Introduction

Dr. Tamer ABUHMED

Java Programming Course (SWE2023)

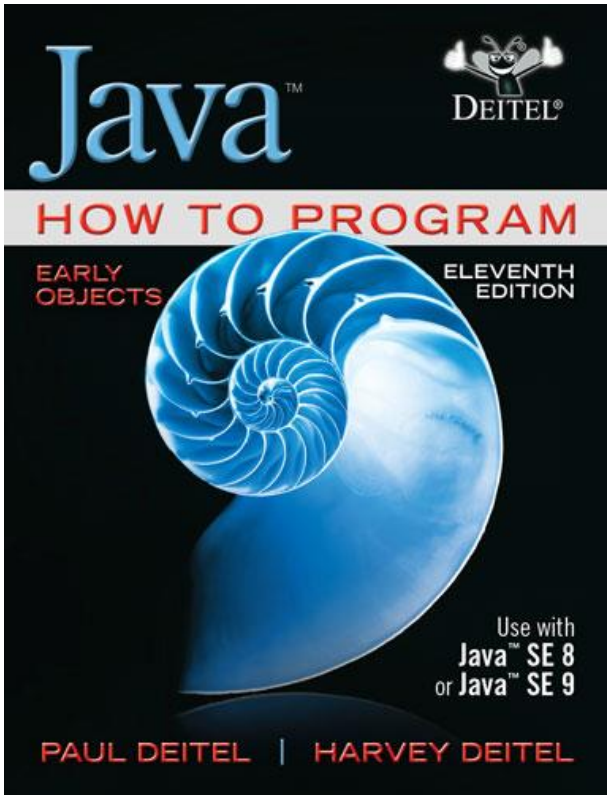
College of Computing

SUNG KYUN KWAN UNIVERSITY

Course Overview

- **Staff**
  - ABUHMED, Tamer - 타메르 (tamer@skku.edu)
  - TA - TBD

- **Textbook**: Java How to Program (ed. 10 or 11)



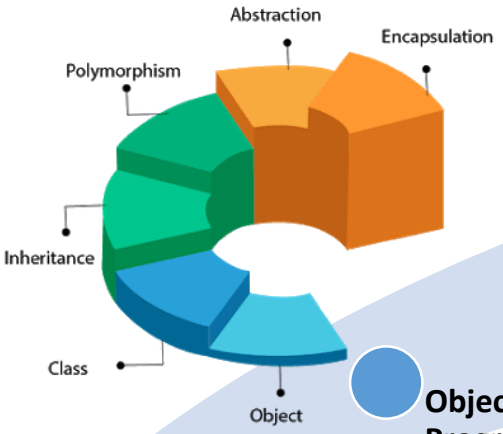
- Grading Policy

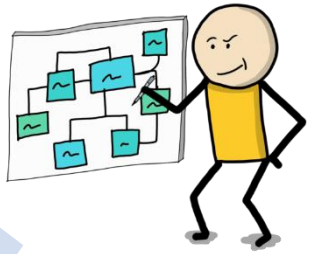
  Assignments (40%), Final exam(30%),

  Attendance (10%), **Class Projects** (20%)

- Cheating Policy
  - Automatic **F** for both

Course Plan





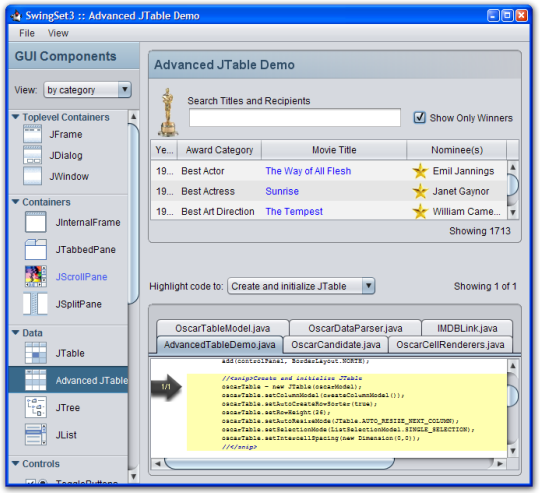
Introduction

Java basics for C++ programmers

Object-oriented Programming

- Classes
- Inheritance
- Polymorphism
- Abstraction
- Exceptions

Graphical User Interface



Advance Topics

- **Generic Collections**
- **Files, Streams and Object Serialization**
- **Java Network Programming**

Important!

- This class is about “Java programming”
- Java syntax will be discussed, but you will have to learn the basics stuffs (if .. Else, loop, functions, etc.) by yourself.

Prerequisite(very strict)

- Object oriented programming C++
- Comfortable in programming using at least one language

Caution!

- This class will require intensive java programming for a skillful programmer (more than 5 hours per week)

Introduction To Java

- Most people are familiar with Java as a language for Internet applications

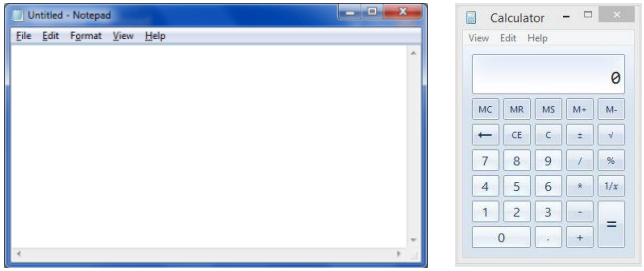
Applet
Servlet
Java Server Pages (JSP)

- We will study Java as a general purpose programming language
  - The syntax of expressions and assignments will be similar to that of other high-level languages such as C++.
- Java is the world's most widely used computer programming language.

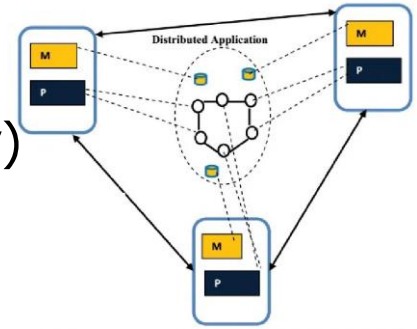
Java Applications

- Standalone applications
  - Console Applications
  - Swing Applications (GUI)
- Web applications
  - Applet
  - Servlet
  - JSP
- Mobile applications
  - J2ME Applications
  - Android Applications
- Distributed Applications
  - Enterprise Java Beans (EJB Technology)

- Embedded Systems Applications
- Java Card Applications
  - smart card programing



Swing Applications (GUI)

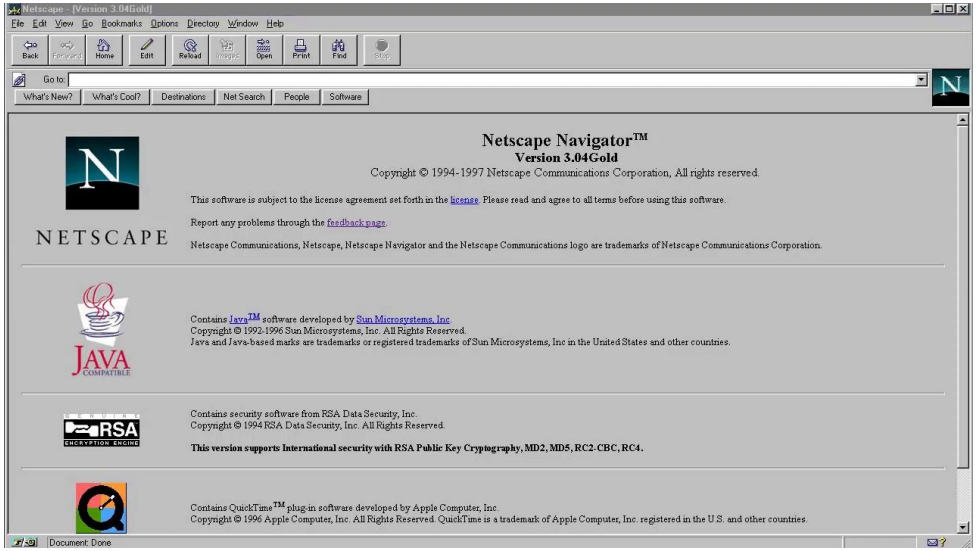


Origins of the Java Language

- Created by Sun Microsystems team led by James Gosling (1991)
- **Why is it called Java?**
- First name of this language was Oak
- The name was existed,
  then it was renamed as Java.
- Originally designed for programming home appliances
  - Difficult task because appliances are controlled by a wide variety of computer processors
  - Team developed a two-step translation process to simplify the task of compiler writing for each class of appliances

Origins of the Java Language

- Patrick Naughton and Jonathan Payne at Sun Microsystems developed a Web browser that could run programs over the Internet (1994)
  - Beginning of Java's connection to the Internet
  - Original browser evolves into HotJava
- Netscape made its Web browser capable of running Java programs (1995)
  - Other companies follow suit



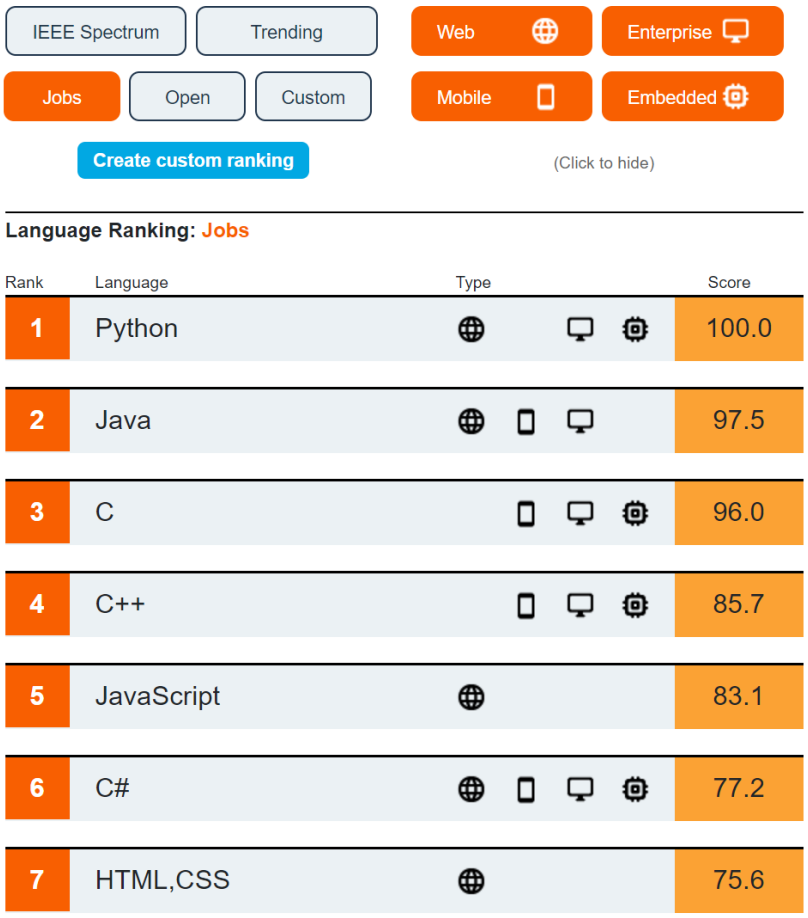
Java is everywhere!

- Sun Microsystems was acquired by Oracle in 2009.

ORACLE TECHNOLOGY NETWORK

- Based on www.java.com website statistics 2016:
  - ✓ 97% of Enterprise Desktops Run Java
  - ✓ 89% of Desktops (or Computers) in the U.S. Run Java
  - ✓ 9 Million Java Developers Worldwide
  - ✓ #1 Choice for Developers
  - ✓ #1 Development Platform
  - ✓ 3 Billion Mobile Phones Run Java
  - ✓ 100% of Blu-ray Disc Players Ship with Java
  - ✓ 5 Billion Java Cards in Use
  - ✓ 125 million TV devices run Java
  - ✓ 5 of the Top 5 Original Equipment Manufacturers Ship Java ME

Java is everywhere!



Source: [IEEE Spectrum]

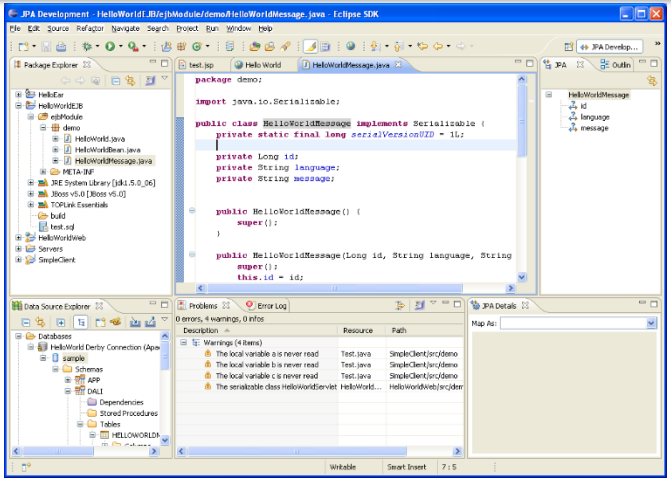
Java Features

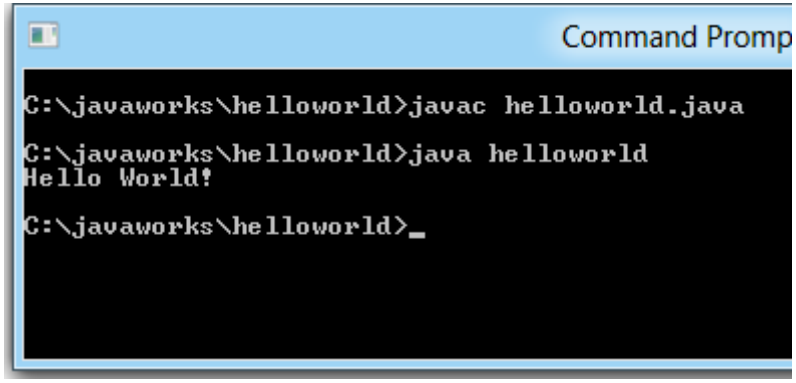
- Simple
  - No pointer
  - Automatic garbage collection
  - Not support multiple inheritances
  - Rich class library
- Object oriented:
  - All code is encapsulated in class.
  - All functions are associated with class.
  - Almost data types are objected

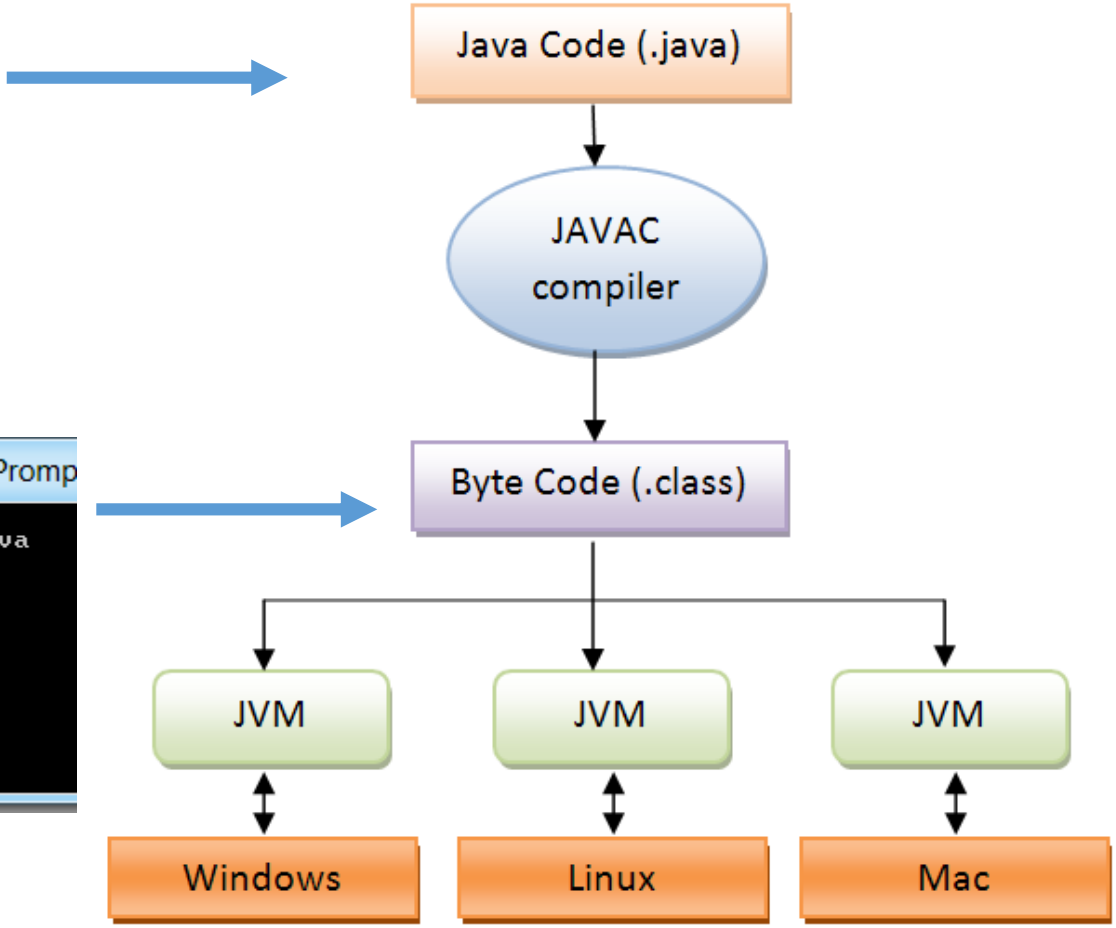
Java Code Execution

Life Cycle

Running Java-based Application







From Source to Machine Code

- *"Compiling a program"*

  translating from a high-level language (HLL) source code to machine (object, or executable) code.

- *"Compiler"*

  a program that translates HLL source code to machine (object, or executable) code.

- *"Assembly"*

  translating from assemble language source code to machine (object, or executable) code.

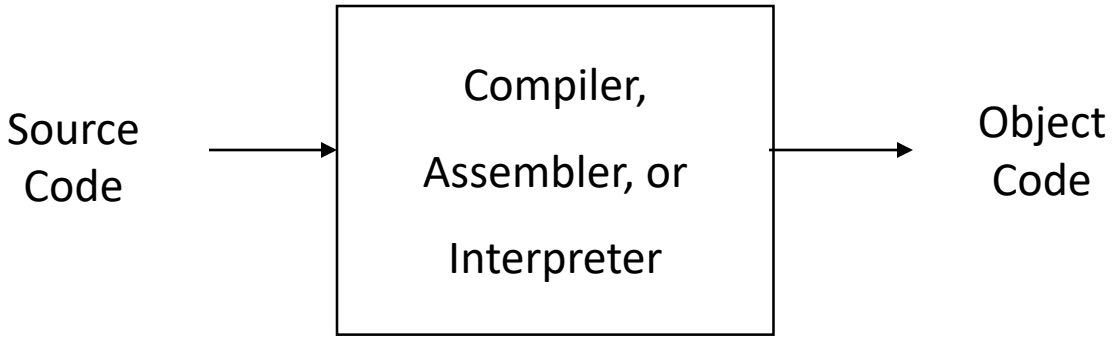
- *"Assembler"*

  a program that translates assembly source code to machine (object, or executable) code.

- Compilers need to know the specific target hardware

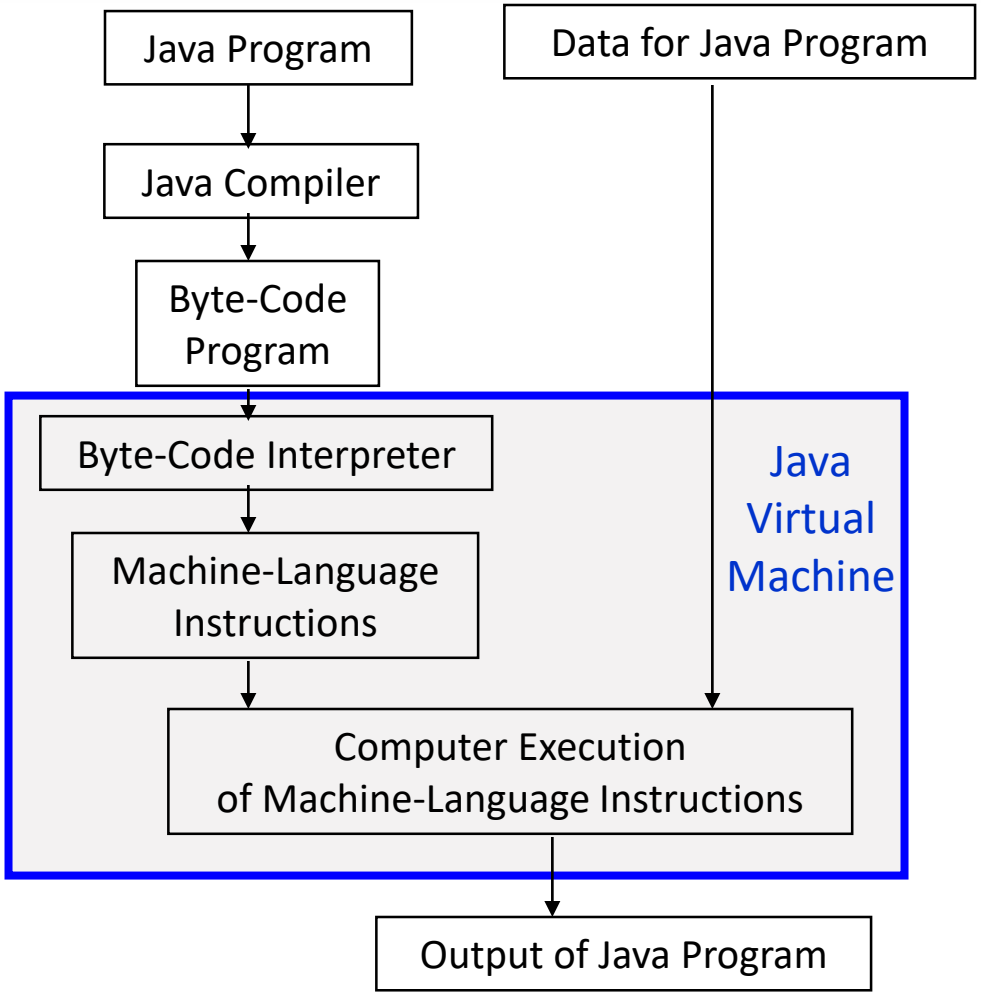
Compilers / Assemblers / Interpreters

- Compilers and Assemblers
  - translation is a separate user step
  - translation is "off-line," i.e. not at run time
- Interpreters - another way to translate source to object code
  - interpretation (from source to object code) is not a separate user step
  - translation is "on-line," i.e. at run time



Java Program Translation

- Both Compilation and Interpretation
- Intermediate Code: *"Byte Code"*
  - similar to assembly code, but hardware *independent*
- Interpreter translates from generic byte code to hardware-specific machine code



Java Byte Code

- **Generated** by Java compiler
  - Instead of generating machine language as most compilers do, the Java compiler generates byte code.
- **Translated** to machine language of various kinds of computers
- **Executed** by Java interpreter
- Invisible to programmer
  - You don't have to know anything about how byte code works to write a Java program.

Why Use Byte Code?

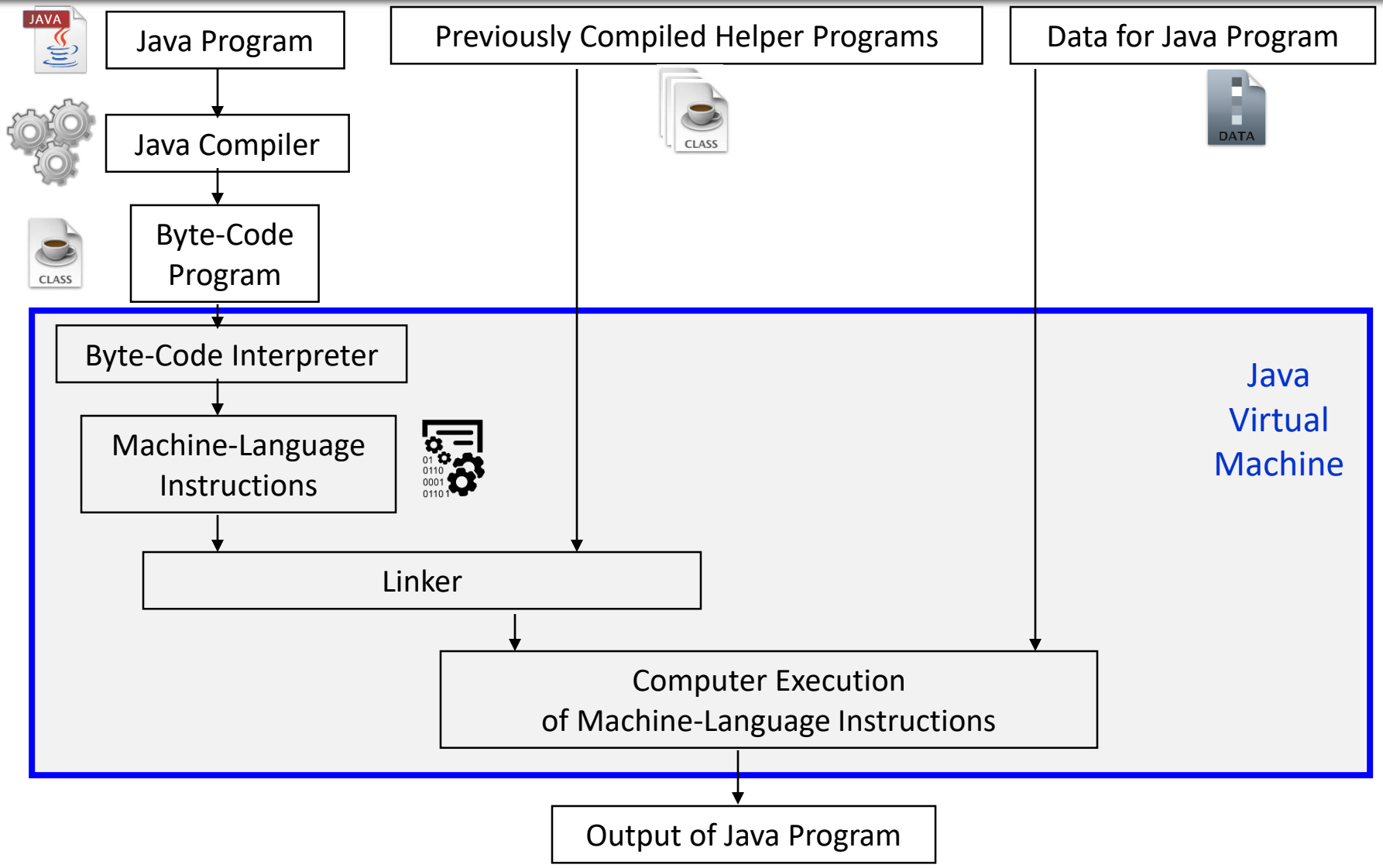
Disadvantages:

- requires both compiler and interpreter
- slower program execution

Advantages:

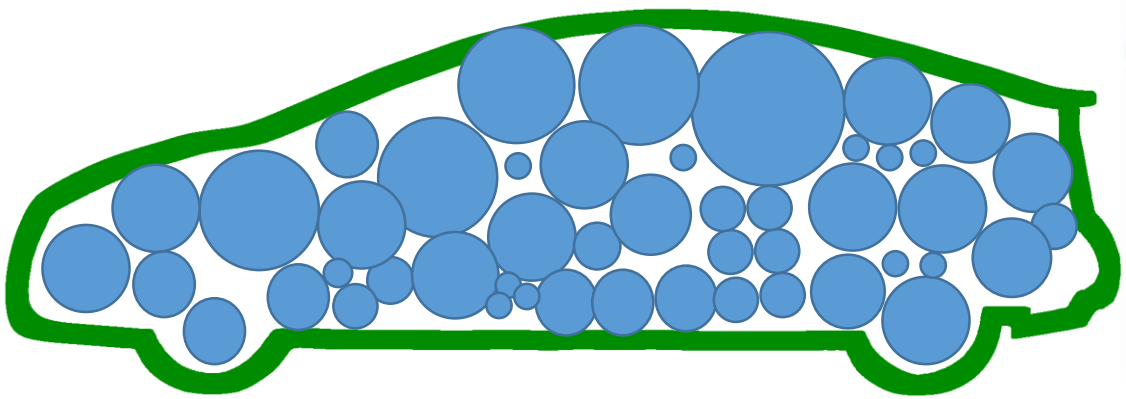
- portability
  - very important
  - same program can run on computers of different types (useful with the Internet)
  - Java compiler for new types of computers can be made quickly

Java Program Translation Including Linker



Object-Oriented Programming (OOP)

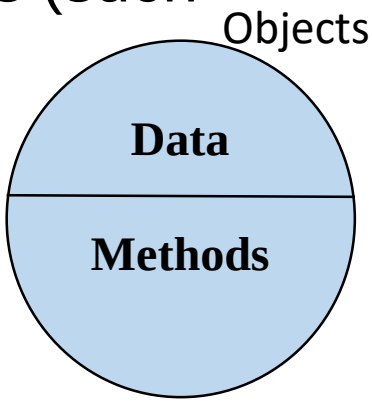
Objects and Methods



- Java is an object-oriented programming (OOP) language
  - Programming methodology that views a program as consisting of objects that interact with one another by means of actions (called **methods**)
  - Objects of the same kind are said to have the same type or be in the same class

Object-Oriented Programming: OOP

- A design and programming technique
- Some terminology:
  - **Object** - usually a person, place or thing (a noun)
  - **Method** - an action performed by an object (a verb)
  - **Type or Class** - a category of similar objects (such as automobiles)
- Objects have both data and methods
- Objects of the same class have the same data elements and methods
- Objects send and receive messages to invoke actions



Example of an Object Class

Example of an Object Class

Class: Automobile

Data Items:

- manufacturer's name
- model name
- year made
- color
- number of doors
- Body shape
- size of engine
- etc.

Methods: (action)

- Define data items (specify manufacturer's name, model, year, etc.)
- Change a data item (color, engine, etc.)
- Display data items
- Calculate cost
- Assemble
- etc.

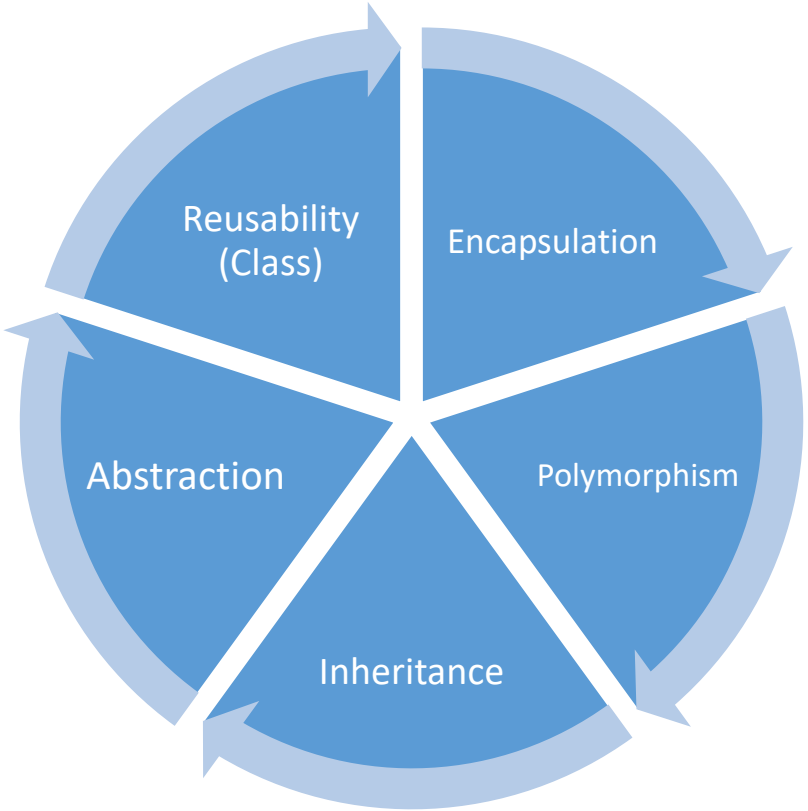
Why OOP?

- Easy to design software as building blocks.
- Save development time (and cost) by reusing code
  - once a class is created, it can be used in other applications
- Easier debugging
  - classes can be tested independently
  - reused objects have already been tested

Design Principles of OOP

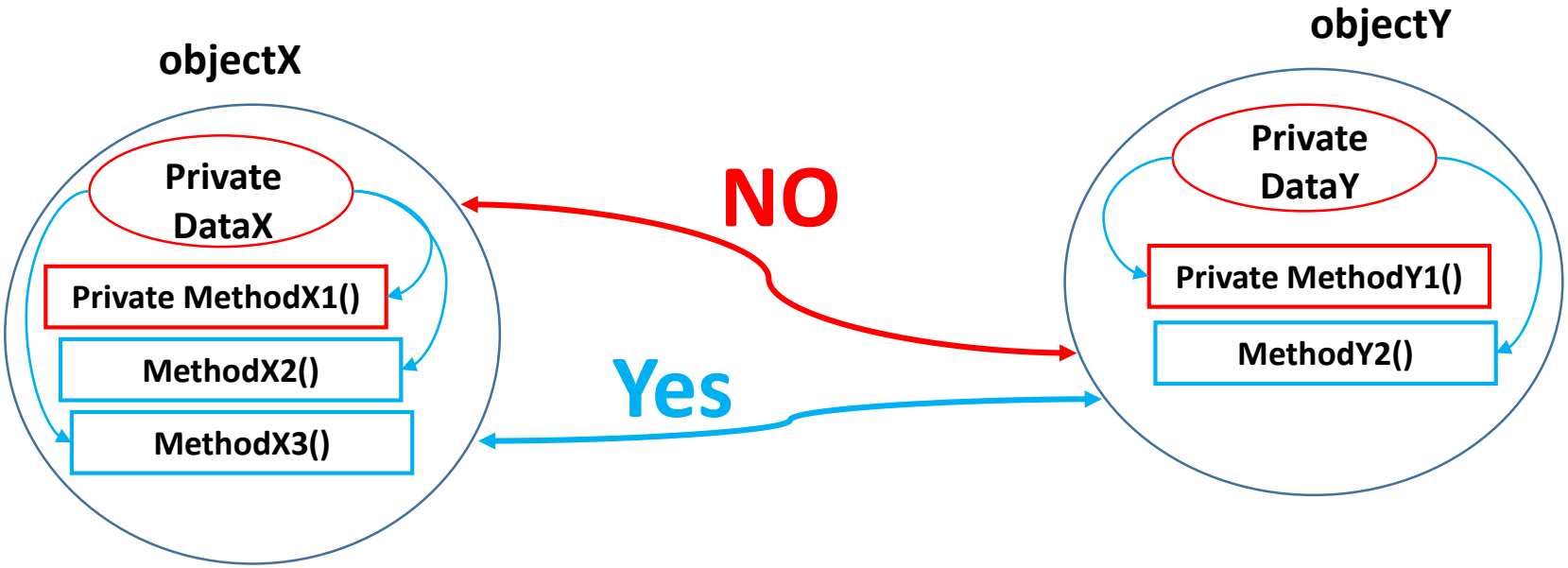
Three main design principles of Object-Oriented Programming (OOP):

- Encapsulation
- Polymorphism
- Inheritance



OOP: Encapsulation

- Design software
  - can be easily used
  - without knowing the details of how it works.
- Also known as *information hiding*



OOP: Reusable Components

Advantages of using reusable components:

- saves time and money
- components that have been used before
  - often better tested and more reliable than new software

Make your classes reusable:

- encapsulation
- general classes have a better chance of being reused than ad hoc classes

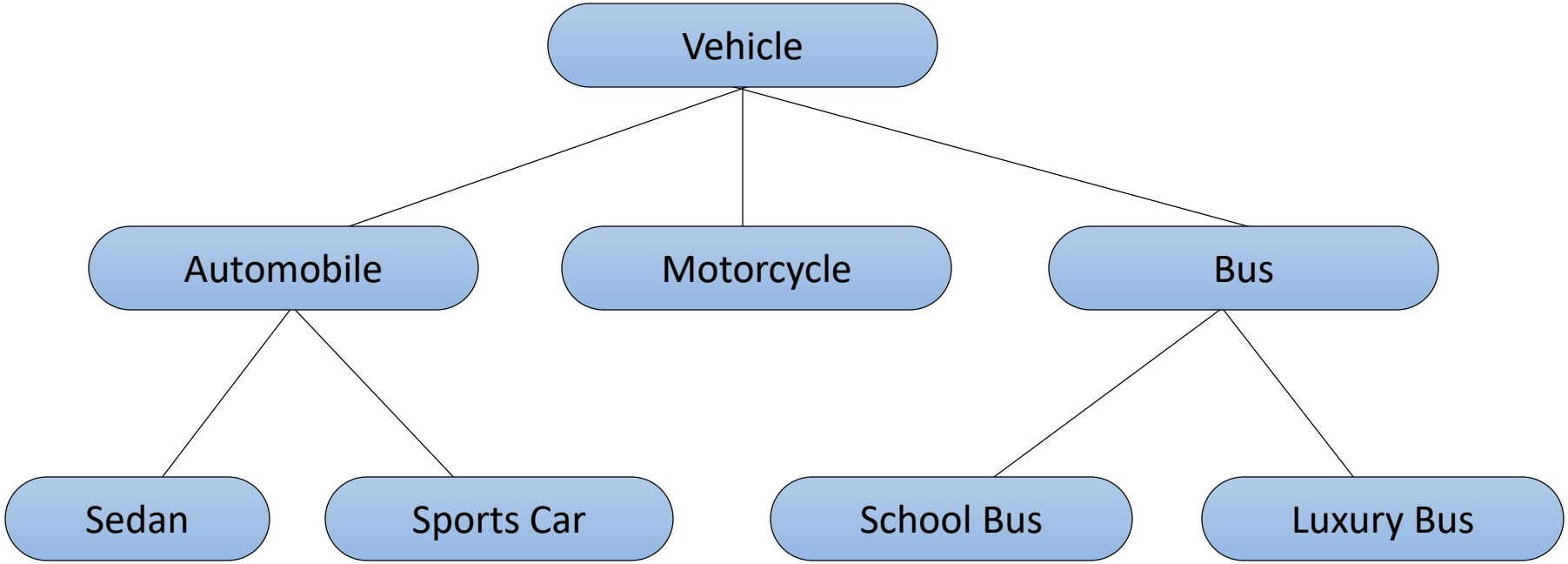
OOP: Polymorphism

- Polymorphism—the same word or phrase can be mean different things in different contexts
- Analogy: in English, **bank** can mean:
  - side of a river or
  - a place to put money
- In Java, two or more classes could each have a method called **output**
- Each **output** method would do the “right thing” for the class that it was in. E.g.
  - display a number (Integer class)
  - display an image (Photo class)

OOP: Inheritance

- Inheritance—a way of organizing classes
- Term comes from inheritance of traits like eye color, hair color, and so on.
- Classes with attributes in common can be grouped so that their common attributes are only defined once.

An Inheritance Hierarchy



What properties does each vehicle inherit from the types of vehicles above it in the diagram?

Java Simple Program

Source

```
public class Program1
{
 public static void main(String[] arg)
 {
    System.out.println("Hello World");
 }
}
```

Output

```
Hello World
```

Programming Environment

Setup and practices

Session Goals

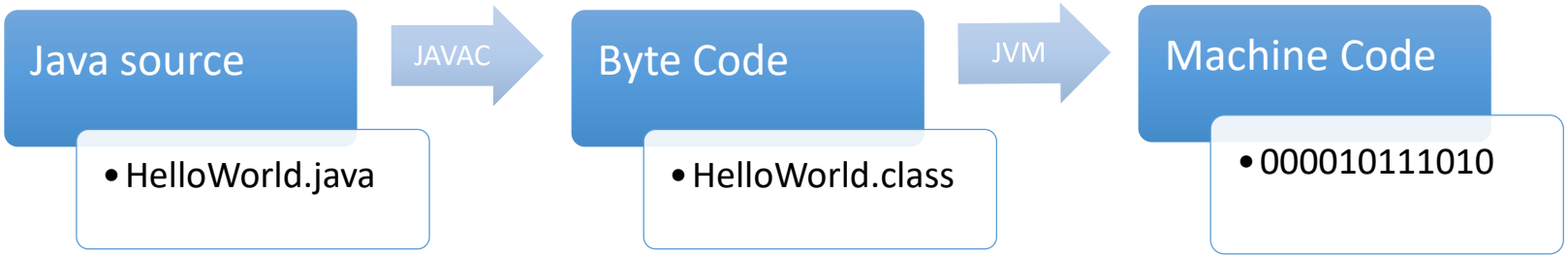
- Install development tools
- Start using **Eclipse** editor software
- Practice **writing**, **compiling**, and **running** Java programs
- Gain familiarity with **syntax errors** and debugging

Basic lab instructions

- Talk to your classmates for help. You can even work on the lab with a partner if you like.
- You may want to bring your textbook or look up the internet for syntax and examples.
- Stuck? Confused? Have a question? Ask a Lab Assistance (LA) for help, or look at the book or past lecture slides.
- Complete as many problems as you can within the allotted time. You don’t need to keep working on these exercises after you leave the lab.
- Feel free to complete problems in any way.

Recap Java

- Interpreted:
  - Compiled into byte code for the JVM (Java Virtual Machine).
  - Byte code is dependent on the Java platform, but is typically independent of operating system specific features.

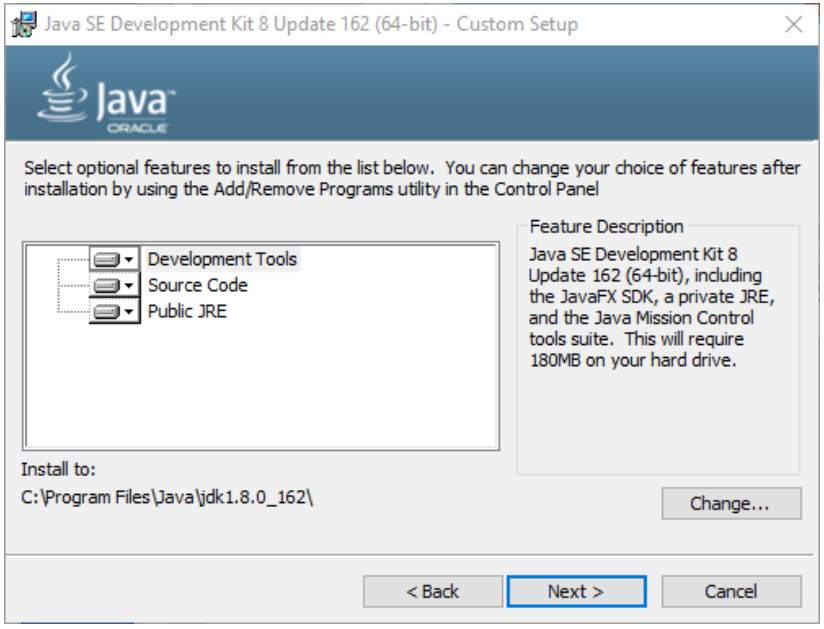


II. TUTORIAL

- ✓ Start project
- ✓ Your first program
- ✓ Running code
- ✓ Debug code
- ✓ Export to executable program

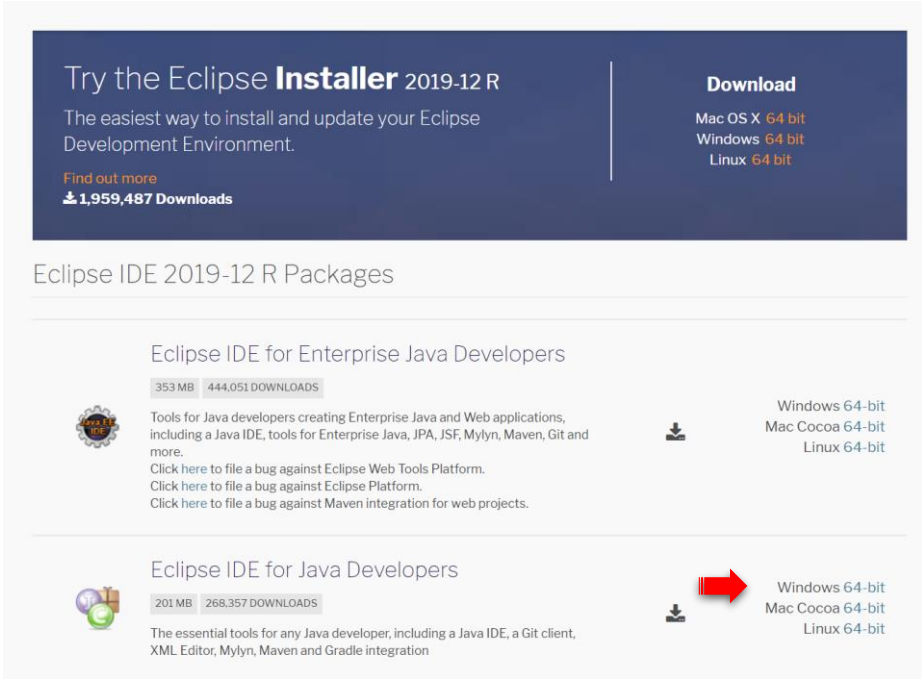
1. Software requirement

- Java SE Software Development Kit 8 (JDK 8~)
  Link:
  http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html
  - Run the execute file and follow the install steps.



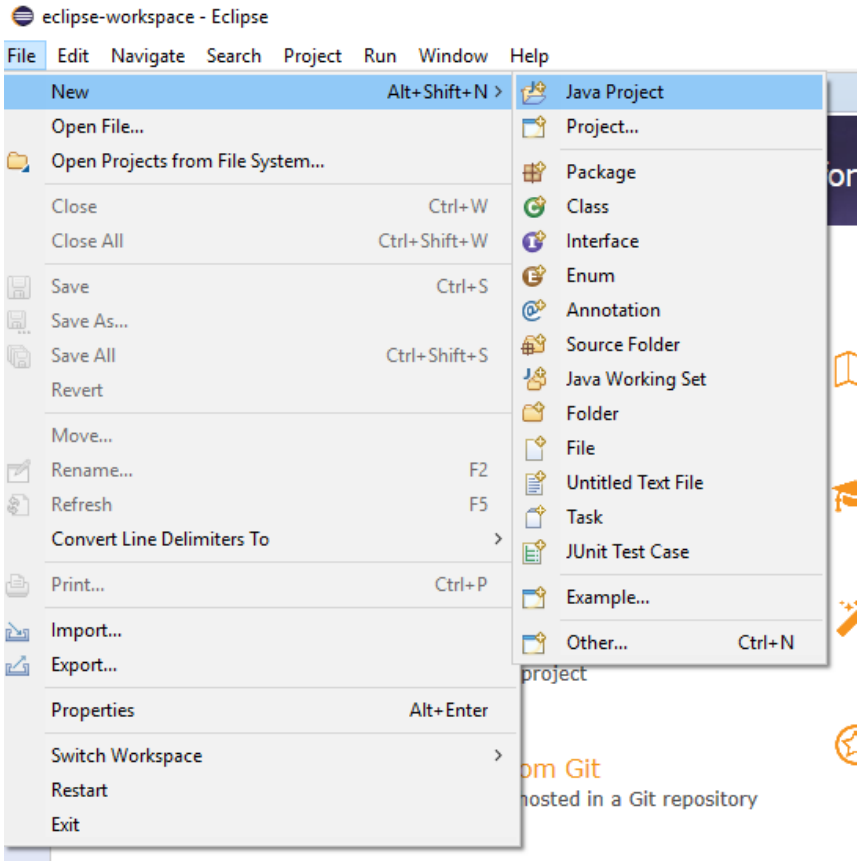
1. Software requirement

- Eclipse for Java Developer
  Link:
  https://www.eclipse.org/downloads/packages/
-

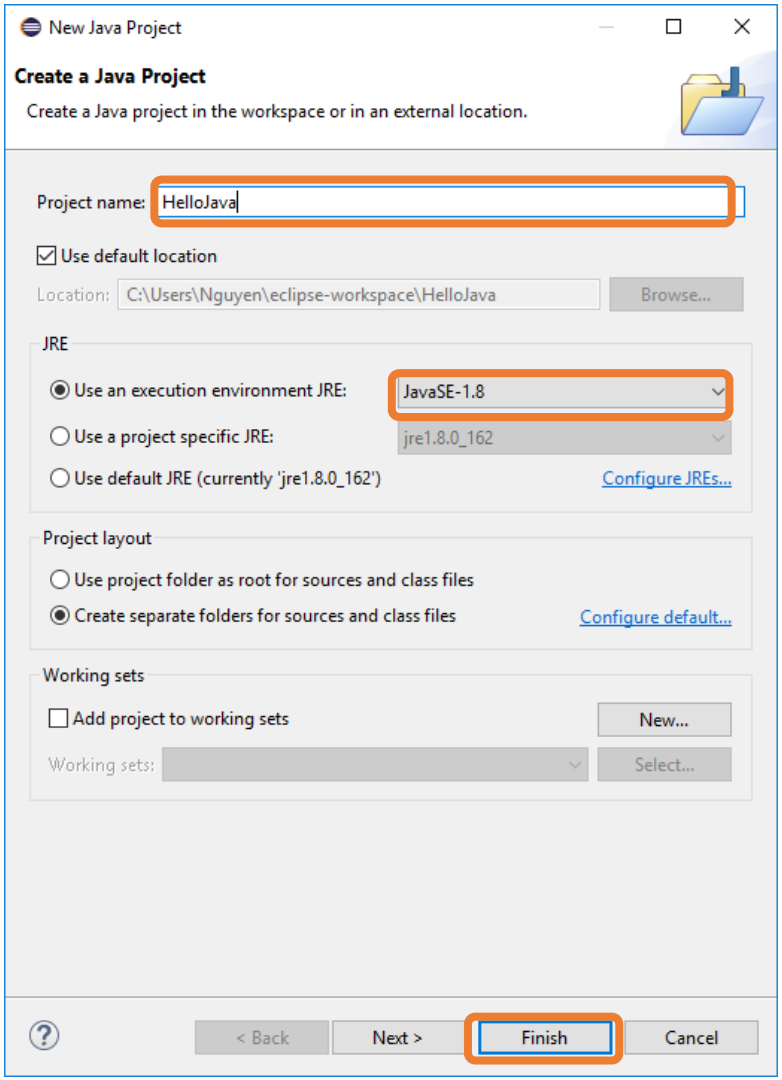


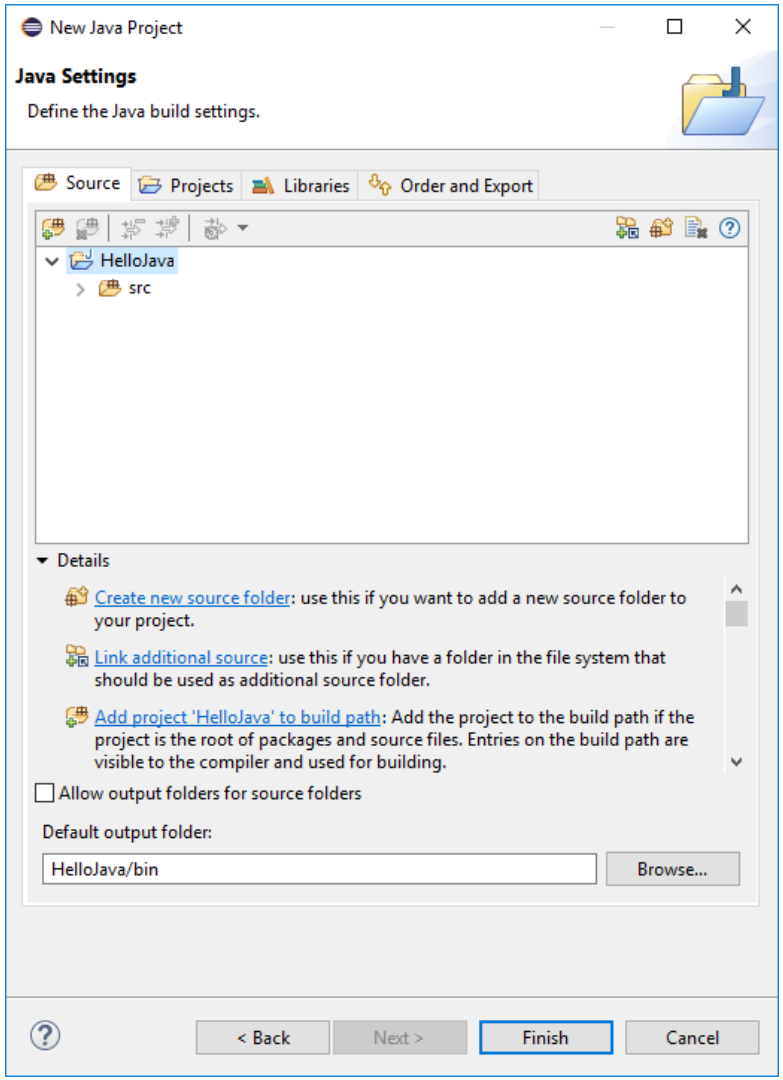
2. Working with Eclipse
Creating new project

- Open Eclipse, and create new project

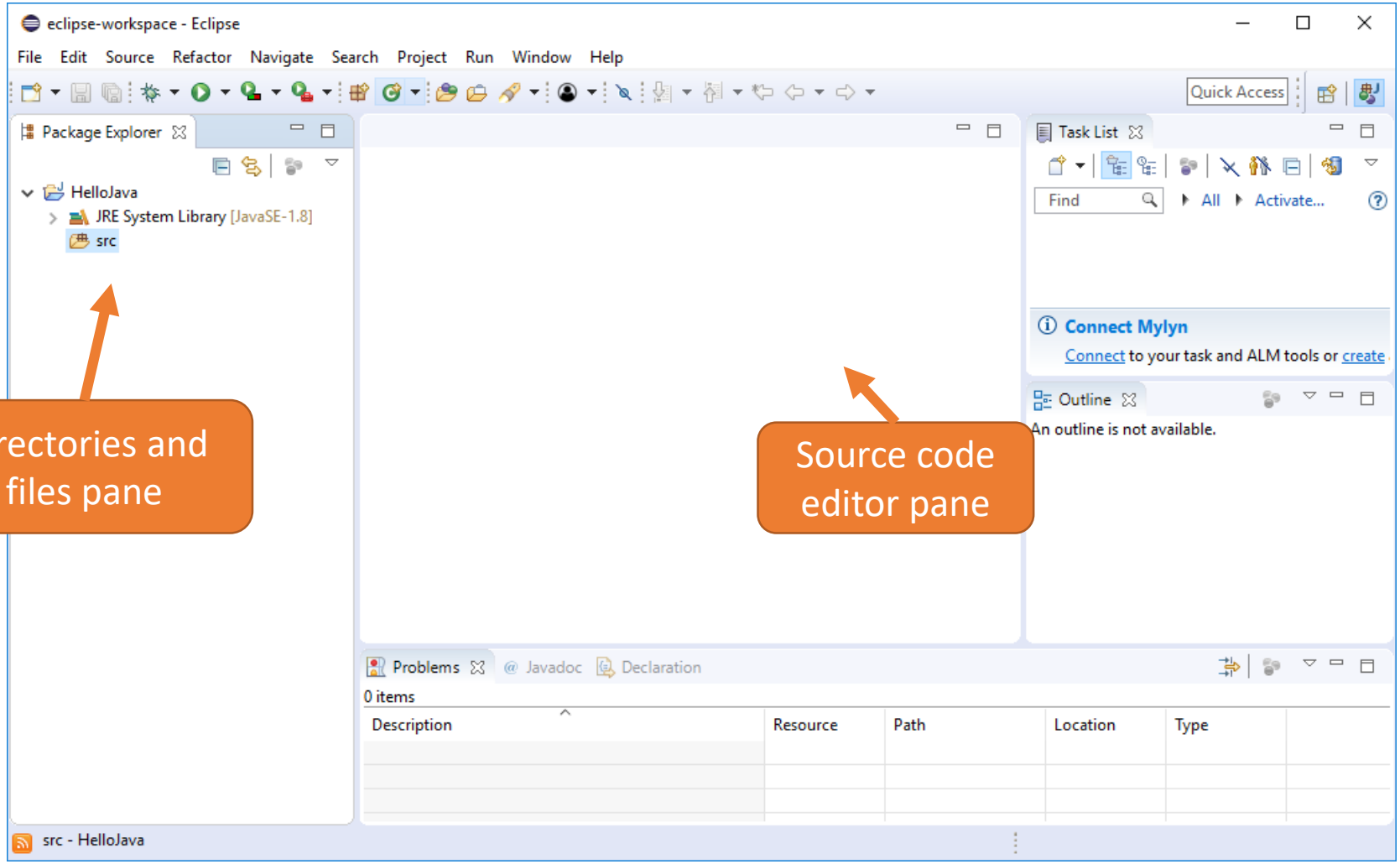


2. Working with Eclipse
Creating new project

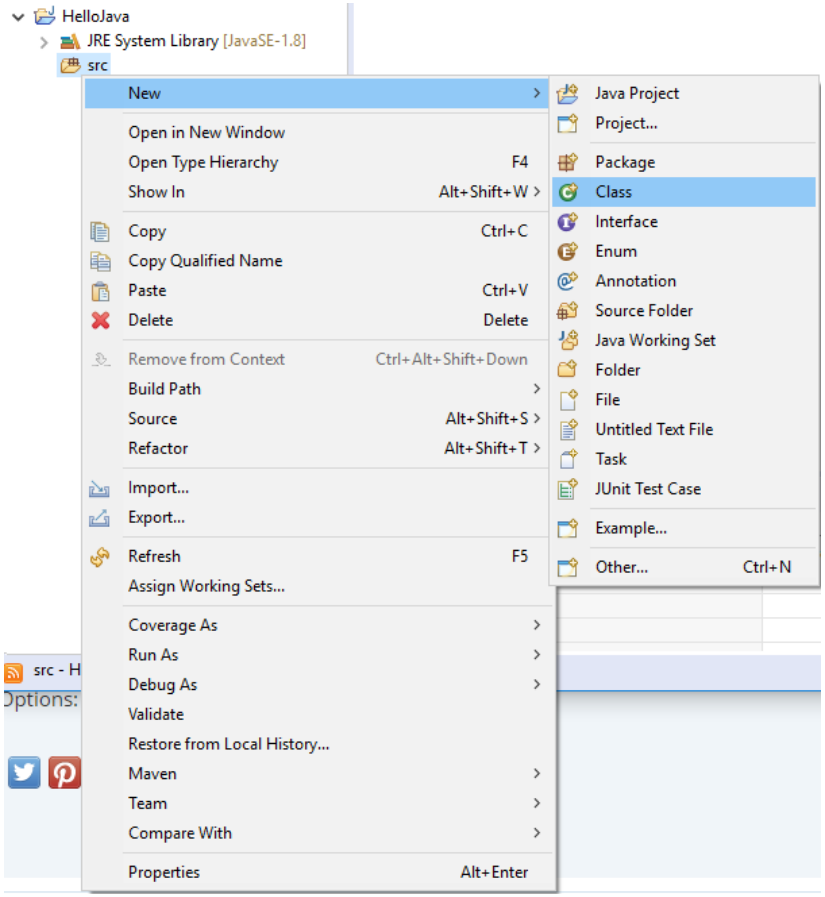


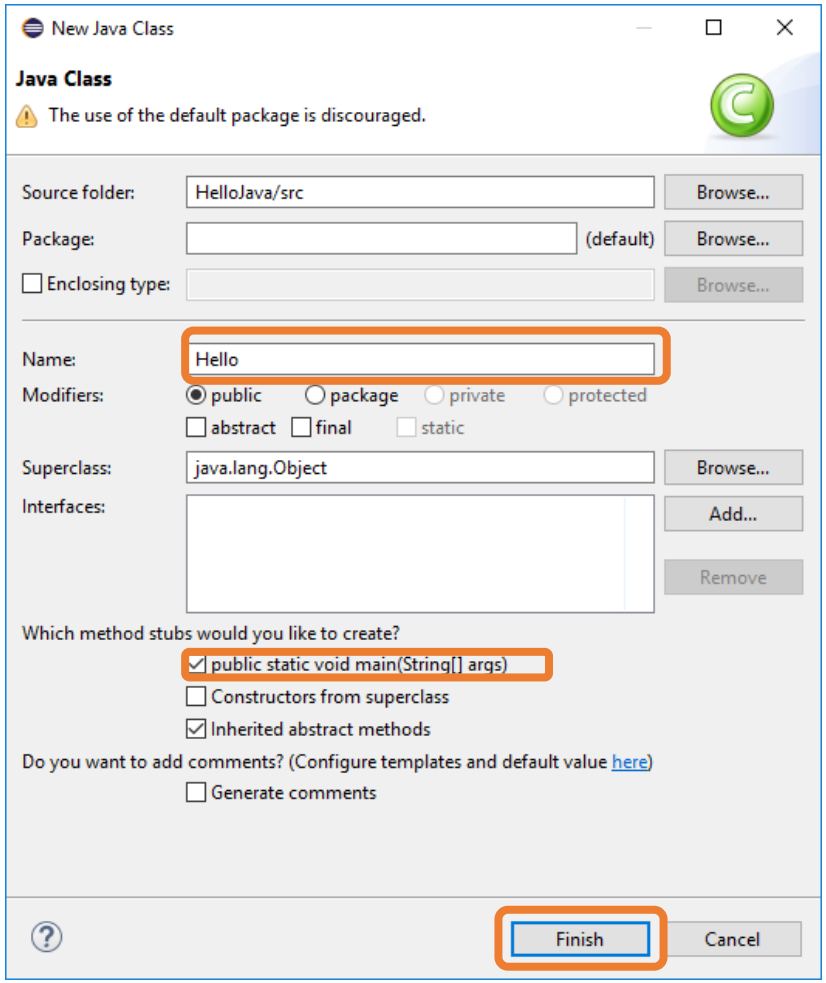


2. Working with Eclipse
Main GUI

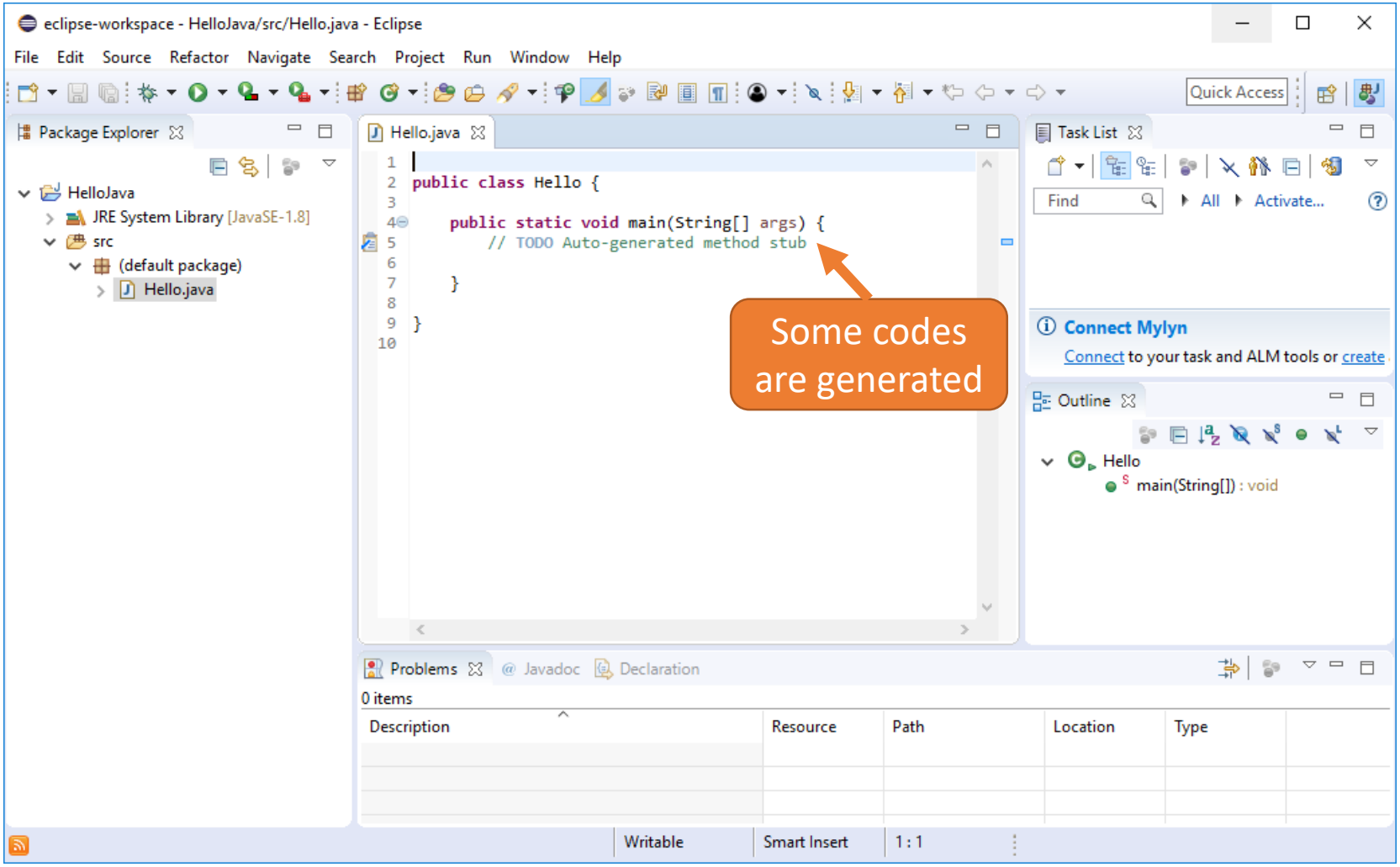


3. First Application
Creating a class





2. Working with Eclipse
Creating a class



3. First Application
Printing output

- Using to print function in java console application
- Standard
  - System.*out*.*print()*
  - System.*out*.*println()*
- With format
  - System.*out*.*printf()*
  - System.*out*.*format()*

```
int a = 10;
int b = 20;
// Tedious string concatenation.
System.out.println("a: " + a + " b: " + b);
// Output using string formatting.
System.out.printf("a: %d b: %d\n", a, b);
```

3. First Application
Printing output with format

- Format String:
  - % [**flags**] [**width**] [.**precision**] conversion-character (square brackets denote optional parameters)
- Flags:
  - **-** : left-justify (default is to right-justify)
  - **+** : output a plus (+) or minus (-) sign for a numerical value
  - **0** : forces numerical values to be zero-padded (default is blank padding)
  - **,** : comma grouping separator (for numbers > 1000)
  - : space will display a minus sign if the number is negative or a space if it is positive
- Conversion-Characters:
  - **d** : decimal integer [byte, short, int, long]
  - **f** : floating-point number [float, double]
  - **c** : character Capital C will uppercase the letter
  - **s** : String Capital S will uppercase all the letters in the string
  - **h** : hashcode A hashcode is like an address. This is useful for printing a reference
  - **n** : newline Platform specific newline character- use %n instead of \n for greater compatibility

3. First Application
Printing output with format example


```
long n = 461012;
System.out.format("%d%n", n);        //  -->  "461012"
System.out.format("%08d%n", n);      //  -->  "00461012"
System.out.format("%,8d%n", n);      // -->  " 461,012"
System.out.format("%+,8d%n", n);     //  -->  "+461,012"

double pi = Math.PI;
System.out.format("%f%n", pi);         // -->  "3.141593"
System.out.format("%.3f%n", pi);       // -->  "3.142"
System.out.format("%10.3f%n", pi);     // -->  "     3.142"
System.out.format("%-10.3f%n", pi);    // -->  "3.142"
```

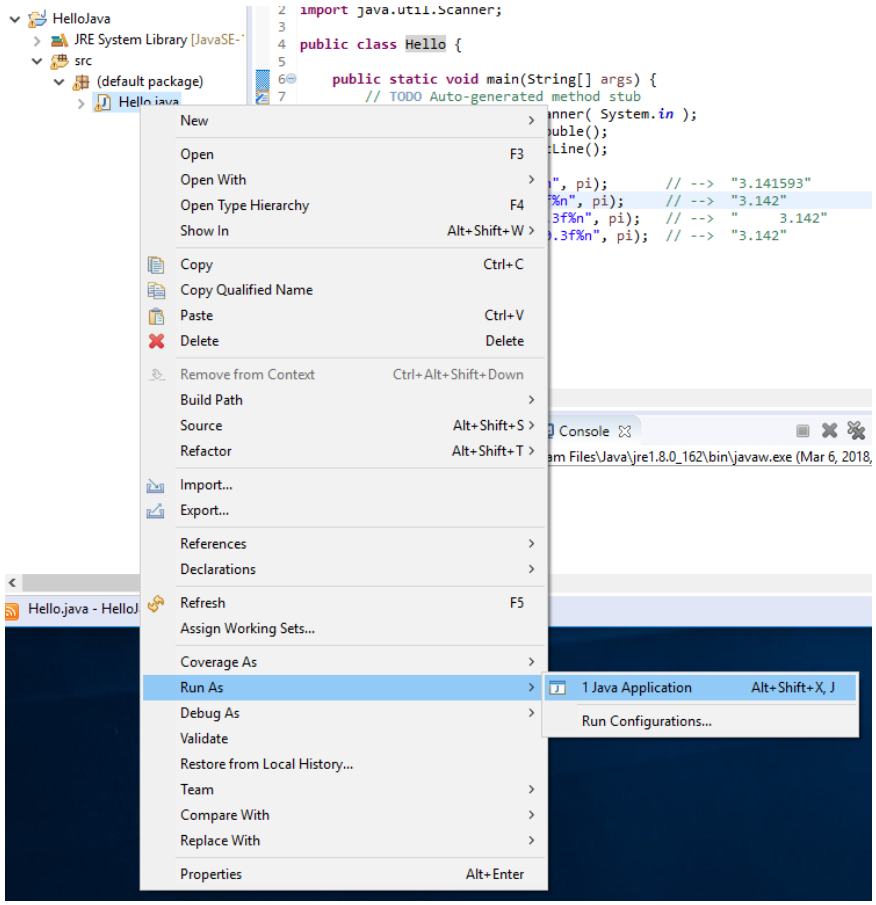
3. First Application
Get the input

- Use Scanner object to read the input:
  - `Scanner input = new Scanner( System.in );`
- For different input type
  - input.nextDouble() to read in double
  - input.nextInt() to read in integer
  - input.nextLine() to read in a String

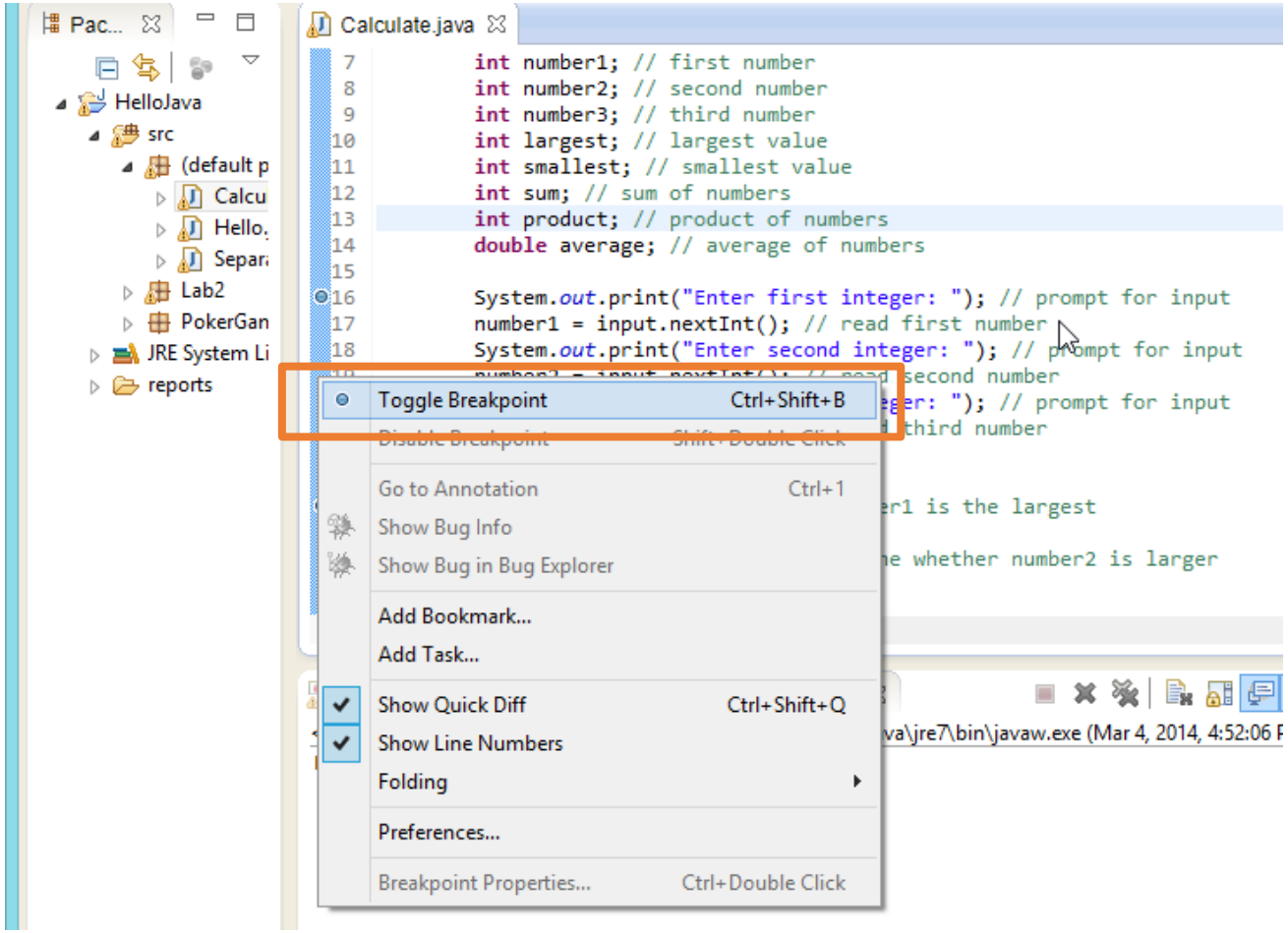
```
import java.util.Scanner;
…
// create Scanner to obtain input from command line
Scanner input = new Scanner( System.in );
int i= input.nextInt();
String str = input.nextLine();
```

4. Running Your App

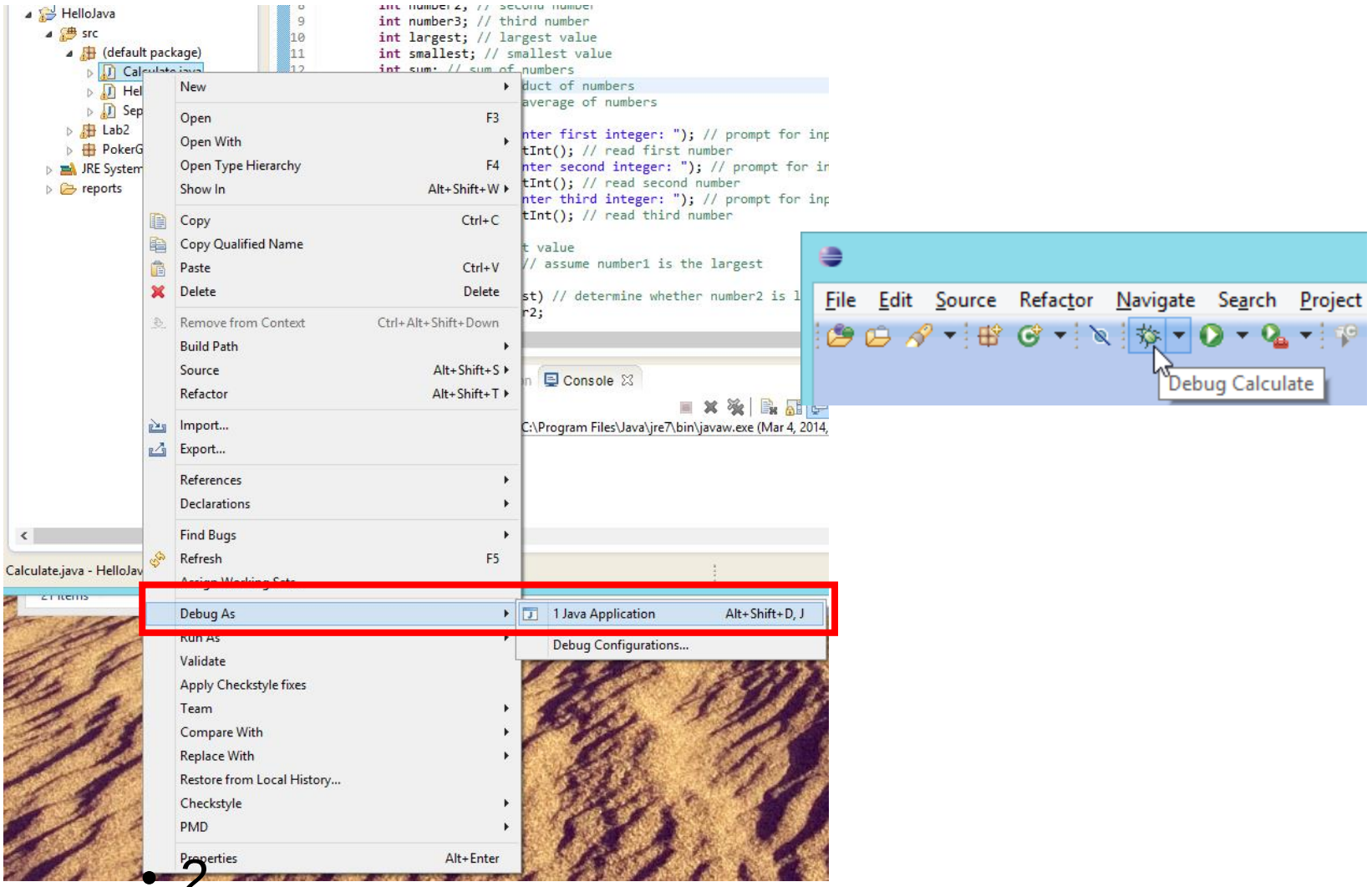
- Right click on the class Select Run As -> Java Application
- Menu Run –> Run
- Note:
  - Show console log: Menu Window-> Show view -> Console



5. Debugging
Setting breakpoints

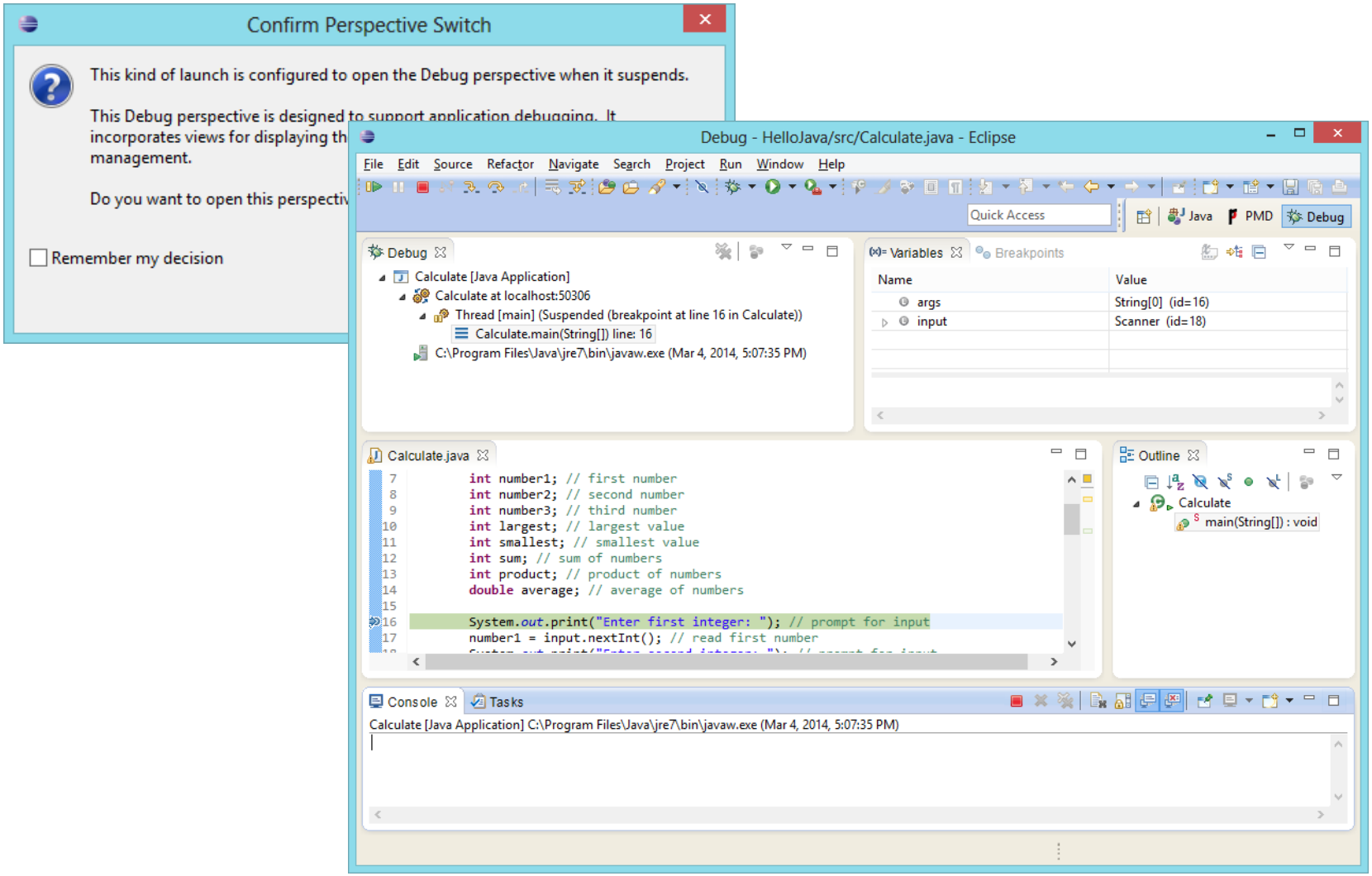


5. Debugging
Starting debugging



- 2.

5. Debugging
Debug perspective



Summary

- Overview about the course
- Introduction to Java
- Java Code Execution
  - How?
- Object-oriented programming
  - What?
  - Why?
- Development environment (Installation& Run)