# Lab 3 – Data Types, Math, Input

## Aim

The aim of this lab is to learn about different variable types, integer/double arithmetic, and input using Scanner.

## Resources

You will find your lecture notes to be very useful. Your lab notes from last week will be a useful guide. This work builds on work that you should have finished last week.

## Tips:

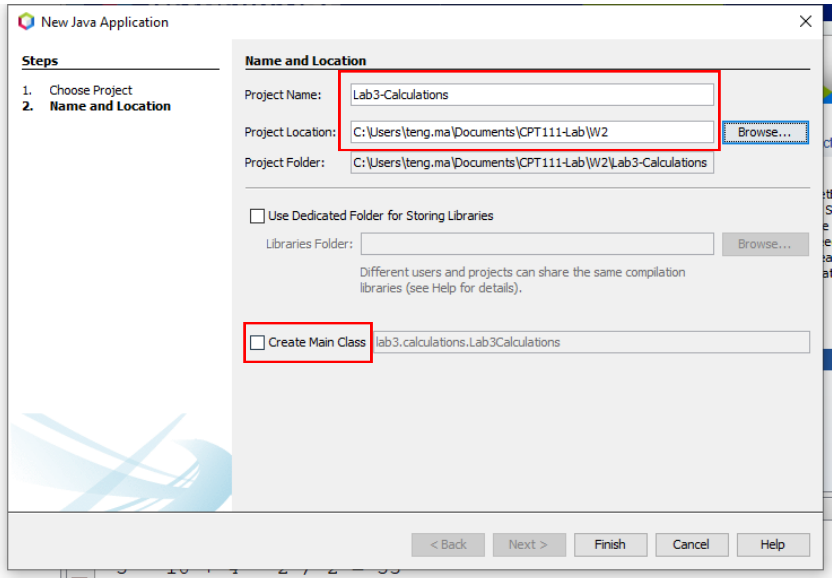
1. Remember, ask a TA in the chatroom/LM Forum if you have problems, they are here to help you!

2. This lab sheet is expected to take more than the allocated hours. You should complete it in your own time before the next classes.

## Java Project Management

- This week, we will modify your calculations class from last week.

- Create a new project, call it `Lab3-Calculations`, and make sure it does not have a new main class (make sure the "Create Main Class" box is not ticked)



Project Name: Lab3-Calculations

Project Location: C:\Users\teng.ma\Documents\CPT111-Lab\W2

Project Folder: C:\Users\teng.ma\Documents\CPT111-Lab\W2\Lab3-Calculations

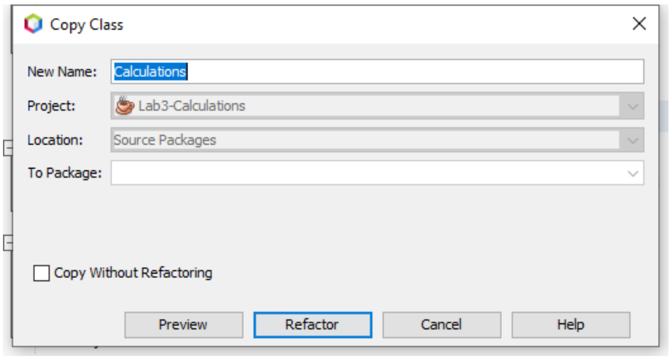
☐ Use Dedicated Folder for Storing Libraries

Libraries Folder:

Different users and projects can share the same compilation libraries (see Help for details).

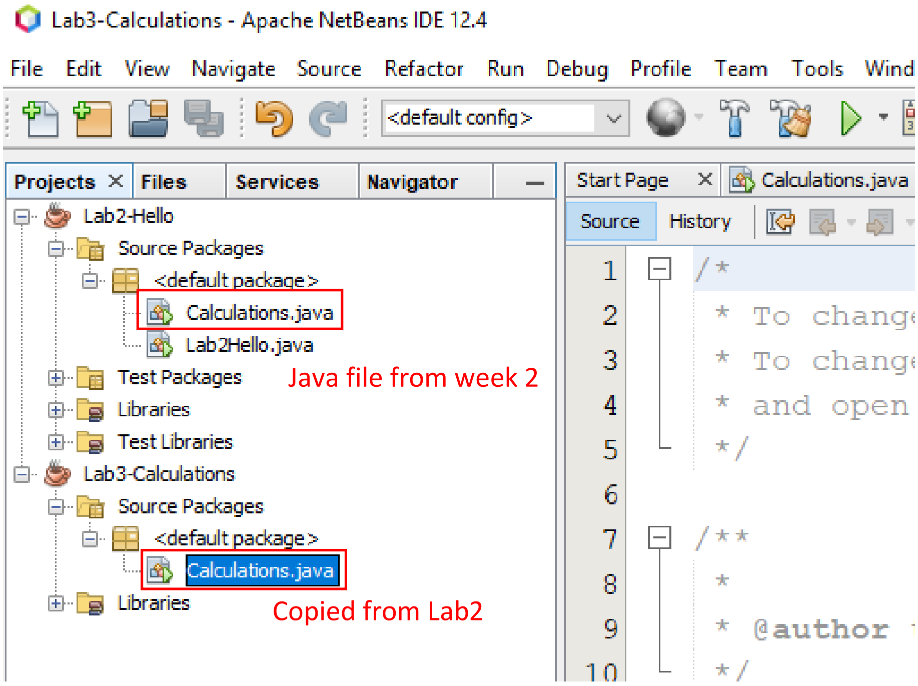
☐ Create Main Class lab3.calculations.Lab3Calculations

- Copy your Calculations.java file (right-click on the Calculations.java file, press copy, and then paste it to your new source package folder in Netbeans) from your old project to your new project. Next, select the "Refactor copy"



New Name: Calculations
Project: Lab3-Calculations
Location: Source Packages
To Package:
□ Copy Without Refactoring

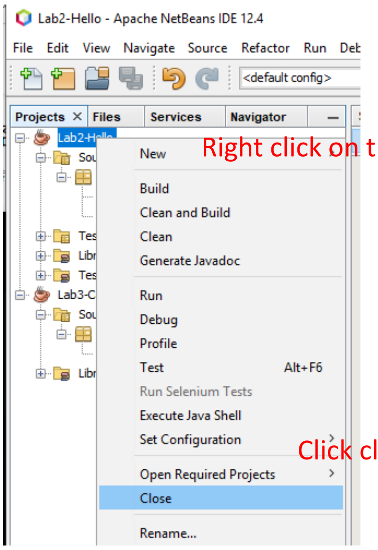
- This will create a copy of your Class while keeping the old class in your old project



Java file from week 2

Copied from Lab2

- Close your project from last week, so that you do not accidentally run the wrong file (see below)



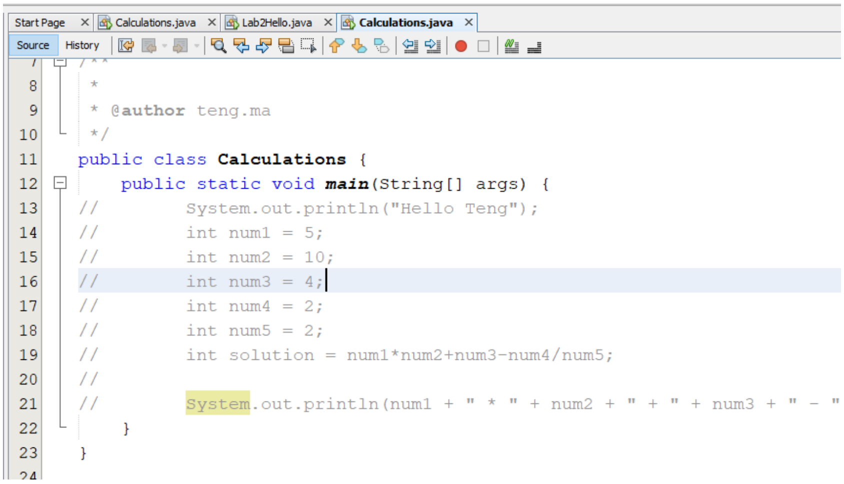
Right click on the project name

Click close

- This is the process of creating a new project with existing Java code and is useful to ensure that you have a backed-up copy of each week's Lab

## Variable Types and Calculations – Ints and Mods

- You will have a lot of code from week 1, but do not delete it, as it could be useful! So first, comment it out. You can comment out code, by putting 2 forward slashes ("//") at the start of each line, or you can achieve this by pressing **Ctrl + /** on your keyboard, as shown below



```
/**
 *
 * @author teng.ma
 */
public class Calculations {
    public static void main(String[] args) {
//          System.out.println("Hello Teng");
//          int num1 = 5;
//          int num2 = 10;
//          int num3 = 4;
//          int num4 = 2;
//          int num5 = 2;
//          int solution = num1*num2+num3-num4/num5;
//
//          System.out.println(num1 + " * " + num2 + " + " + num3 + " - "
    }
}
```

- Using your Week 1 work as a guide, declare 2 integer variables called num1 and num2. Assign them values of num1 = 2 and num2 = 3

- Create an integer variable called sol, and make sol = num1 + num2

- Use a System.out to output your solution, use text like:

  ```
  System.out.println("The solution to num1+num2 is " + sol);
  ```

- Create calculations for num1*num2, num1-num2, and num1/num2, and output the answers to your console window

- Check your answer to num1/num2. Is the answer what you expect?

- Add additional code to calculate the modulo (%), num1 % num2. Output the result on the screen. Is the answer what you expect?

- Experiment with different values for num1 and num2 for both integer division (/) and modulo (%). First work out the expected answer on paper. Then experiment with your program. Is the result what you expect? Try num1 = 5, num2 = 7; or num1 = 30, num2 = 4; or others.

## Variable Types and Calculations – Doubles and Operator Precedence

- So far you have used integers, which means your answers have been returned in **whole numbers**

- Change your `int` values to doubles (instead of `int num1`, call it `double num1`) to store **real numbers**. Look at the results of your calculations. Do they match what you expect? What is the difference? Try for the same variables as you tried above

- Now try a new calculation. Initialise and Assign 3 double variables as shown below

```
        double val1 = 4;
        double val2 = 8;
        double val3 = -1;
```

- Use these variables to create the calculation (*replace* the numbers with your variables)

```
        double complexCalc = 4 + 8 * -1 - 4 + 4 / 8 + -1;
```

- Calculate the answer to this calculation on paper; what do you expect it to be?

- Now add a system.out to display the Java calculation, and compare your result to your result. Are your answers different? If they are, then try to work out why.

- The lecture notes discuss the **precedence of operators**. Can you add **parentheses ()** so that the result will be -2.5?

## Variable Types and Calculations – Maths and Randoms

- Java can perform much more complex calculations. To do this, you can use `Math` class, which can be accessed by typing "`Math.`" in Netbeans, and a list of options will appear. For example, to get the value of the constant Pi, type in `Math.PI`

- Comment out your previous code

- Output PI as a System.out (i.e. "`The value of Pi is 3.141592653589793`")

- Can you calculate the square root of 5 (look at the lecture notes)?

- Recall from the lecture, that `Math.random()` will give you a random real number between `0.0` and `1.0`, but not including `1.0`. In math symbol, `[0.0, 1.0)`. Therefore, using it to generate a random integer `randomInteger` between `min` and `max`, we can use the formula `randomInteger = min + (int)(Math.random() * (max - min + 1))`

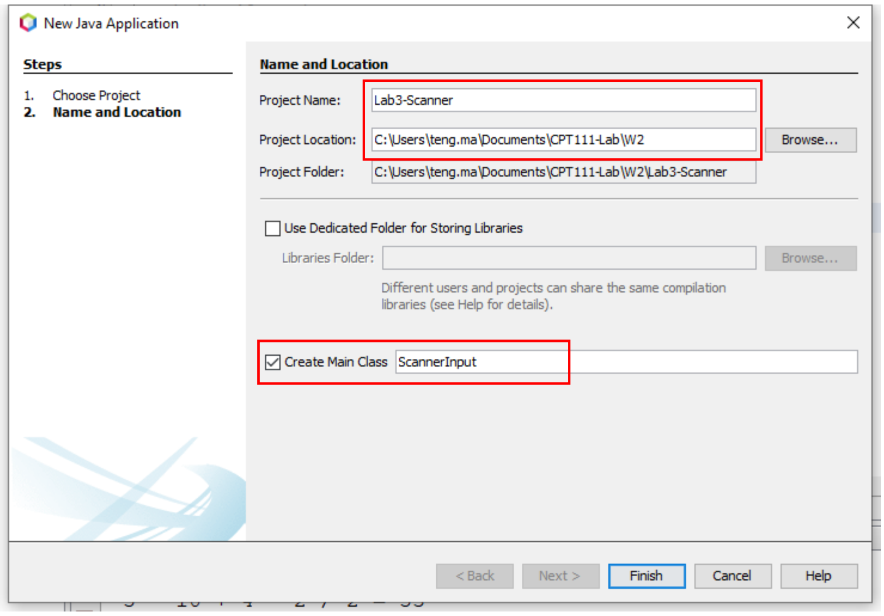
- Now, generate a random whole between 2 and 5. Output a message like "`The random value is 3`"

- Compile and run the program several times; does the message change each time? Congratulations, you have generated a random number!

## Introduction to the Scanner

The `Scanner` object is a useful way to access characters that you type.

- Create a new Java Project, call it `lab3-scanner`, and create a new java class `ScannerInput`, with the main method.



New Java Application

Steps

1. Choose Project
2. **Name and Location**

Name and Location

Project Name: Lab3-Scanner

Project Location: C:\Users\teng.ma\Documents\CPT111-Lab\W2

Project Folder: C:\Users\teng.ma\Documents\CPT111-Lab\W2\Lab3-Scanner

□ Use Dedicated Folder for Storing Libraries

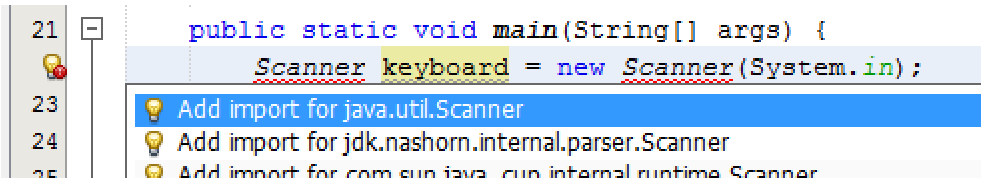
Libraries Folder:

Different users and projects can share the same compilation libraries (see Help for details).

☑ Create Main Class ScannerInput

- Using your lecture notes, add a new `Scanner` object, named `keyboard`

- This may cause an error in Netbeans, click on the small lightbulb to the left of the line to find out more about the error:



```
public static void main(String[] args) {
    Scanner keyboard = new Scanner(System.in);
```

- Add import for java.util.Scanner
- Add import for jdk.nashorn.internal.parser.Scanner
- Add import for com.sun.java_cup.internal.runtime.Scanner

- The error here is because the `Scanner` object requires an external library to be used, i.e. something outside the standard Java code. Click the "Add import for java.util.Scanner" option

- Check the top of your Java class. You should see that the line:

  ```
  import java.util.Scanner;
  ```

  has been added to your code. Every time you need to use a Java library, you will need to import it before you can use it

- To use the `Scanner` successfully, it is first useful to add a prompt to display a message. So below your `Scanner` creation, add a System.out, asking "`What is your name?`"

- To then receive the input from the `Scanner`, you need to receive the input. Using your lecture notes, create a `String` variable called `input`, and initialise it to `keyboard.nextLine()`. Here, the output of the `Scanner` is being assigned to a variable.

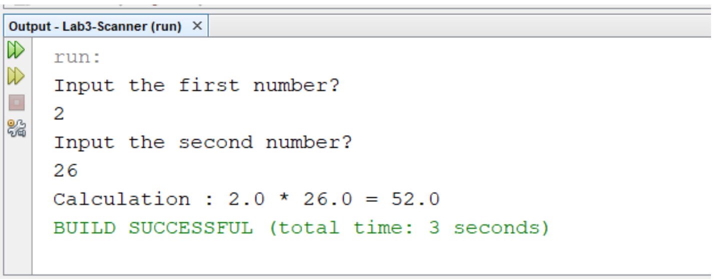
- When you run the program, you should be able to click on the console window and then type your name.

- Add a `System.out` to display your name, so the final console output should look like:

```
Input name
Teng
Hello Teng!
```

## Further Use of the Scanner

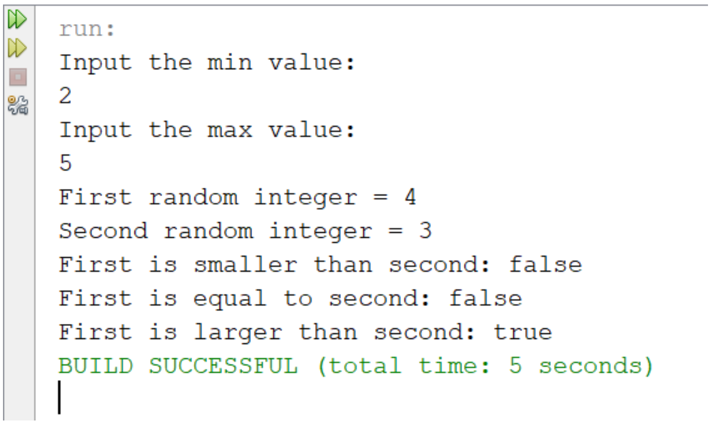
- Sometimes, you may want to use a numeric value rather than a String value. Comment out some of your code, and create a scanner input that will receive 2 double values, multiply them, and display the result.
    - **Use `nextLine()`** and then **convert** the string to double, as discussed in lecture notes
- Your console result should look like this:



```
run:
Input the first number?
2
Input the second number?
26
Calculation : 2.0 * 26.0 = 52.0
BUILD SUCCESSFUL (total time: 3 seconds)
```

## Lab Exercise 3.1 Larger Smaller Random Numbers

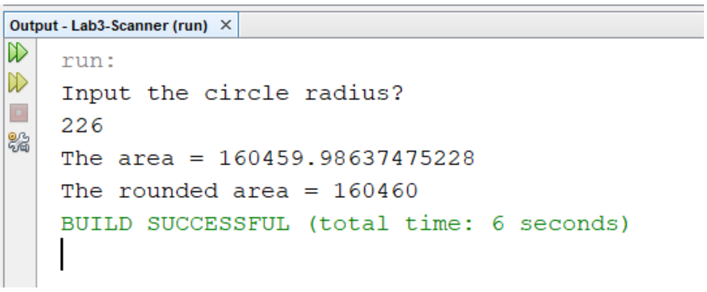
- Write a Java program that takes two input integers, `min` and `max`, from the user, and generate two random integers between `min` and `max`, inclusive
- After that, print two two random integers and report whether one is smaller, equal to, or larger than the other
- Use boolean value (`true` or `false`) to report the comparison between the two random integers
- Your program's input/output interaction should look like:



```
run:
Input the min value:
2
Input the max value:
5
First random integer = 4
Second random integer = 3
First is smaller than second: false
First is equal to second: false
First is larger than second: true
BUILD SUCCESSFUL (total time: 5 seconds)
```

## Lab Exercise 3.2 Calculations Using Math

- Write a Java program that takes an input double, `radius`, from the user, and compute the area of a circle, $a = \pi * radius^2$
- After that, print the area a in `double`, and also the area rounded to the nearest integer Recall that Math.round returns a `long`, and you can use casting to convert it into `int` For example, `(int) Math.round(2.715)` is evaluated to an integer 3
- You may want to use constants and functions from the `Math` class
- Your program’s input/output interaction should look like:



```
run:
Input the circle radius?
226
The area = 160459.98637475228
The rounded area = 160460
BUILD SUCCESSFUL (total time: 6 seconds)
```

This is the end of CPT111 2022 Lab 3 Task Sheet.