JAVA

Lecture 001 – Introduction to Java

MODULE INFORMATION

- Lecturer: Ning Xue

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LECTURES

- Monday
- ***Java Programming: A Comprehensive Introduction***, Herbert Schildt and Dale Skrien, 2013.
-
- Exam is mostly knowledge based
- Labs and Coursework is mostly comprehension and application
- Possibly learn more in the labs than the lectures (I would)

ROUGHLY 6 TOPICS

- 1. Fundamentals
- 2. Classes, Objects, Methods
- 3. Inheritance
- 4. Interfaces
- 5. Exception Handling and IO
- 6. Packages

- Chapters 1-11 of "Java Programming: A Comprehensive Introduction, Herbert Schildt and Dale Skrien, 2013."

JAVA ON INTERNET

- What's in this module:
  - A very basic introduction to Java and OOP
  - We assume you do not have any Java experience.
  - All the materials covered in this module are available on the internet
  - You may find online tutorials useful
  - But please try yourself

WHAT IS JAVA

- Java is a **high-level** programming language conceived by James Gosling in 1991. (Originally called Oak and then Green)
- It was named "Java" in 1995 (apparently after the coffee they drunk)
- Its syntax is similar to the older languages C and especially C++
- It is an important language for the Internet (Servlets, Apps…more recently Machine learning, simulation)
- Best known for:
  - **Cross-platform**
  - **Safety**

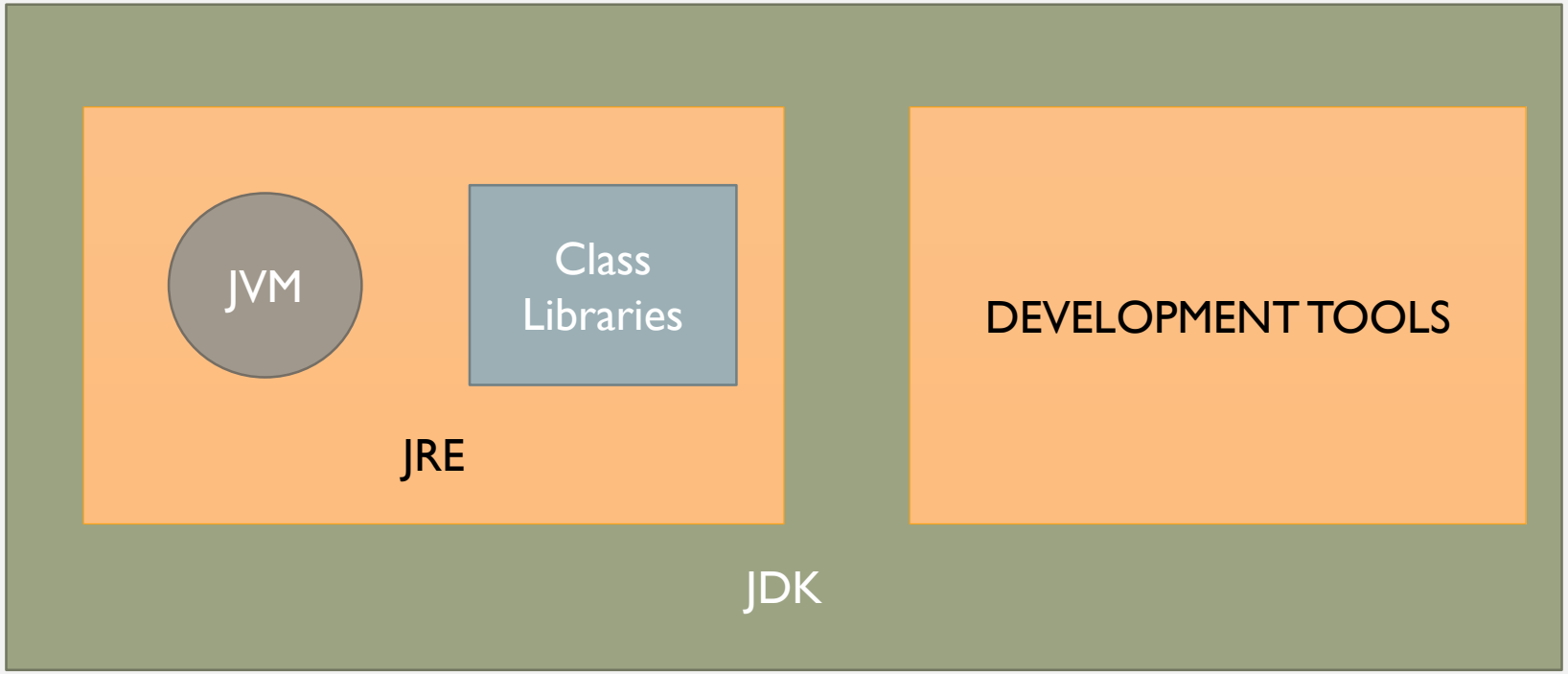
WHY JAVA

- Java is popular and in demand-ish
- Good for jobs, and almost 'expected' of CS grads
- Also used in many later modules
- And can help you to understand more complex languages like C++
- Java 'forces' some kind of object orientedness (Unlike C++ and Python)
- Everything is defined in a class in Java
- Java has a lot of classes available **(java.util.HashMap, java.lang.Exception….)**
- Cross-platform – no recompilation for platforms

BEFORE START PROGRAMMING

- Java Development Kit (JDK): a software development environment used for developing Java applications
  - Development Tools like compilers, debuggers
  - JRE
- Java Runtime Environment (JRE): minimum requirements for executing a Java application
  - Java Virtual Machine (JVM).
  - Java Class Library.
  - …

JDK, JRE AND JVM



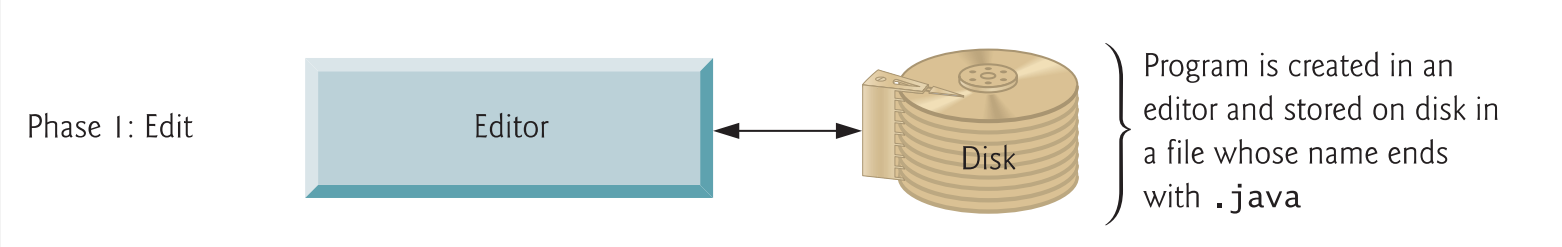
JVM

- Compiler: a special program that translates high-level programming languages' source code into machine code (for specific operating systems and computer architecture)
- Java: source code is translated into bytecode (intermediate language).
- Java Virtual Machine: a program to execute Java bytecode.

JAVA

- Creating and executing a Java application using a Java development environment normally include 5 steps:
  - Step 1: Creating a program
  - Step 2: Compiling a Java program into Bytecodes
  - Step 3: Loading the bytecode into Memory
  - Step 4: Bytecode Verification
  - Step 5: Execution

STEP 1: CREATING A PROGRAM

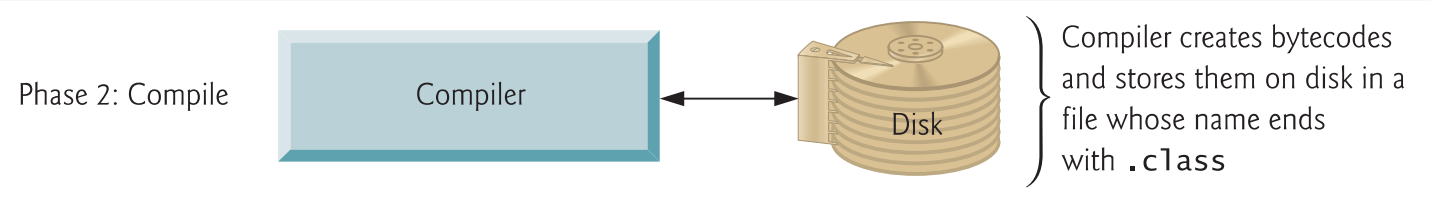


- Write Java program:
  - Plain text editor: Notepad++, VS Code, Sublime, Vim, Emacs…
  - Integrated Development Environments (IDEs): Eclipse, Intellij, Netbeans… (for complex development)
- The program is created and stored on a storage device in a file whose name ends with .java
  - Each file contains one or more class definitions.
  - Each file contains at most one public class.
  - Filename must match the class name.

FIRST PROGRAM

```
/*
This is a simple Java program.
Call this file HelloWorld.java.
*/
public class HelloWorld {
        // A Java program begins with a call to main().
        public static void main(String[] args) {
                System.out.println(“Hello World");
        }
}
```

STEP2: COMPILING

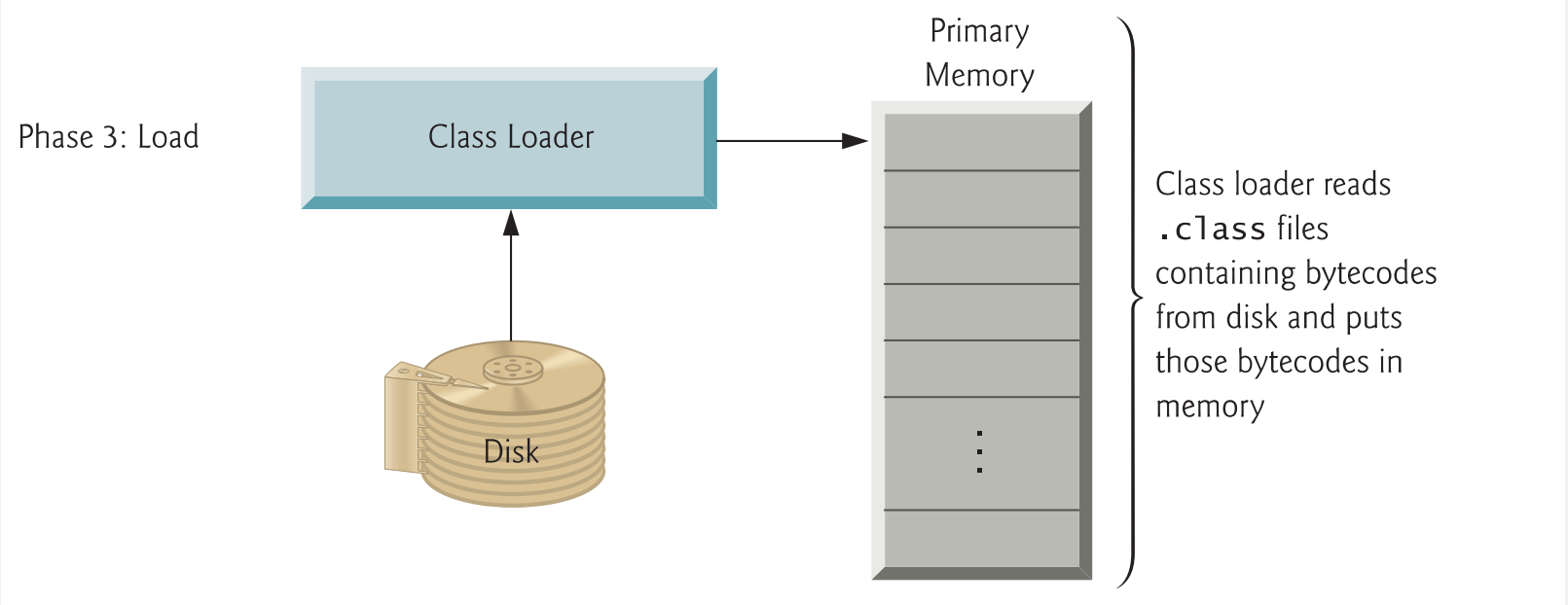


- To compile the program, on the command line, type in javac (Java compiler):
  - *javac HelloWorld.java*
- The java compiler translate Java source code into bytecodes and produce a .class file (e.g., HelloWorld.class)
- Java compilers do not generate machine code for a CPU but for a Java Virtual Machine (JVM)
- JVM: a part of the JDK and the foundation of the Java platform.
- Bytecodes are executed by a JVM on each computer.

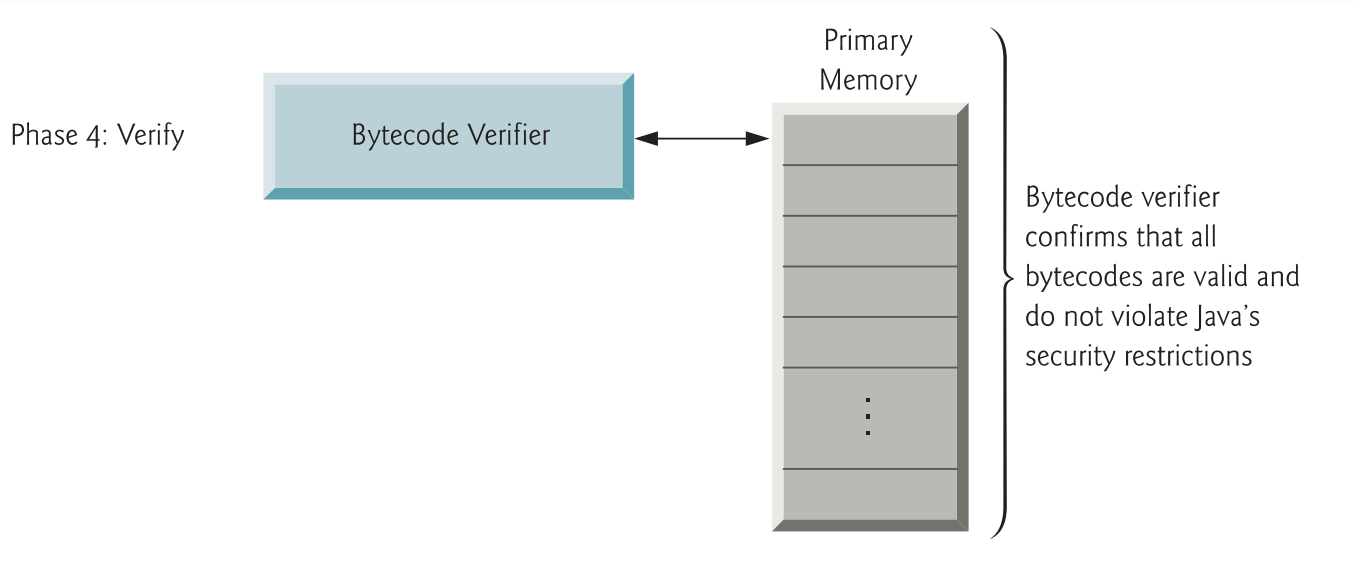
JVM

- JVM: A software application that simulates a computer but hides the underlying operating system and hardware from the program that interact with it.
  - JVM is a much simpler machine
  - The details of the JVM will differ from platform to platform
  - Same Java bytecode
- Portable: the same bytecodes can execute on any platform containing JVM without recompiling.
- more convenient to program than real CPUs
- JVM is invoked by the *java* command, i.e., to execute a java application
  - *java HelloWorld*

STEP3: LOADING A PROGRAM INTO MEMORY

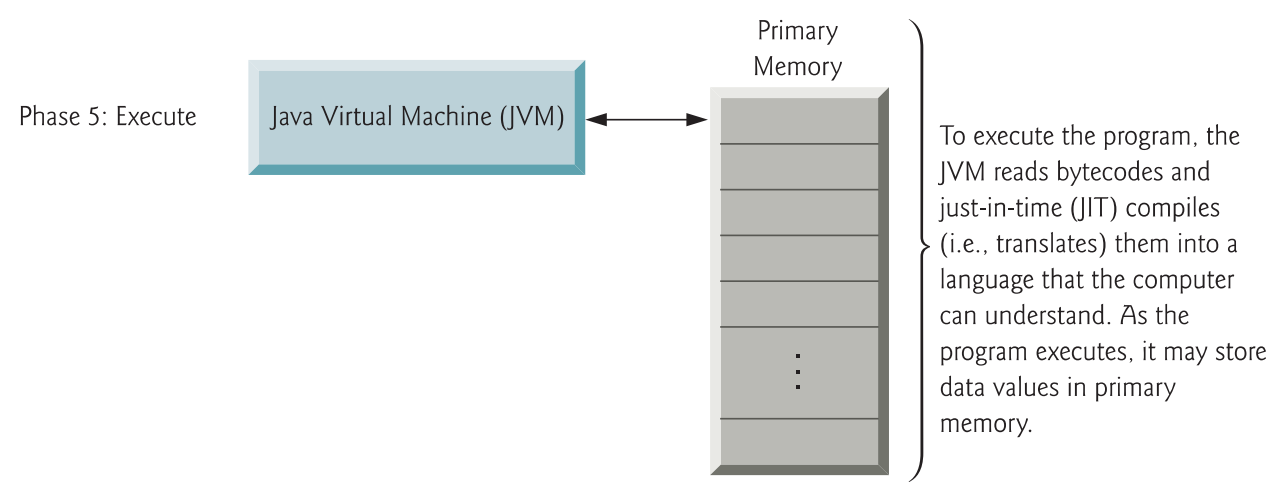


STEP4: BYTECODE VERIFICATION



- Java enforces strong security to make sure that Java programs arriving over the network do not damage your files or your systems (e.g., viruses and worms)

STEP5: EXECUTION



- JVM **executes** the program's bytecodes, thus performing the actions specified by the program.
  - Early versions: JVM was simply an interpreter for bytecodes. slow, interpret and execute one bytecode at a time.
  - Today: using a combination of JVM and so-called just-in-time (JIT) compilation.
  - JVM searches for hot spots, JIT translate such bytecode into machine languages.

FIRST PROGRAM

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public class HelloWorld {
        // A Java program begins with a call to main().
        public static void main(String[] args) {
                System.out.println(“Hello World");
        }
}
```

COMMENTS

```
/*
This is a simple Java program.
Call this file HelloWorld.java.
*/
public class HelloWorld {
        // A Java program begins with a call to main()
        public static void main(String[] args) {
                System.out.println(“Hello World");
        }
}
```

Multiline Comments

Single-line Comments

JAVA CLASS

- public class HelloWorld {
    - …….
- }
- **Declare a Class:**
    - class: a keyword (reserved word) for class declaration.
    - Class name: an identifier.
    - By convention, begin with a capital letter and capitalise the first letter of each word.

- **Brace {}:**
    - Braces limit the scope of variables and allow statements to be grouped
    - The elements between the braces are members of the class

MAIN IN JAVA

- public static void main (String[] args){
  - ……
- }

- Parentheses: indicating it is a programming building block called method.
- Methods are defined in a class.
- When the program starts up we need a starting method.
- Main is the starting point of every Java application.
- Each Java application must have a main method.

MAIN IN JAVA

- public static void main (String[] args)

- **public** – Access modifier. It means that you can call this method from outside of the current class. The main method must be declared as public.
- **static** – Keyword. When the JVM makes a call to the main method there is no object existing for the class being called. Static allows main() to be executed independently of any object.
- **void** - No particular type of data has to be returned through the function.
- **main** – The name of the method.
- **(String[] args)** – parameters. main method accepts an array of String as its input when you run it.

PRINTLN

- System.out.println("Hello World");

- **println():** built-in method that display the given string.
- **System:** a pre-defined class which provides access to the system
- **out:** is the output stream that is connected to the console.
- **Semicolon:** a separator to terminate a statement. All statements end with a semicolon.

SYNTAX ERRORS

- **Errors in Java:**
  - Syntax errors: errors in the syntax of a programming language
    - Java compiler will report any syntax errors at compile time.
  - Runtime errors: errors that occur while the program is running.
    - We will learn it later.

- Spelling mistakes
- Using keywords as identifiers
- Incorrect use of characters in identifiers
- Case differences
- Missing {
- ….