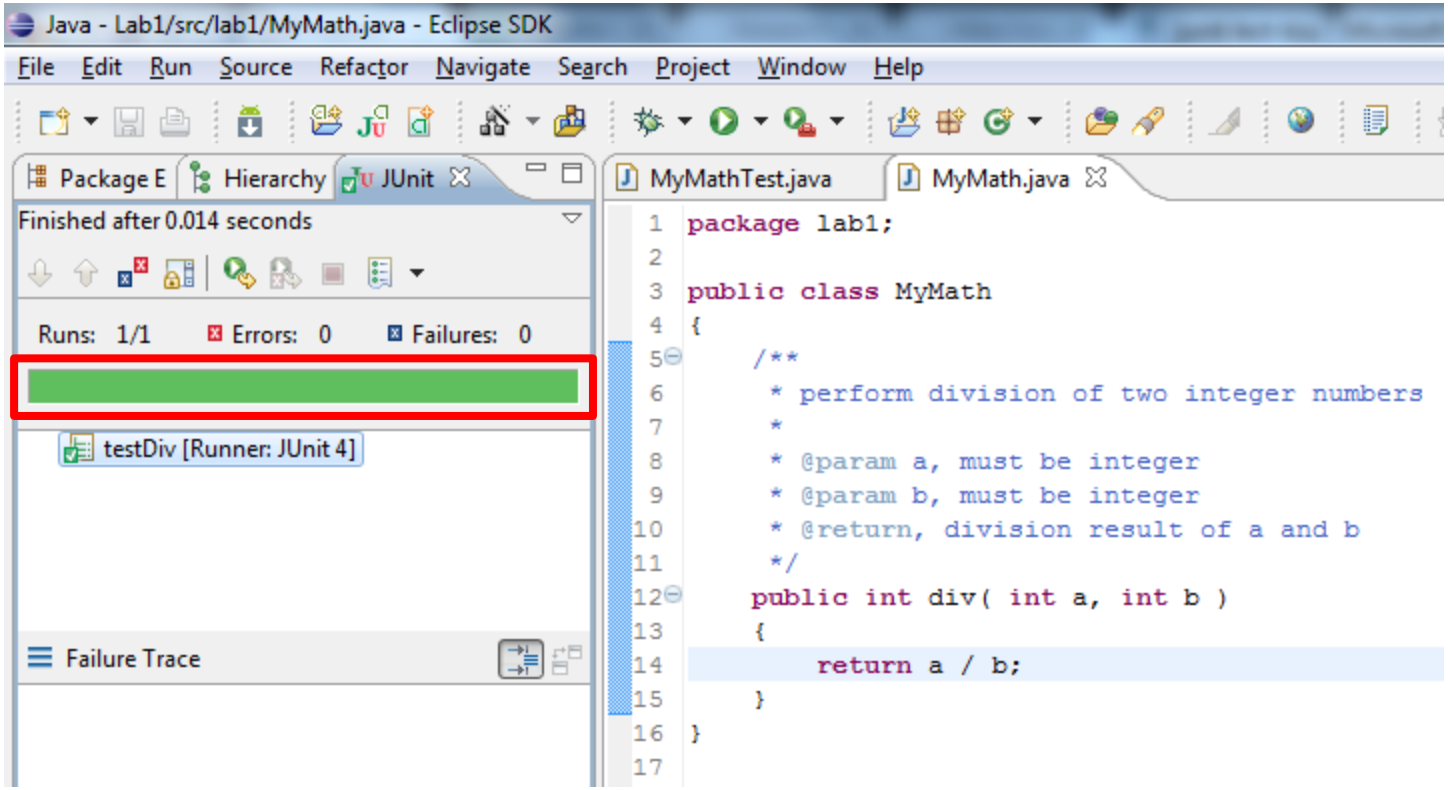
Determine whether a test was successful or not?

Run the JUnit Test Case



Test Verdict - *PASS*

- **Finally**, we got the green bar, our test is successful.



QUIZ - 1

- **Practical Lab Quiz**
  - **Date:** Next Week
  - **Time:** 02:00PM
- **Topics Covered**
  - Junit test method implementation
- **Rules**
  - Absence = Zero (0) Points