CSE3040 Java Language

Lecture #01

Dept. of Computer Engineering,

Sogang University

This material is based on lecture notes by Prof. Juho Kim. Do not post it on the Internet.

Course Intro

Welcome to CSE3040!

- Course Title: Java Language (Class 1, 2)
- Time and Location: Wed/Fri 09:00-10:15, 15:00-16:15 (Online Lectures)
- Instructor: Jungmin So (AS818A, jso1@sogang.ac.kr)
- TAs
  - Sanghyeon An (AS818B, ansh941@sogang.ac.kr)
  - Minjun Lee (AS818B, roblee100@sogang.ac.kr)
- Lecture slides and other information will appear at http://cyber.sogang.ac.kr.

English Course

- This is an English course.
  - All lectures will be in English.
  - All materials including lecture slides, project documents, and (exams) will be in English.

- I will try to upload additional lectures recorded in Korean.
  - To help you understand better.
  - English lecture videos will be the primary material.

- The students can ask questions in Korean. You are encouraged to do so.

- The students can use Korean in their projects and exams.

Course Objectives

- This is a course that learns a new programming language.
  - The course is not about learning theories.
  - You must practice on your own!
    - Similar to learning English or other spoken languages.
  - I would recommend writing at least 5-10 short programs in a week, related to the concepts learned in the class.

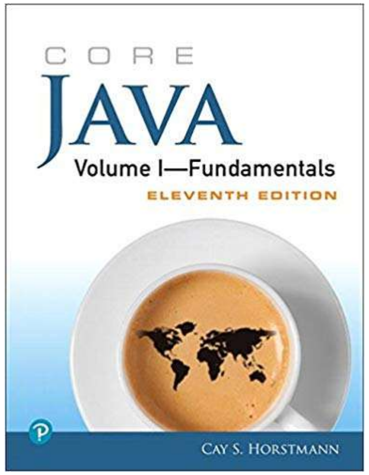
- Prerequisites
  - There is no prerequisite for this course.
    - The course does not require you to have any knowledge on programming language.
  - Most people taking this course have some background on programming languages, such as C, C++, or Python.
    - It would be wasteful to spend too much time on basic grammar.
  - I will cover the basic grammar of Java, but will quickly move on to spend more time on object oriented programming concepts and other features of Java.

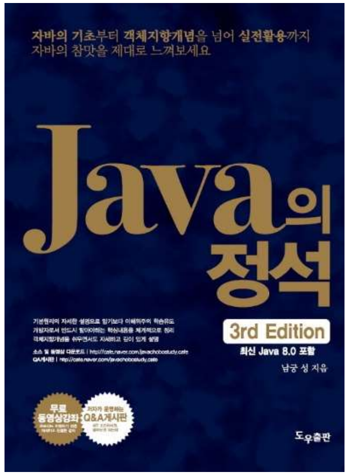
Course Format and Evaluation Criteria

- Course Format
  - Due to COVID-19, all lectures will be done online.
  - The lecture videos will be uploaded before the lecture time. (W/F 9am)
  - I encourage you to watch the video and follow all the practice problems at the given lecture time.
- Evaluation
  - Participation: 10%
    - Watching lecture videos
  - Programming Assignments: 30%
  - Mid-term exam: 30%
    - The mid-term exam will be replaced by programming assignments
  - Final exam: 30%
    - We have over 200 students enrolled in the two classes. If we cannot have an offline exam due to COVID-19, final exam will also be replaced by programming assignments.
    - The final exam format will be decided and announced during the course.
    - There will be no online exams.

Textbooks and Recommended Readings

- Lectures slides are mostly from
  - Original lectures slides from Prof. Juho Kim.
  - Cay S. Horstmann, Core Java, Volume I – Fundamentals, 11th Ed., Pearson.
- Some examples are from
  - 남궁 성, Java의 정석
- Other examples are from
  - The Internet




자바의 기초부터 객체지향개념을 넘어 실전활용까지
자바의 참맛을 제대로 느껴보세요
Java의
정석
3rd Edition
최신 Java 8.0 포함
남궁 성 지음
도우출판

Course Topics and Tentative schedule

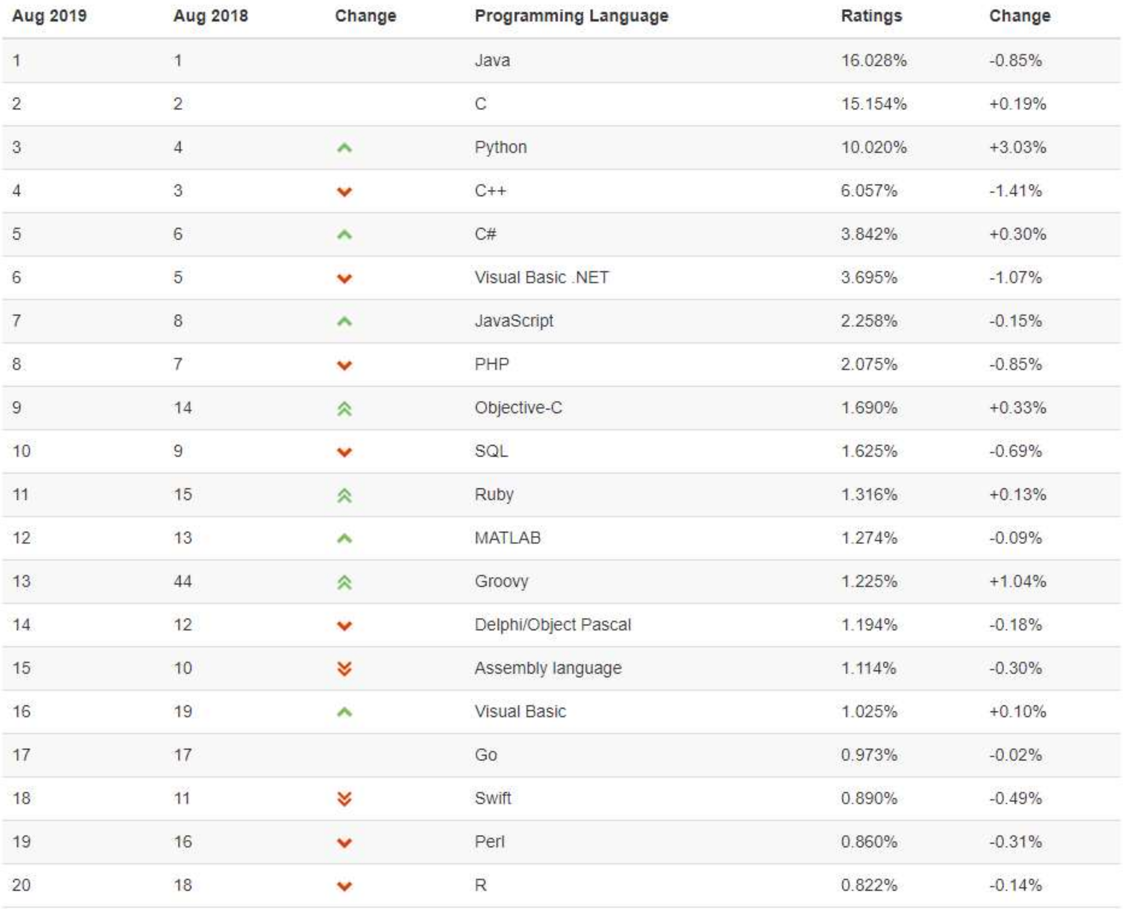
W1: 9/2, 9/4 Introduction to Java Programming Environment	**W2:** 9/9, 9/11 Fundamental Programming Structures	**W3:** 9/16, 9/18 Object and Classes 1	**W4:** 9/23, 9/25 Objects and Classes 2
W5: **9/30**, **10/1** Holidays (no class)	**W6:** 10/7, 10/9 Inheritance & Interfaces	**W7:** 10/14, 10/16 Inheritance & Interfaces Exception Handling	**W8:** 10/19 - 10/23 **MIDTERM**
W9: 10/28, 10/30 Generic Programming	**W10:** 11/4, 11/6 Collection Framework 1	**W11:** 11/11, 11/13 Collection Framework 2	**W12:** 11/18, 11/20 Java Networking 1
W13: 11/25, 11/27 Multithreading 1	**W14:** 12/2, 12/4 Multithreading 2	**W15:** 12/9, 12/11 Java Networking Other Topics	**W16:** 12/14 - 12/18 **FINAL**

Course schedules are subject to change.

A Brief Introduction to Java Language

What is Java?

- A general-purpose programming language
- Developed by James Gosling, released in 1995
- As of 2019, Java is the most popular programming language

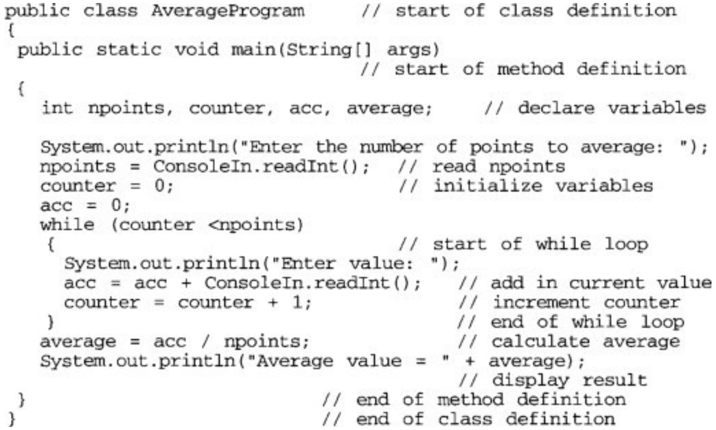


Aug 2019	Aug 2018	Change	Programming Language	Ratings	Change
1	1		Java	16.028%	-0.85%
2	2		C	15.154%	+0.19%
3	4	⌃	Python	10.020%	+3.03%
4	3	⌄	C++	6.057%	-1.41%
5	6	⌃	C#	3.842%	+0.30%
6	5	⌄	Visual Basic .NET	3.695%	-1.07%
7	8	⌃	JavaScript	2.258%	-0.15%
8	7	⌄	PHP	2.075%	-0.85%
9	14	⌃⌃	Objective-C	1.690%	+0.33%
10	9	⌄	SQL	1.625%	-0.69%
11	15	⌃⌃	Ruby	1.316%	+0.13%
12	13	⌃	MATLAB	1.274%	-0.09%
13	44	⌃⌃	Groovy	1.225%	+1.04%
14	12	⌄	Delphi/Object Pascal	1.194%	-0.18%
15	10	⌄⌄	Assembly language	1.114%	-0.30%
16	19	⌃	Visual Basic	1.025%	+0.10%
17	17		Go	0.973%	-0.02%
18	11	⌄⌄	Swift	0.890%	-0.49%
19	16	⌄	Perl	0.860%	-0.31%
20	18	⌄	R	0.822%	-0.14%

Detour: Programming Languages

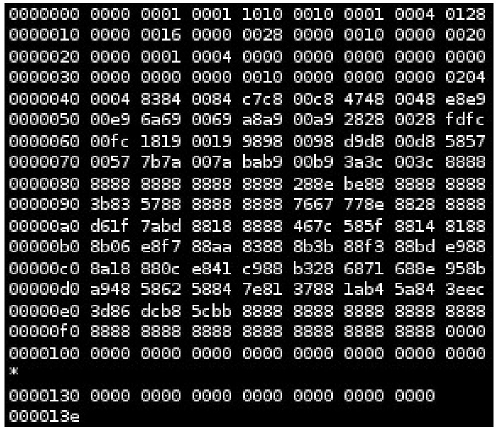
- What is a programming language?
  - A language that is used to run instructions on a computer.

- Why do we need a programming language?
  - The computer (CPU) understands a set of machine language instructions.
  - Machine language is too low-level for human to understand, or write algorithms efficiently.
  - Programmers write applications using a programming language, which is compiled or interpreted into machine language and executed on a machine.



```
public class AverageProgram     // start of class definition
{
 public static void main(String[] args)
                                // start of method definition
 {
   int npoints, counter, acc, average;     // declare variables

   System.out.println("Enter the number of points to average: ");
   npoints = ConsoleIn.readInt();   // read npoints
   counter = 0;                     // initialize variables
   acc = 0;
   while (counter <npoints)
    {                               // start of while loop
     System.out.println("Enter value: ");
     acc = acc + ConsoleIn.readInt();    // add in current value
     counter = counter + 1;              // increment counter
    }                                    // end of while loop
   average = acc / npoints;              // calculate average
   System.out.println("Average value = " + average);
                                         // display result
 }                             // end of method definition
}                              // end of class definition
```



```
0000000 0000 0001 0001 1010 0010 0001 0004 0128
0000010 0000 0016 0000 0028 0000 0010 0000 0020
0000020 0000 0001 0004 0000 0000 0000 0000 0000
0000030 0000 0000 0000 0010 0000 0000 0000 0204
0000040 0004 8384 0084 c7c8 00c8 4748 0048 e8e9
0000050 00e9 6a69 0069 a8a9 00a9 2828 0028 fdfc
0000060 00fc 1819 0019 9898 0098 d9d8 00d8 5857
0000070 0057 7b7a 007a bab9 00b9 3a3c 003c 8888
0000080 8888 8888 8888 8888 288e be88 8888 8888
0000090 3b83 5788 8888 8888 7667 778e 8828 8888
00000a0 d61f 7abd 8818 8888 467c 585f 8814 8188
00000b0 8b06 e8f7 88aa 8388 8b3b 88f3 88bd e988
00000c0 8a18 880c e841 c988 b328 6871 688e 958b
00000d0 a948 5862 5884 7e81 3788 1ab4 5a84 3eec
00000e0 3d86 dcb8 5cbb 8888 8888 8888 8888 8888
00000f0 8888 8888 8888 8888 8888 8888 8888 0000
0000100 0000 0000 0000 0000 0000 0000 0000 0000
*
0000130 0000 0000 0000 0000 0000 0000 0000
000013e
```

Detour: Programming Languages

- Compiled Languages
  - A compiler reads the entire program and converts it into an object code (machine language or binary code).
  - The execution is fast, because you do not need to translate language at execution time. (Compile once, run many times.)
  - Common compiled languages: C, C++, Go, etc.

- Interpreted Languages
  - An interpreter reads the source code of your program one line at a time, performing specific instructions contained in that line.
  - The execution is slow, because the code needs translation at execution time.
  - You can switch commands during run time.
    - Suitable for debugging/prototyping.
  - Common interpreted languages: Perl, Python, etc.

- What about Java?

Characteristics of Java

- Platform-Independent
  - After writing Java source code, you compile the code.
  - The Java compiler produces byte code.
    - Byte code is not a native machine language.
  - When you execute the byte code, it is interpreted using the Java Virtual Machine (JVM).
    - For fast processing, JVM can do Just-In-Time compilation and translates byte code into machine language.
    - JVM does both interpreting and JIT compilation depending on the code itself.
    - The programmer can give options to disable JIT compilation.
  - So if a programmer writes a Java program on Windows and compile the code, he/she can take the compiled byte code to a Linux machine and run the code.
  - Because of JVM, execution of Java could be slower than C/C++. However, the performance of JVM has improved through time.

Characteristics of Java

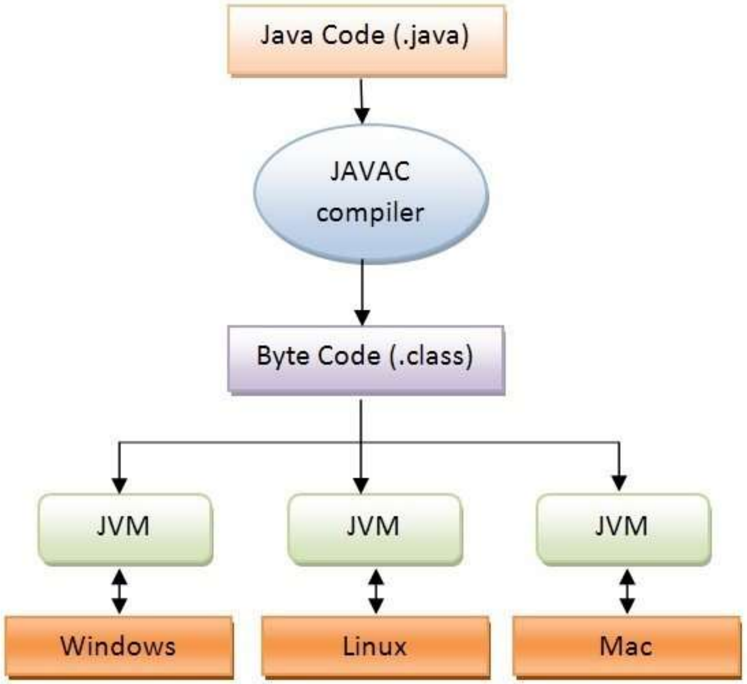
- Object-Oriented Language
  - Java is a language designed for object-oriented programming (OOP).
  - We will learn what OOP is as we go.
  - C++ is also an OOP language, but Java claims to have a “cleaner” syntax.
  - No header files, no pointers, no structures, no unions, no operator overloading, no virtual base classes, and so on.

- Garbage Collection
  - A garbage collector collects unused memory spaces so the programmer does not need to explicitly check and return unused memory spaces.

- Good support of networking and multi-threading
  - Java provides a large set of libraries for the programmers to conveniently do network programming and multi-threaded programming.

JVM (Java Virtual Machine)

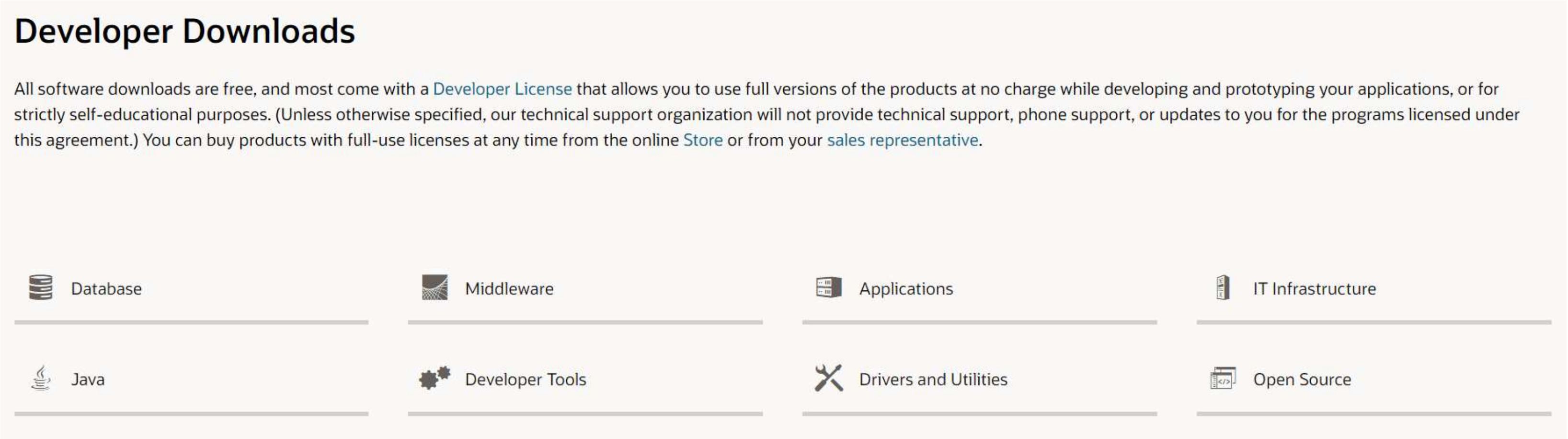
- A software layer between OS and the Java application
- Provides and environment to run Java byte code
- The byte code is platform-independent because of JVM



Programming Lab #01

Install Java and Eclipse on Your Computer

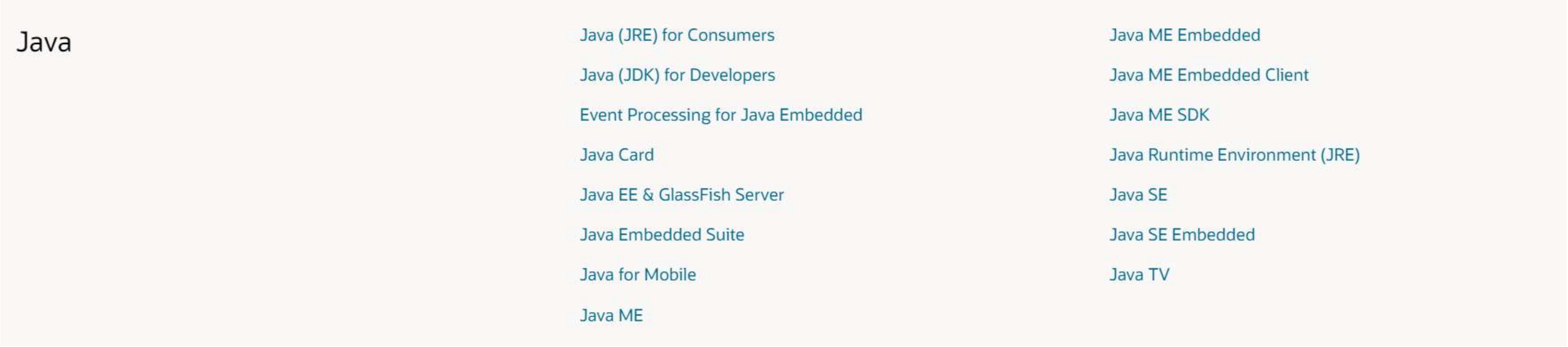
- Install Java Development Kit (JDK)
  - Go to http://oracle.com/downloads



Developer Downloads

All software downloads are free, and most come with a Developer License that allows you to use full versions of the products at no charge while developing and prototyping your applications, or for strictly self-educational purposes. (Unless otherwise specified, our technical support organization will not provide technical support, phone support, or updates to you for the programs licensed under this agreement.) You can buy products with full-use licenses at any time from the online Store or from your sales representative.

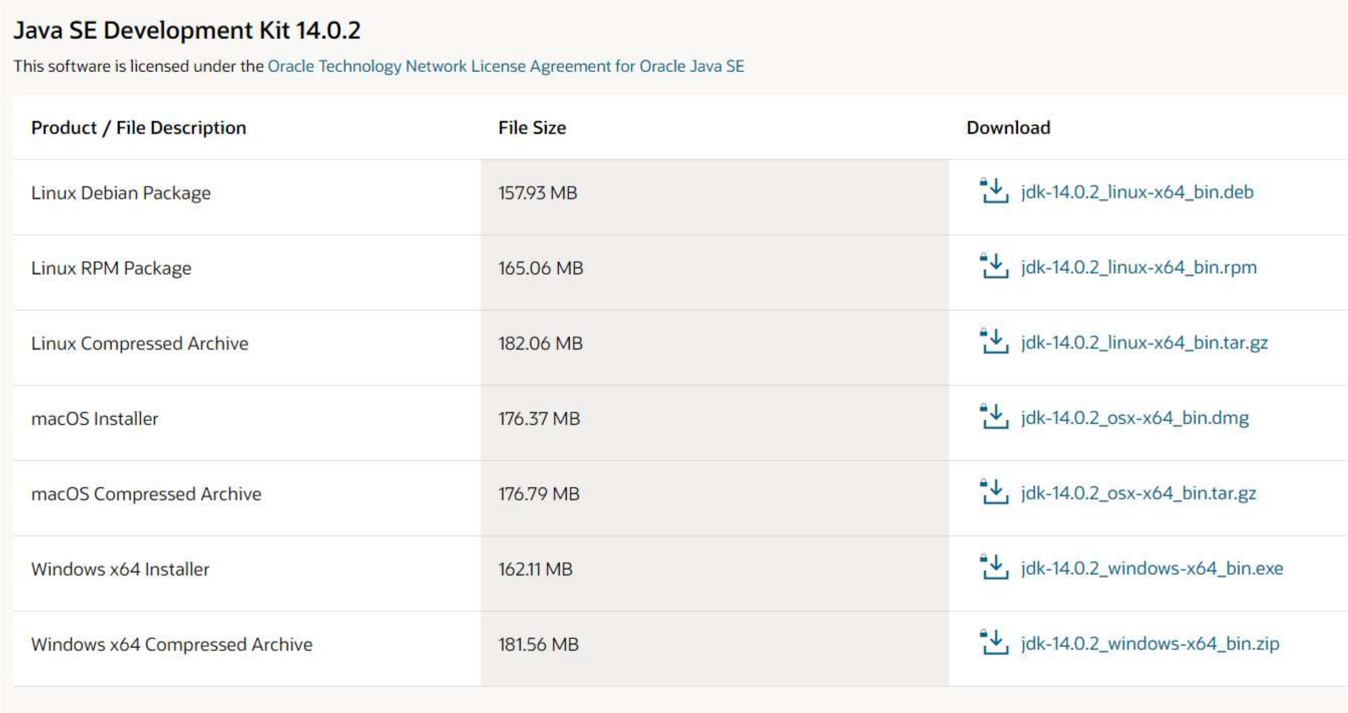
  - Select Java → Java (JDK) for Developers



Java

Install Java and Eclipse on Your Computer

- Install Java Development Kit (JDK)
  - Download Java SE 14.0.2. (Latest)
  - Agree on the License to download Java SE Development Kit 14.0.2.
  - Download the file depending on your OS.



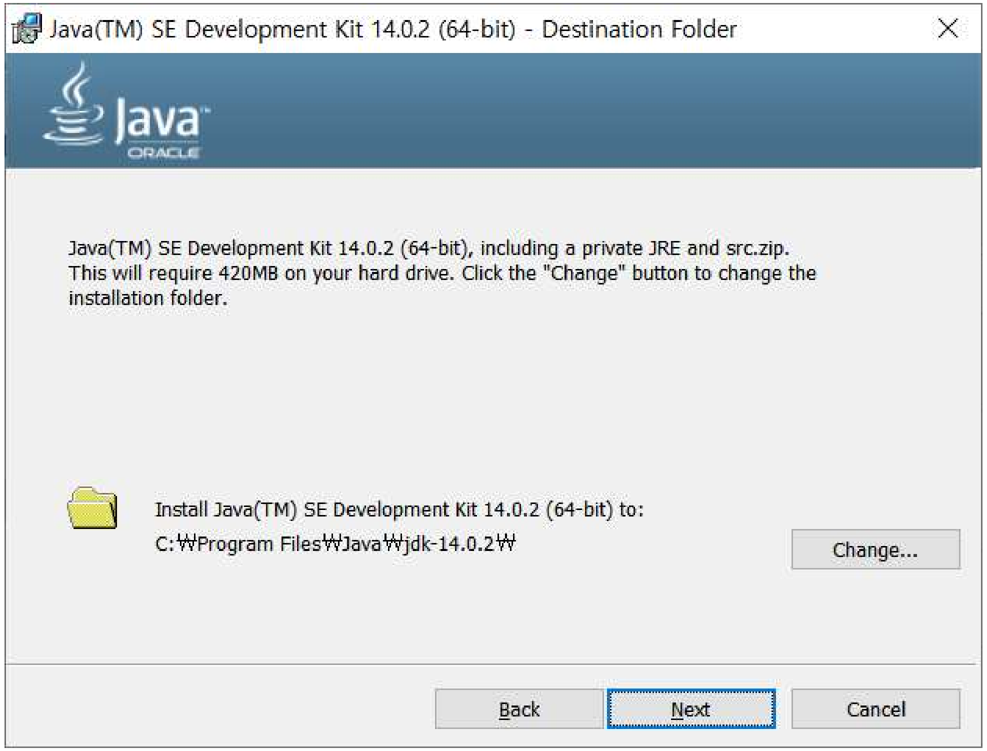
Java SE Development Kit 14.0.2

This software is licensed under the Oracle Technology Network License Agreement for Oracle Java SE

Product / File Description	File Size	Download
Linux Debian Package	157.93 MB	jdk-14.0.2_linux-x64_bin.deb
Linux RPM Package	165.06 MB	jdk-14.0.2_linux-x64_bin.rpm
Linux Compressed Archive	182.06 MB	jdk-14.0.2_linux-x64_bin.tar.gz
macOS Installer	176.37 MB	jdk-14.0.2_osx-x64_bin.dmg
macOS Compressed Archive	176.79 MB	jdk-14.0.2_osx-x64_bin.tar.gz
Windows x64 Installer	162.11 MB	jdk-14.0.2_windows-x64_bin.exe
Windows x64 Compressed Archive	181.56 MB	jdk-14.0.2_windows-x64_bin.zip

Install Java and Eclipse on Your Computer

- If you are using .exe file to install JDK, choose the path
- Choose the path where Java SE will be installed.



Java(TM) SE Development Kit 14.0.2 (64-bit) - Destination Folder
Java
ORACLE

Java(TM) SE Development Kit 14.0.2 (64-bit), including a private JRE and src.zip. This will require 420MB on your hard drive. Click the "Change" button to change the installation folder.

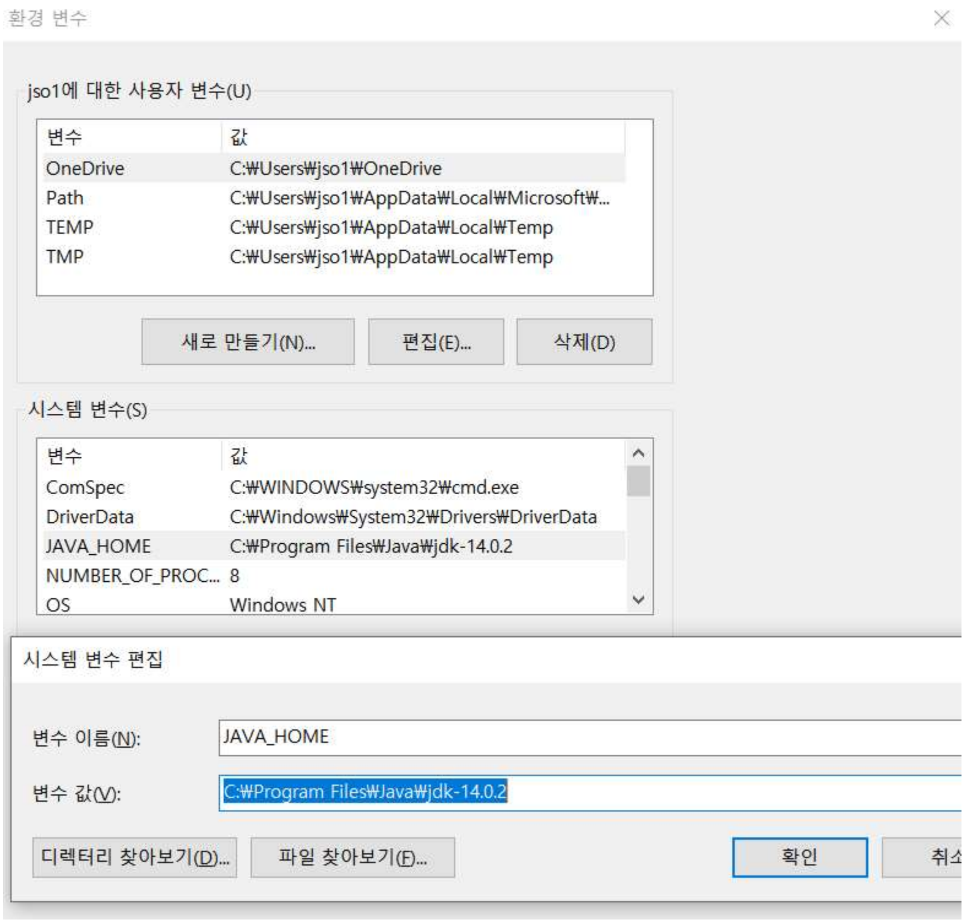
Install Java(TM) SE Development Kit 14.0.2 (64-bit) to:
C:₩Program Files₩Java₩jdk-14.0.2₩

Change...
Back
Next
Cancel

- If you have downloaded compressed zip file, then you can extract the files on the directory you want to install JDK.

Install Java and Eclipse on Your Computer

- You need to set the System Environment Variables.
  - In the System Environments, create a new variable called JAVA_HOME, and set its value to the path where JDK is installed.



변수	값
OneDrive	C:₩Users₩jso1₩OneDrive
Path	C:₩Users₩jso1₩AppData₩Local₩Microsoft₩...
TEMP	C:₩Users₩jso1₩AppData₩Local₩Temp
TMP	C:₩Users₩jso1₩AppData₩Local₩Temp

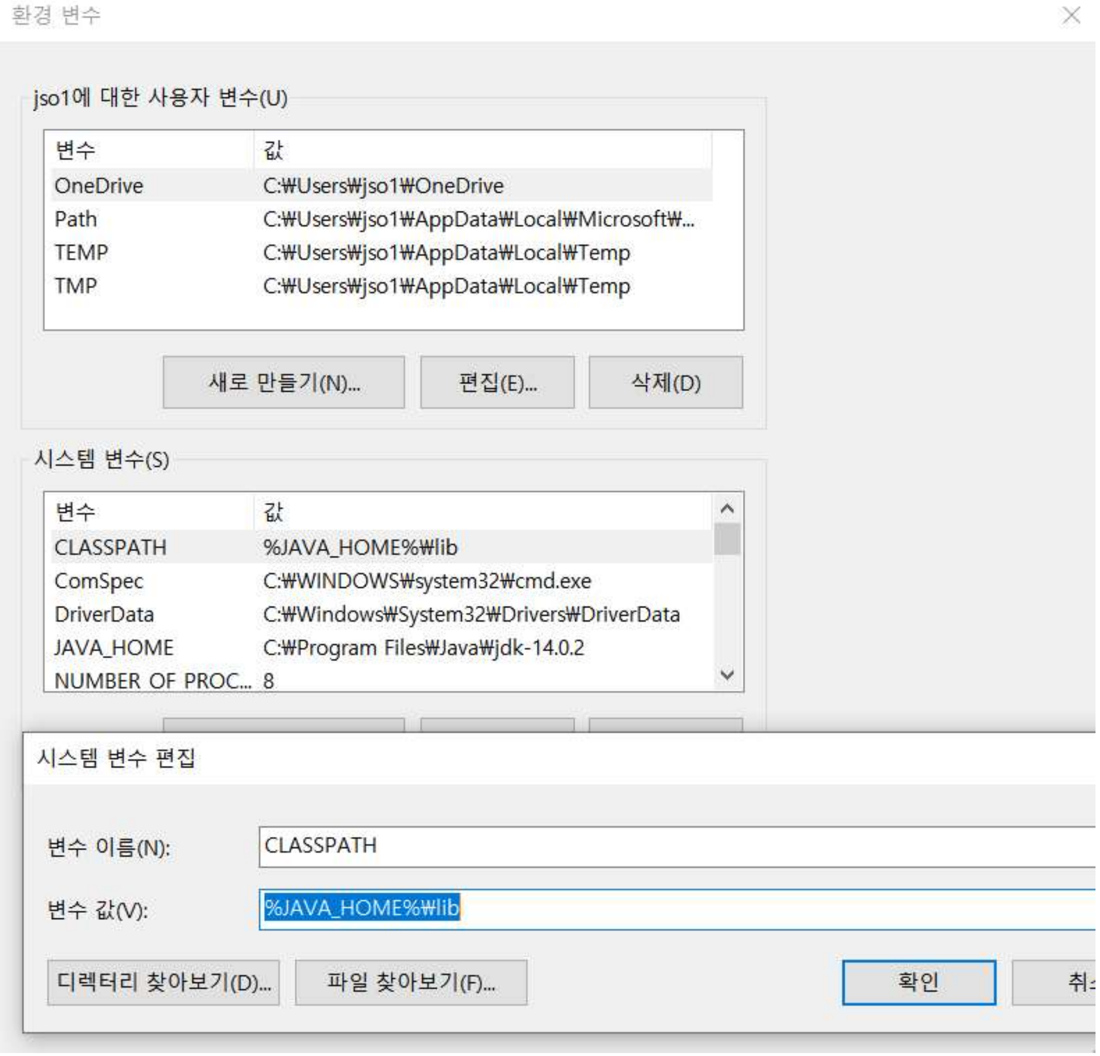
변수	값
ComSpec	C:₩WINDOWS₩system32₩cmd.exe
DriverData	C:₩Windows₩System32₩Drivers₩DriverData
JAVA_HOME	C:₩Program Files₩Java₩jdk-14.0.2
NUMBER_OF_PROC...	8
OS	Windows NT

변수 이름(N): JAVA_HOME

변수 값(V): C:₩Program Files₩Java₩jdk-14.0.2

Install Java and Eclipse on Your Computer

- You need to set the System Environment Variables.
  - Create another variable CLASSPATH, and set its value to %JAVA_HOME%\lib



jso1에 대한 사용자 변수(U)

변수	값
OneDrive	C:₩Users₩jso1₩OneDrive
Path	C:₩Users₩jso1₩AppData₩Local₩Microsoft₩...
TEMP	C:₩Users₩jso1₩AppData₩Local₩Temp
TMP	C:₩Users₩jso1₩AppData₩Local₩Temp

시스템 변수(S)

변수	값
CLASSPATH	%JAVA_HOME%₩lib
ComSpec	C:₩WINDOWS₩system32₩cmd.exe
DriverData	C:₩Windows₩System32₩Drivers₩DriverData
JAVA_HOME	C:₩Program Files₩Java₩jdk-14.0.2
NUMBER_OF_PROC...	8

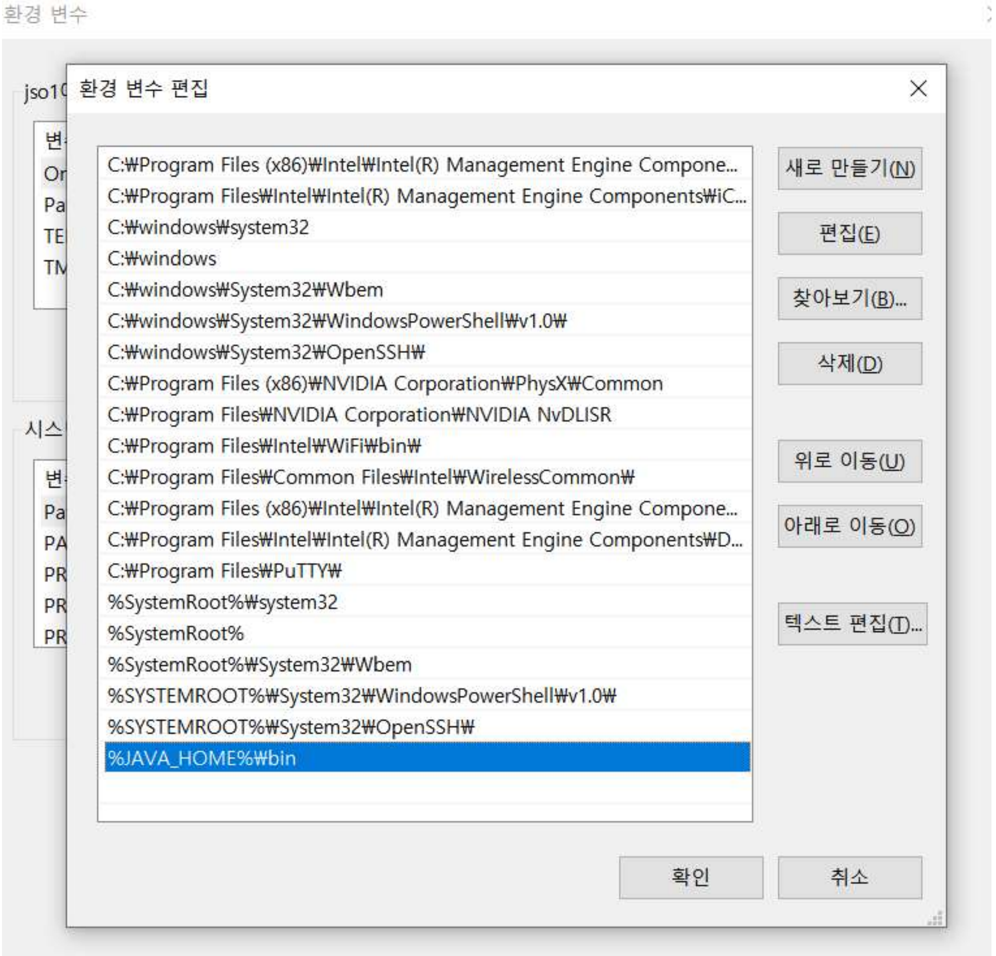
시스템 변수 편집

변수 이름(N): CLASSPATH

변수 값(V): %JAVA_HOME%₩lib

Install Java and Eclipse on Your Computer

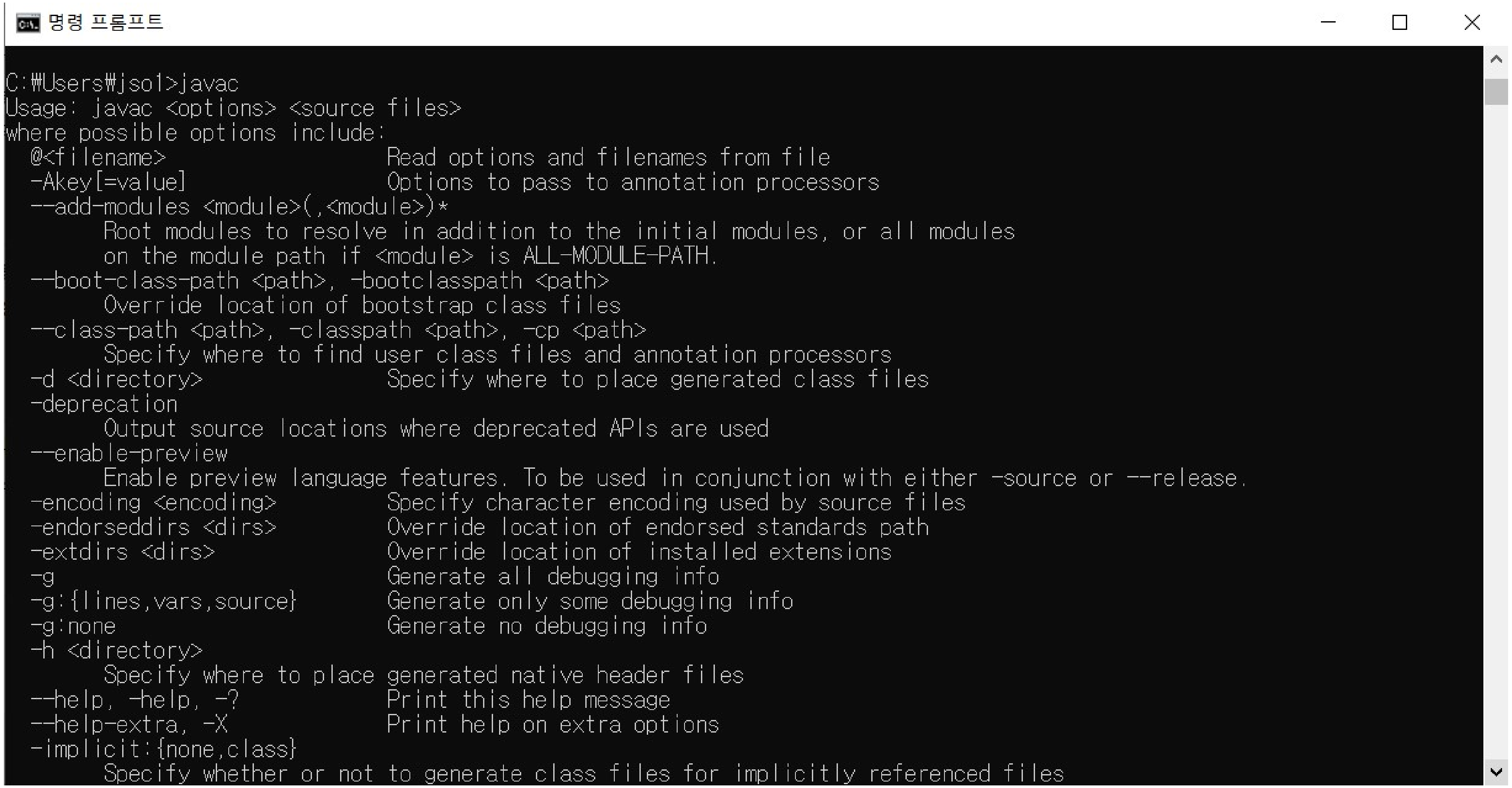
- You need to set the System Environment Variables.
  - The variable PATH will already be there, edit its value as follows.
    - Add %JAVA_HOME%\bin



```
C:₩Program Files (x86)₩Intel₩Intel(R) Management Engine Compone...
C:₩Program Files₩Intel₩Intel(R) Management Engine Components₩iC...
C:₩windows₩system32
C:₩windows
C:₩windows₩System32₩Wbem
C:₩windows₩System32₩WindowsPowerShell₩v1.0₩
C:₩windows₩System32₩OpenSSH₩
C:₩Program Files (x86)₩NVIDIA Corporation₩PhysX₩Common
C:₩Program Files₩NVIDIA Corporation₩NVIDIA NvDLISR
C:₩Program Files₩Intel₩WiFi₩bin₩
C:₩Program Files₩Common Files₩Intel₩WirelessCommon₩
C:₩Program Files (x86)₩Intel₩Intel(R) Management Engine Compone...
C:₩Program Files₩Intel₩Intel(R) Management Engine Components₩D...
C:₩Program Files₩PuTTY₩
%SystemRoot%₩system32
%SystemRoot%
%SystemRoot%₩System32₩Wbem
%SYSTEMROOT%₩System32₩WindowsPowerShell₩v1.0₩
%SYSTEMROOT%₩System32₩OpenSSH₩
%JAVA_HOME%₩bin
```

Install Java and Eclipse on Your Computer

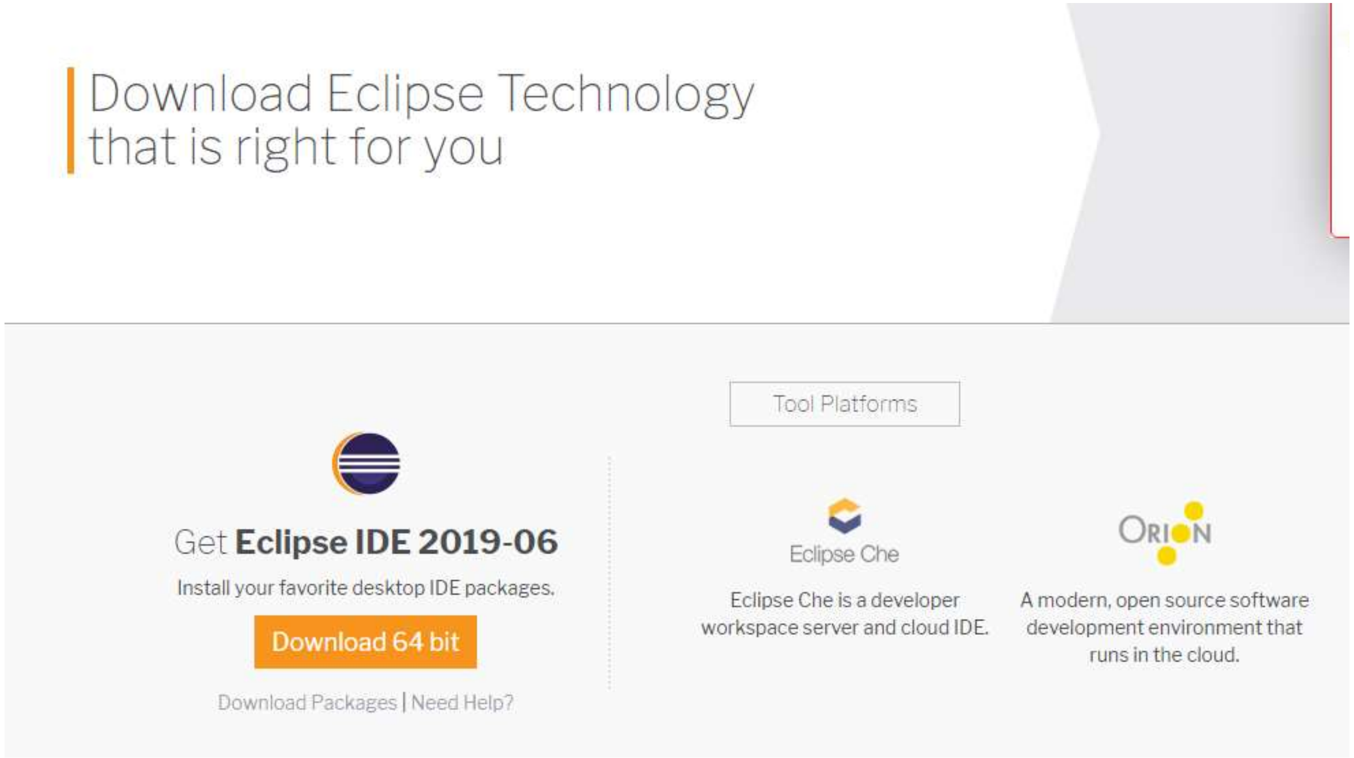
- Check if installation is successful by running javac and java on your command prompt.
  - run "cmd" from the Run command window.



```
C:₩Users₩jso1>javac
Usage: javac <options> <source files>
where possible options include:
  @<filename>                  Read options and filenames from file
  -Akey[=value]                Options to pass to annotation processors
  --add-modules <module>(,<module>)*
        Root modules to resolve in addition to the initial modules, or all modules
        on the module path if <module> is ALL-MODULE-PATH.
  --boot-class-path <path>, -bootclasspath <path>
        Override location of bootstrap class files
  --class-path <path>, -classpath <path>, -cp <path>
        Specify where to find user class files and annotation processors
  -d <directory>               Specify where to place generated class files
  -deprecation
        Output source locations where deprecated APIs are used
  --enable-preview
        Enable preview language features. To be used in conjunction with either -source or --release.
  -encoding <encoding>         Specify character encoding used by source files
  -endorseddirs <dirs>         Override location of endorsed standards path
  -extdirs <dirs>              Override location of installed extensions
  -g                           Generate all debugging info
  -g:{lines,vars,source}       Generate only some debugging info
  -g:none                      Generate no debugging info
  -h <directory>
        Specify where to place generated native header files
  --help, -help, -?            Print this help message
  --help-extra, -X             Print help on extra options
  -implicit:{none,class}
        Specify whether or not to generate class files for implicitly referenced files
```

Install Java and Eclipse on Your Computer

- Install eclipse
  - eclipse is an IDE (Integrated Development Environment) for Java
  - Go to http://eclipse.org/downloads



Download Eclipse Technology that is right for you

Tool Platforms

Get **Eclipse IDE 2019-06**

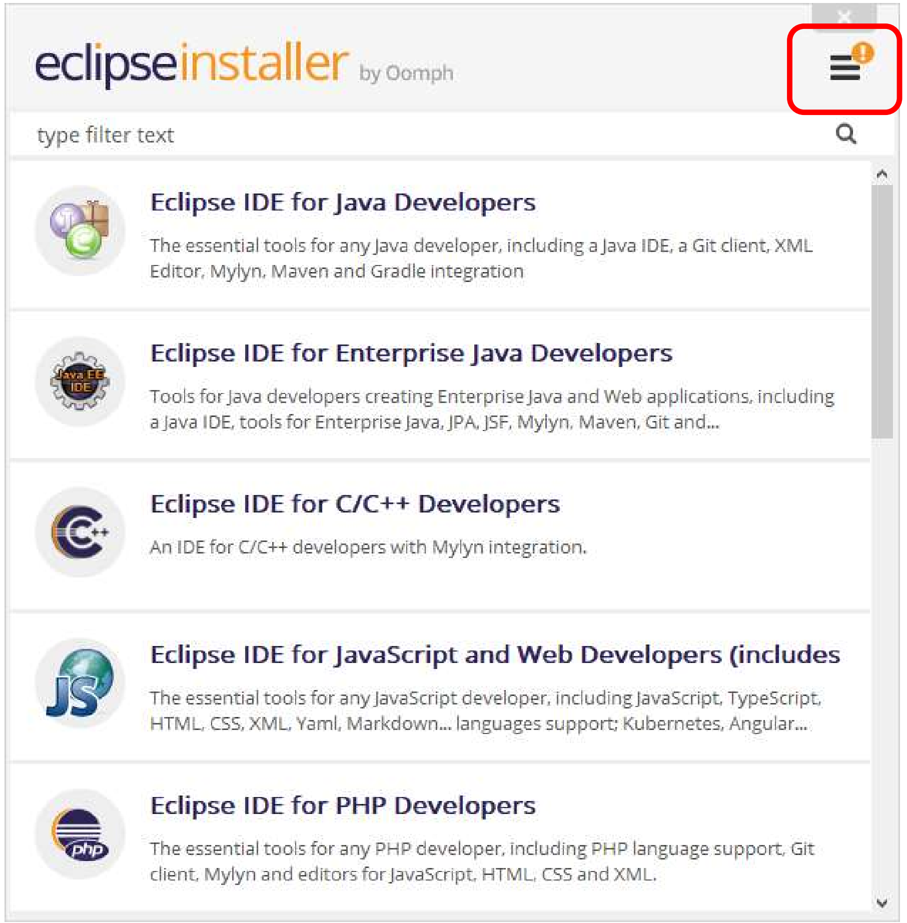
Install your favorite desktop IDE packages.

Eclipse Che is a developer workspace server and cloud IDE.

A modern, open source software development environment that runs in the cloud.

Install Java and Eclipse on Your Computer

- Install eclipse
  - Download and run eclipse installer
  - Update Installer



Eclipse IDE for Java Developers

The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Mylyn, Maven and Gradle integration

Eclipse IDE for Enterprise Java Developers

Tools for Java developers creating Enterprise Java and Web applications, including a Java IDE, tools for Enterprise Java, JPA, JSF, Mylyn, Maven, Git and...

Eclipse IDE for C/C++ Developers

An IDE for C/C++ developers with Mylyn integration.

Eclipse IDE for JavaScript and Web Developers (includes

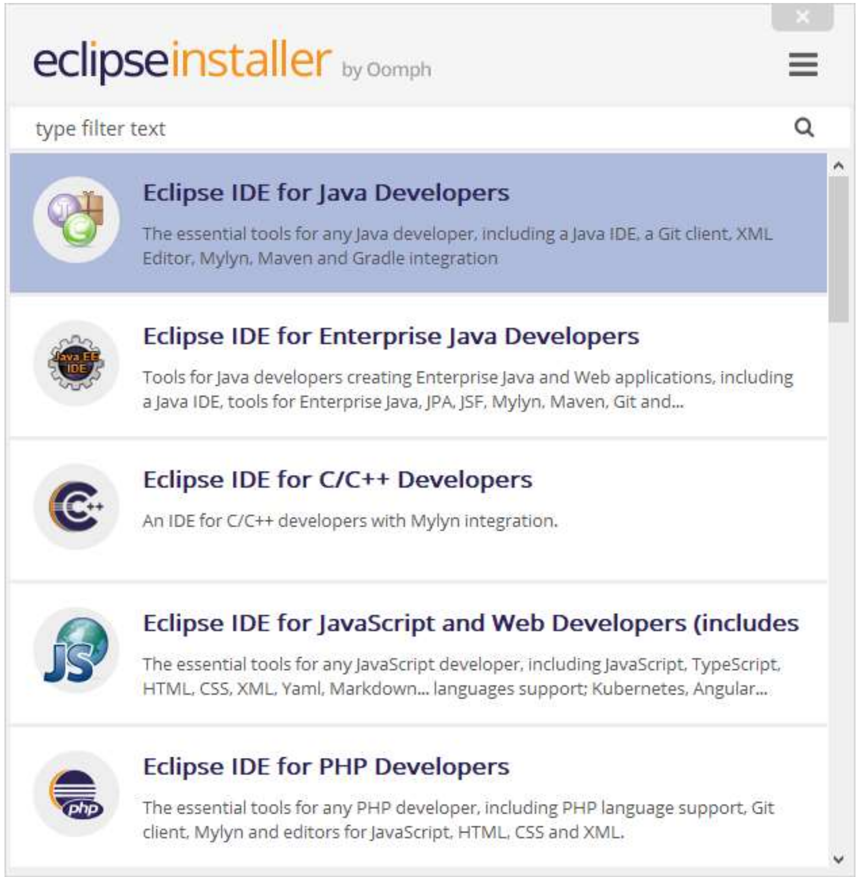
The essential tools for any JavaScript developer, including JavaScript, TypeScript, HTML, CSS, XML, Yaml, Markdown... languages support; Kubernetes, Angular...

Eclipse IDE for PHP Developers

The essential tools for any PHP developer, including PHP language support, Git client, Mylyn and editors for JavaScript, HTML, CSS and XML.

Install Java and Eclipse on Your Computer

- Install eclipse
  - Install Eclipse IDE for Java Developers



eclipseinstaller by Oomph

type filter text

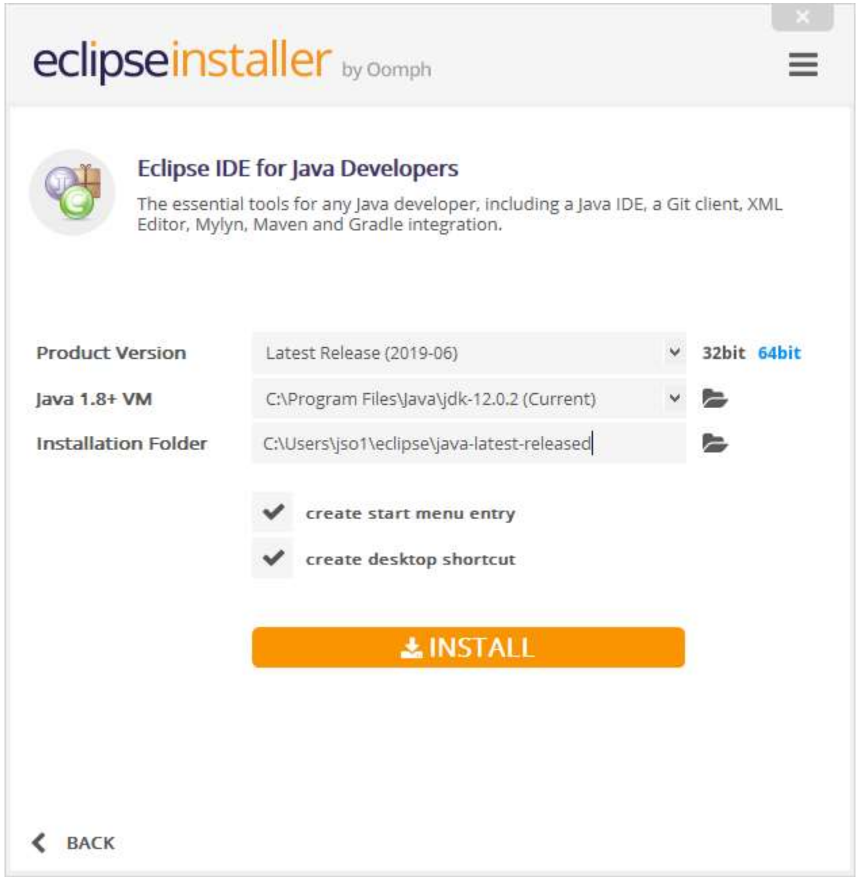
Eclipse IDE for Java Developers
The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Mylyn, Maven and Gradle integration

Eclipse IDE for Enterprise Java Developers
Tools for Java developers creating Enterprise Java and Web applications, including a Java IDE, tools for Enterprise Java, JPA, JSF, Mylyn, Maven, Git and...

Eclipse IDE for C/C++ Developers
An IDE for C/C++ developers with Mylyn integration.

Eclipse IDE for JavaScript and Web Developers (includes
The essential tools for any JavaScript developer, including JavaScript, TypeScript, HTML, CSS, XML, Yaml, Markdown... languages support; Kubernetes, Angular...

Eclipse IDE for PHP Developers
The essential tools for any PHP developer, including PHP language support, Git client, Mylyn and editors for JavaScript, HTML, CSS and XML.



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Eclipse IDE for Java Developers
The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Mylyn, Maven and Gradle integration.

Product Version: Latest Release (2019-06) — 32bit 64bit

Java 1.8+ VM: C:\Program Files\Java\jdk-12.0.2 (Current)

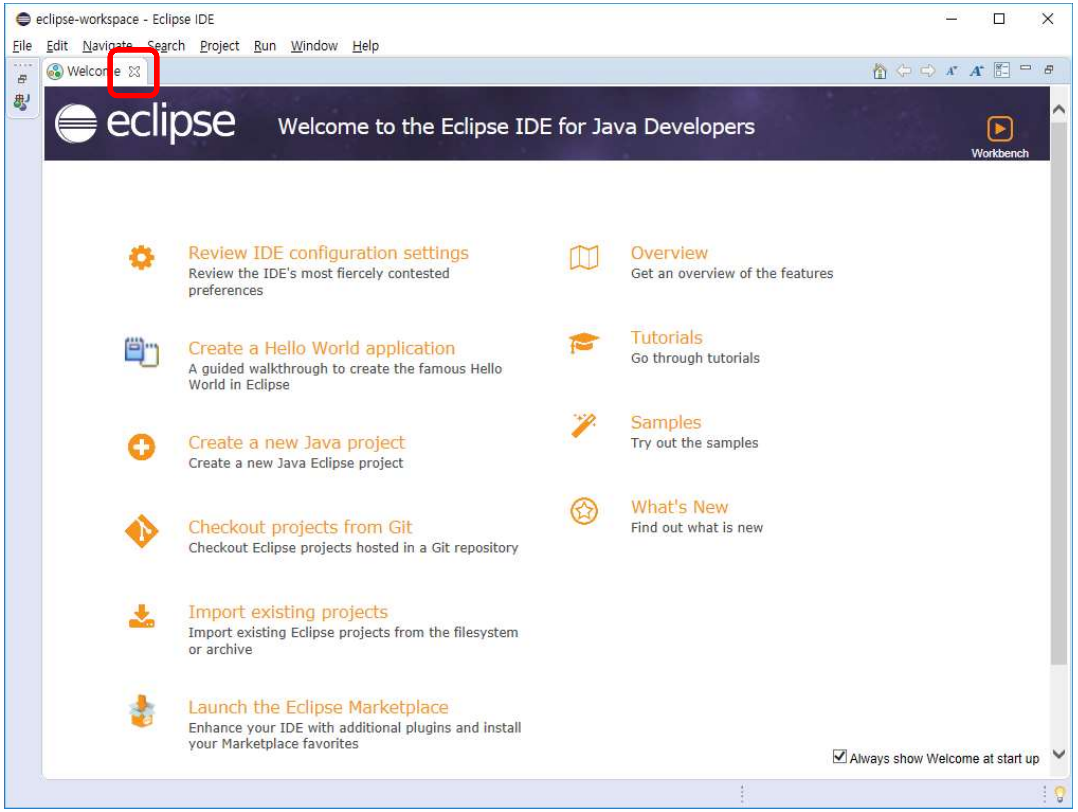
Installation Folder: C:\Users\jso1\eclipse\java-latest-released

✓ create start menu entry

✓ create desktop shortcut

Install Java and Eclipse on Your Computer

- Install eclipse
  - Once the installation is done, launch eclipse
  - Select the default directory as workspace directory
  - When the Welcome page appears, remove it by clicking 'x'.



Welcome to the Eclipse IDE for Java Developers

Review IDE configuration settings
Review the IDE's most fiercely contested preferences

Create a Hello World application
A guided walkthrough to create the famous Hello World in Eclipse

Create a new Java project
Create a new Java Eclipse project

Checkout projects from Git
Checkout Eclipse projects hosted in a Git repository

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Import existing Eclipse projects from the filesystem or archive

Launch the Eclipse Marketplace
Enhance your IDE with additional plugins and install your Marketplace favorites

Overview
Get an overview of the features

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Try out the samples

What's New
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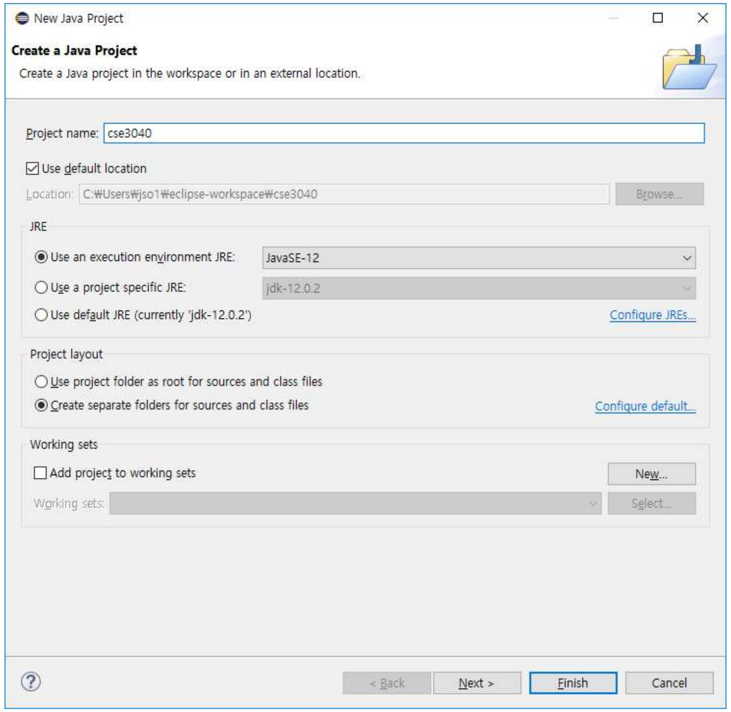
☑ Always show Welcome at start up

Install Java and Eclipse on Your Computer

- Try writing Java code and running it.
  - Select File → New → Java Project
  - Project name: cse3040
    - You can use a different name, but use lower-case letters. (Java naming convention)
  - Click 'Finish'.
  - Do not create module-info.java.



New Java Project

Create a Java Project

Create a Java project in the workspace or in an external location.

Project name: cse3040

☑ Use default location

Location: C:₩Users₩jso1₩eclipse-workspace₩cse3040

JRE

● Use an execution environment JRE: JavaSE-12

○ Use a project specific JRE: jdk-12.0.2

○ Use default JRE (currently 'jdk-12.0.2')

Project layout

○ Use project folder as root for sources and class files

● Create separate folders for sources and class files

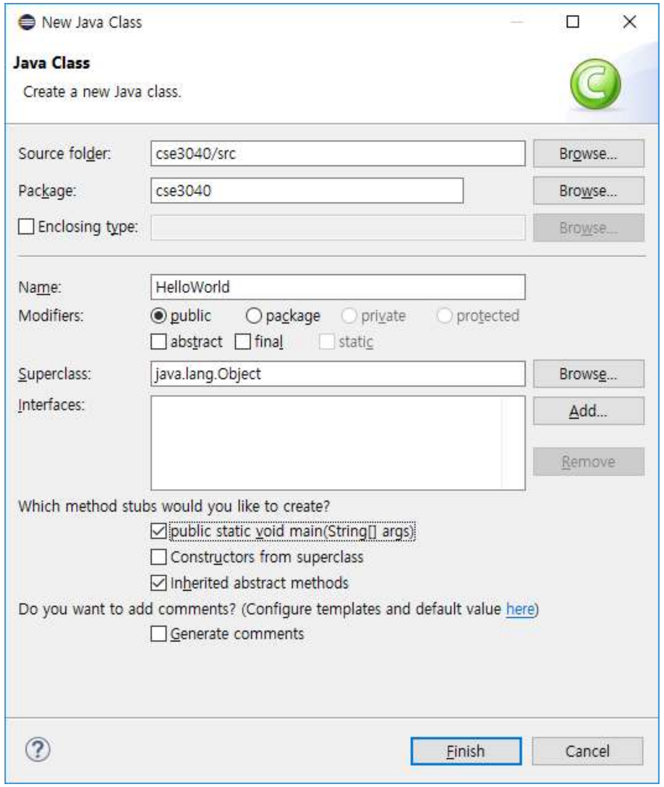
Working sets

☐ Add project to working sets

Working sets:

Install Java and Eclipse on Your Computer

- Try writing Java code and running it.
  - In the Package Explorer on the left, right-click at 'src' and select New → Class.
  - Name: HelloWorld
  - Check 'public static void main(String[] args)'
  - Click 'Finish'.



New Java Class

Java Class

Create a new Java class.

Source folder: cse3040/src

Package: cse3040

☐ Enclosing type:

Name: HelloWorld

Modifiers: ● public ○ package ○ private ○ protected

☐ abstract ☐ final ☐ static

Superclass: java.lang.Object

Interfaces:

Which method stubs would you like to create?

☑ public static void main(String[] args)

☐ Constructors from superclass

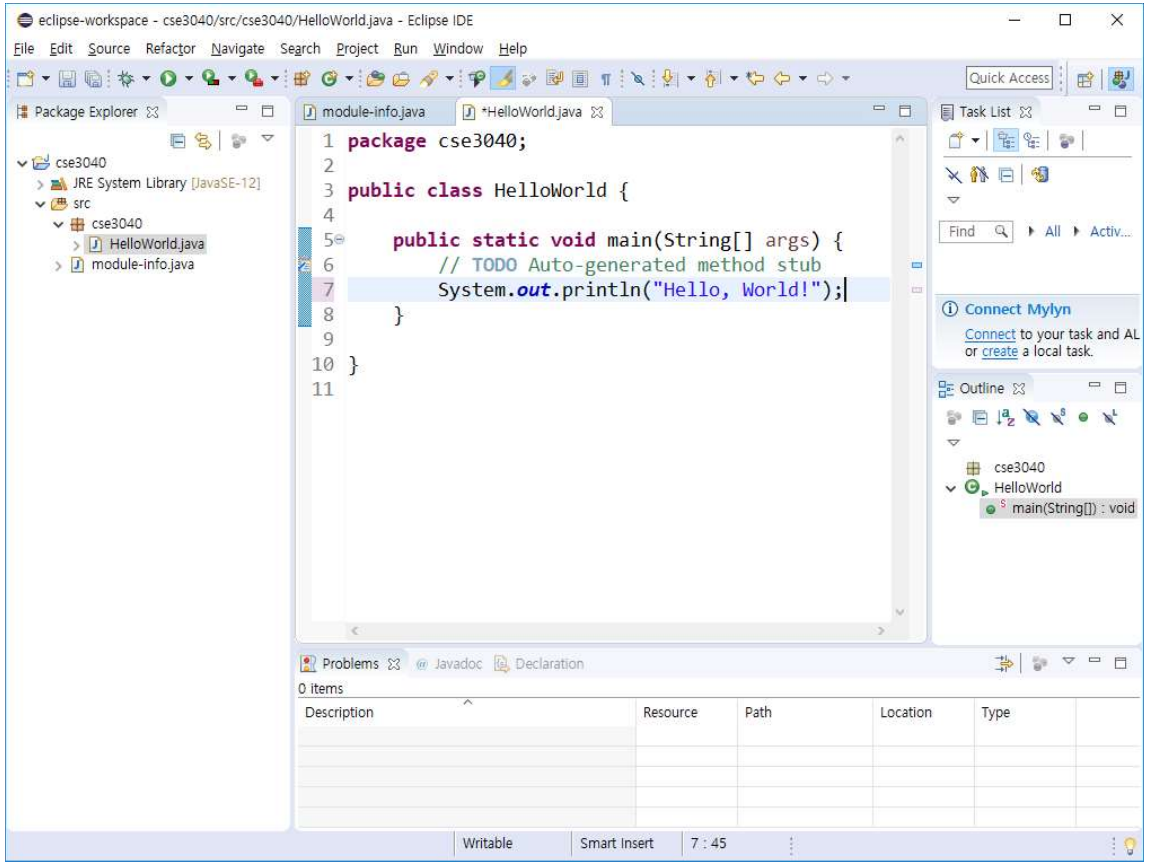
☑ Inherited abstract methods

Do you want to add comments? (Configure templates and default value here)

☐ Generate comments

MP0: Install Java and Eclipse on Your Computer

- Try writing Java code and running it.
  - You will find that HelloWorld.java has been created. This is your source code file.
  - Now, inside the main method, write the following line:
    - `System.out.println("Hello, World!");`



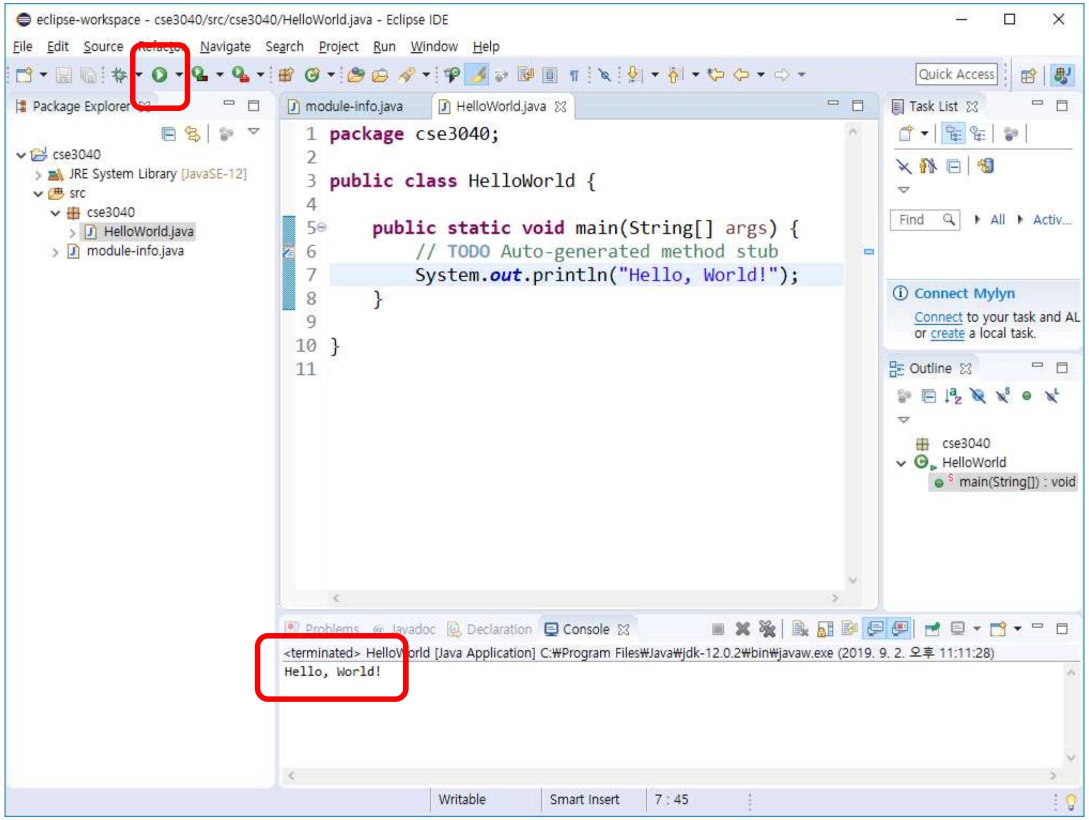
```java
package cse3040;

public class HelloWorld {

    public static void main(String[] args) {
        // TODO Auto-generated method stub
        System.out.println("Hello, World!");
    }

}

```

0 items

Description	Resource	Path	Location	Type

MP0: Install Java and Eclipse on Your Computer

- Try writing Java code and running it.
  - Click on the ‘Run’ button or press F11.
- Congratulations! You just wrote and executed a Java program.



```
package cse3040;

public class HelloWorld {

    public static void main(String[] args) {
        // TODO Auto-generated method stub
        System.out.println("Hello, World!");
    }

}
```

```
<terminated> HelloWorld [Java Application] C:₩Program Files₩Java₩jdk-12.0.2₩bin₩javaw.exe (2019. 9. 2. 오후 11:11:28)
Hello, World!
```

End of Class

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