NYU

Lecture 1

Introduction to Computers, Programs, and Java

Course Goals

- Learn to program in Java
- Acquire the the basics of object oriented programming
- Use modern software engineering techniques

Organization

- Weekly lectures
  - Tuesdays 3:30 - 4:45pm – 25 West 4th Street room C-20
  - Thursdays 3:30 - 4:45pm – 25 West 4th Street room C-20
- Office hours:
  - Thursdays 2:15 - 3:15pm – 60 Fifth Ave - 5th floor
- Tutors:
  - 60 Washington Square South, 4th Floor (Kimmel Center)
- Final exam
  - Thursday, December 19, 2019 – 4:00 - 5:50pm
- Book

  Introduction to JAVA programming
  Brief version, 11th edition
  Y. Daniel Liang
  ISBN: 0-13-359220-0

Course outline

- Part 1: Fundamentals of Programming
  - Command line
  - Types
  - Control flow
  - Looping
  - Input output
  - Strings
  - Functions
  - Arrays
- Midterm 1

Course outline

- Part 2: Object oriented programming and design
  - Objects and classes
  - Object oriented design
- Midterm 2
- Part 3: Advanced concepts
  - Inheritance
  - Polymorphism
  - Exception handling
  - Abstract classes and interfaces
  - (Recursion)
- Final exam

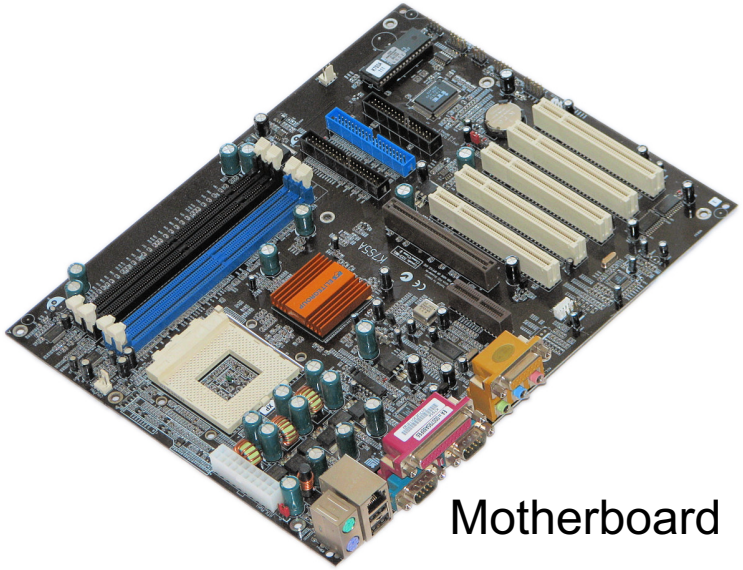
Grading

- Assignments and quizzes 10%
  - Late assignments count 70%
- Project 10%
- In class participation 5%
- Midterms 20% each
- Final 35%

Policy

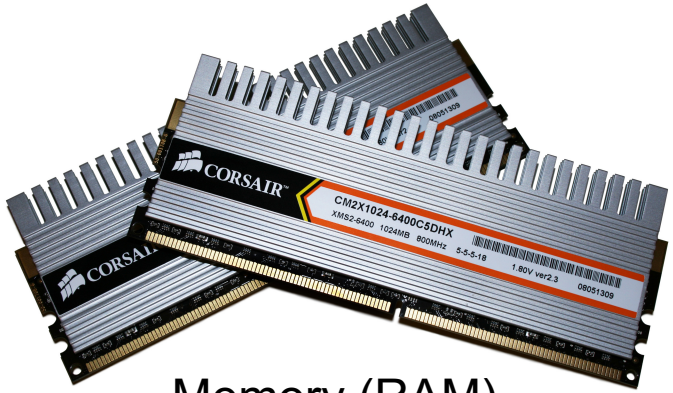
- You are encouraged to consult with your classmates/friends but collaboration in the assignments is **NOT** allowed.
- You are **NOT** allowed to copy code online or use external libraries (except those provided in the class).
- We will use plagiarism tools to validate all homework. Plagiarism will be punished with a zero-tolerance policy: **the minimal penalty will be a score of 0 points on the assignment, the reduction of 1 letter grade in the final score, and a permanent ban on NYU-related jobs.**
- If you are stuck in an assignment:
  - Google
  - Ask the tutors
  - Come to the office hours

What is a Computer?



Motherboard

CPU



Memory (RAM)

Hard disk

CPU

- The central processing unit (CPU) is the brain of a computer.
- It retrieves instructions from memory and executes them.
- The CPU speed is measured in gigahertz (GHz)
  - 1 megahertz equaling 1 million millions pulses per second.
- The speed of the CPU has been improved continuously.
- If you buy a PC now, you can get an Intel i9 Processor at 4.80GHz

Memory

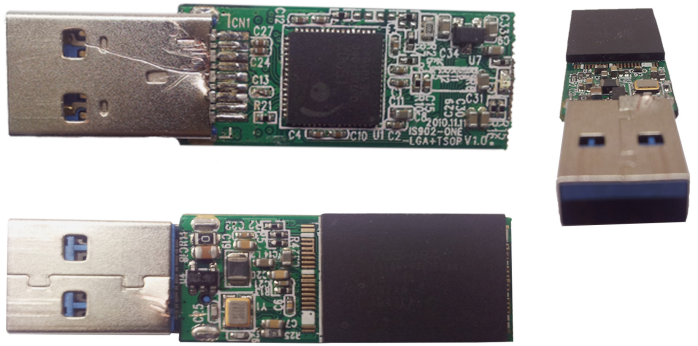
- *Memory* is to store data and program instructions for CPU to execute.
- A memory unit is an ordered sequence of bytes, each holds eight bits.
- A program and its data must be brought to memory before they can be executed.
- A memory byte is never empty, but its initial content may be meaningless to your program.
- The current content of a memory byte is lost whenever new information is placed in it.

How Data is Stored?

- Data of various kinds, such as numbers, characters, and strings, are encoded as a series of bits (zeros and ones).
- Computers use zeros and ones because digital devices have two stable states, which are referred to as zero and one by convention.
- The programmers need not to be concerned about the encoding and decoding of data, which is performed automatically by the system based on the encoding scheme.
- No two data can share or split a same byte.
- A byte is the minimum storage unit.

Storage Devices

- Memory is volatile, because information is lost when the power is off.
- Programs and data are permanently stored on storage devices and are moved to memory when the computer actually uses them.



Programs

- Computer programs, known as software, are instructions to the computer.
- You tell a computer what to do through programs.
- Without programs, a computer is an empty machine.
- Computers do not understand human languages, so you need to use computer languages to communicate with them.
- Programs are written using programming languages.

Machine Language

- Machine language is a set of primitive instructions built into every computer.
- The instructions are in the form of binary code, so you have to enter binary codes for various instructions.
- Program with native machine language is a tedious process.
- Moreover the programs are highly difficult to read and modify.
- Example:
  - to add two numbers, you might write an instruction in binary like this:
  - `1101101010011010`

Assembly Language

- Assembly languages were developed to make programming easy.
- Since the computer cannot understand assembly language, however, a program called assembler is used to convert assembly language programs into machine code.
- Example:
  - to add two numbers, you might write an instruction in assembly code like this:
  - `ADDF3 R1, R2, R3`

High-Level Language

- The high-level languages are English-like and easy to learn and program.

- Example:
  - compute the area of a circle with radius 5:
  - `area = 5 * 5 * 3.1415`

Popular High-Level Languages

Language	Description
C	Developed at Bell Laboratories. C combines the power of an assembly language with the ease of use and portability of a high-level language.
C++	C++ is an object-oriented language, based on C.
C#	Pronounced “C Sharp”. It is a hybrid of Java and C++ and was developed by Microsoft.
Java	Developed by Sun Microsystems, now part of Oracle. It is widely used for developing platform-independent Internet applications.
Python	A simple general-purpose scripting language good for writing short programs.
JavaScript	A high-level, interpreted programming language often used for the Web. It is a language which is also characterized as dynamic, weakly typed, prototype-based and multi-paradigm.
Swift	A general-purpose, multi-paradigm, compiled programming language developed by Apple for iOS, macOS, watchOS, tvOS, and Linux.

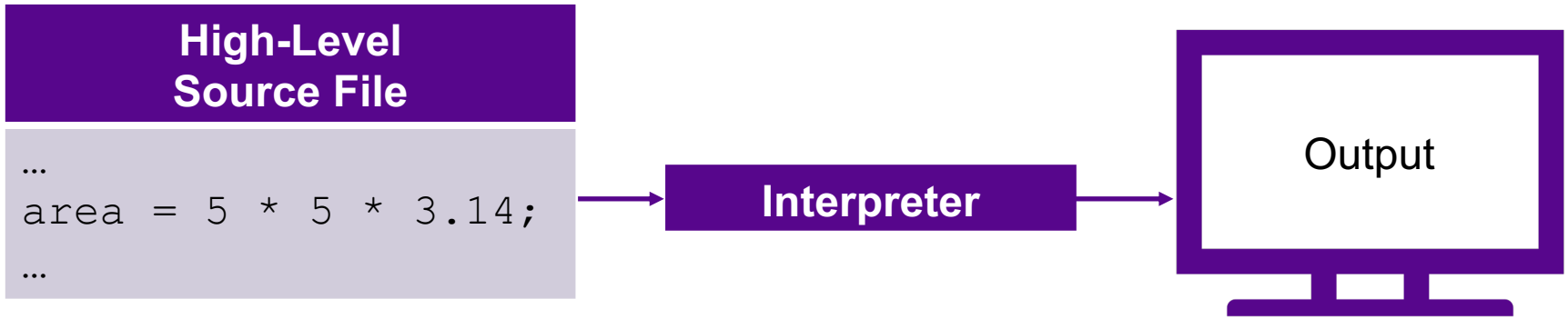
Interpreting/Compiling Source Code

- A program written in a high-level language is called a source program or **source code**.
- Because a computer cannot understand a source program, a source program must be translated into machine code for execution.
- The translation can be done using another programming tool called an interpreter or a compiler.

Interpreting Source Code

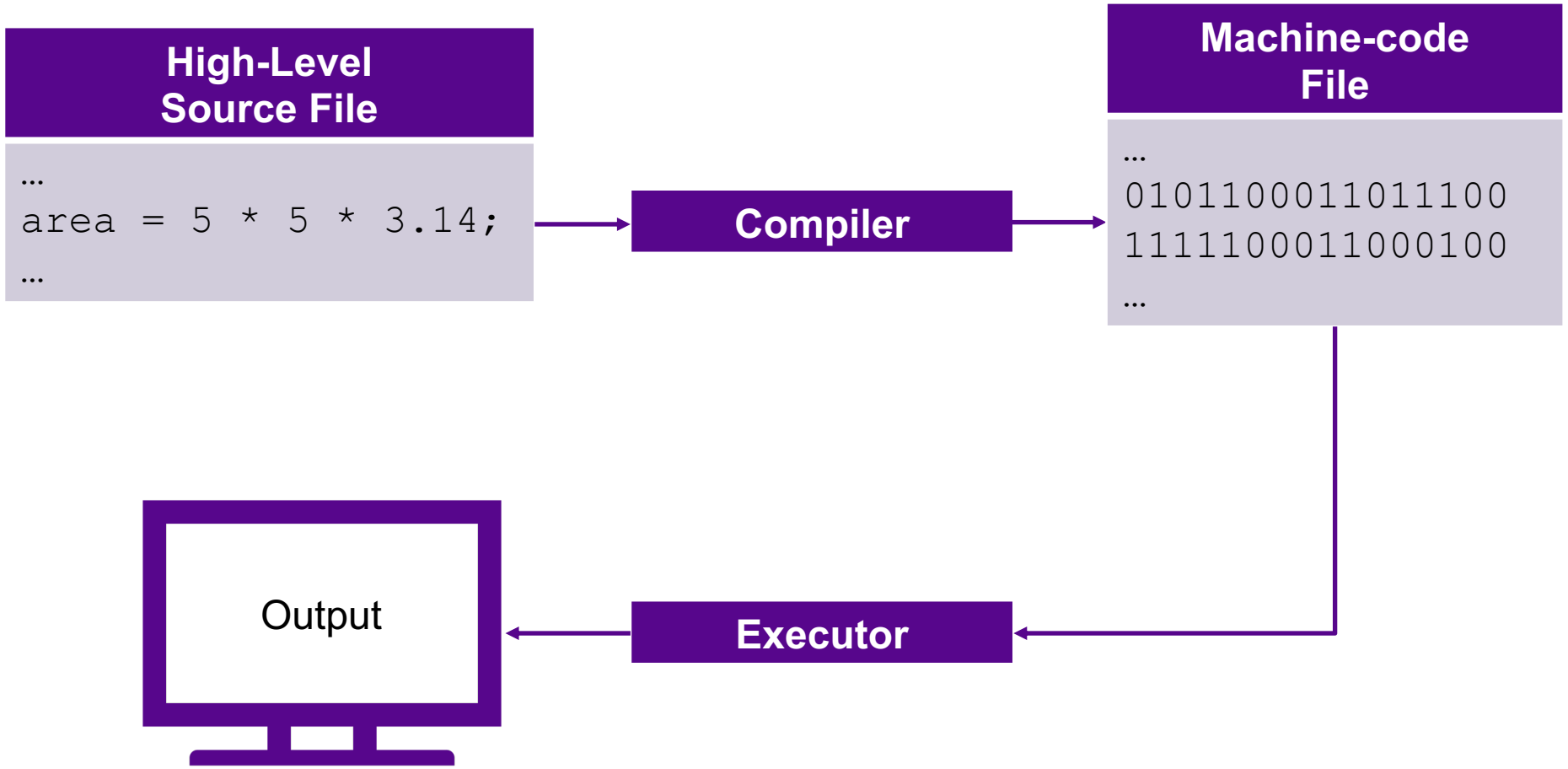
- An interpreter
  - reads one statement from the source code,
  - translates it to the machine code or virtual machine code,
  - then executes it right away.

- Note that a statement from the source code may be translated into several machine instructions.



Compiling Source Code

- A compiler translates the entire source code into a machine-code file, and the machine-code file is then executed



Characteristics of Java

- Java Is Simple
- Java Is Object-Oriented
- Java Is Distributed
- Java Is Interpreted
- Java Is Robust
- Java Is Secure
- Java Is Architecture-Neutral
- Java Is Portable
- Java's Performance
- Java Is Multithreaded
- Java Is Dynamic

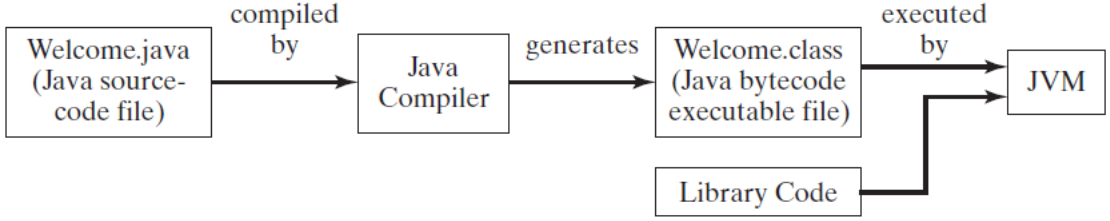
A Simple Java Program

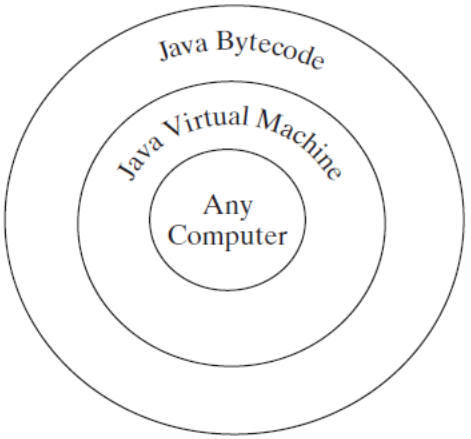
```
// This program prints Welcome to Java!
public class Welcome {
  public static void main(String[] args) {
    System.out.println("Welcome to Java!");
  }
}
```

```
################ python
if __name__ == "__main__":
  print("Welcome to Java!")
```

Compiling Java Source Code

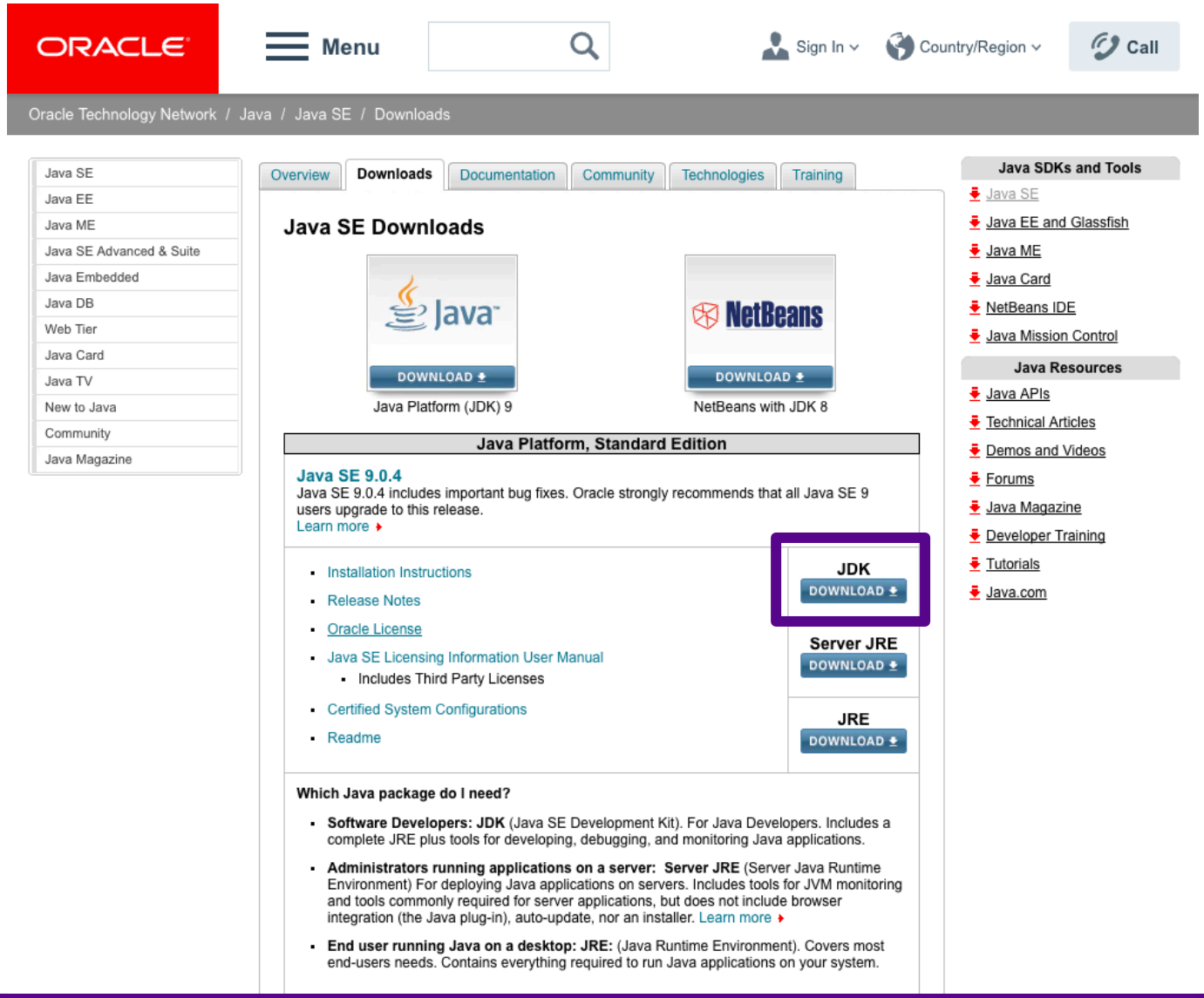
- You can port a source program to any machine with appropriate compilers.
- The source program must be recompiled, however, because the object program can only run on a specific machine.
- Java was designed to run object programs on any platform.
- With Java, you write the program once, and compile the source program into a special type of object code, known as bytecode.
- The bytecode can then run on any computer with a Java Virtual Machine.
- Java Virtual Machine is a software that interprets Java bytecode.





Install Java

http://www.oracle.com/technetwork/java/javase/downloads/index.html



Compiling and Running Java from the Command Window

- Set path to JDK bin directory
- Set classpath to include the current directory
- Compile
  - `javac Welcome.java`

- Run
  - `java Welcome`

Command line

Mac	Windows
mkdir	mk
cd <folder>	cd <folder>
rm <file>	erase <file>
ls	dir
ls | grep	dir | findstr -i
cat	type
cp <file> <out>	copy <file> <out>
mv <file> <out>	rename <file> <out>
javac	javac
java	java
pwd	