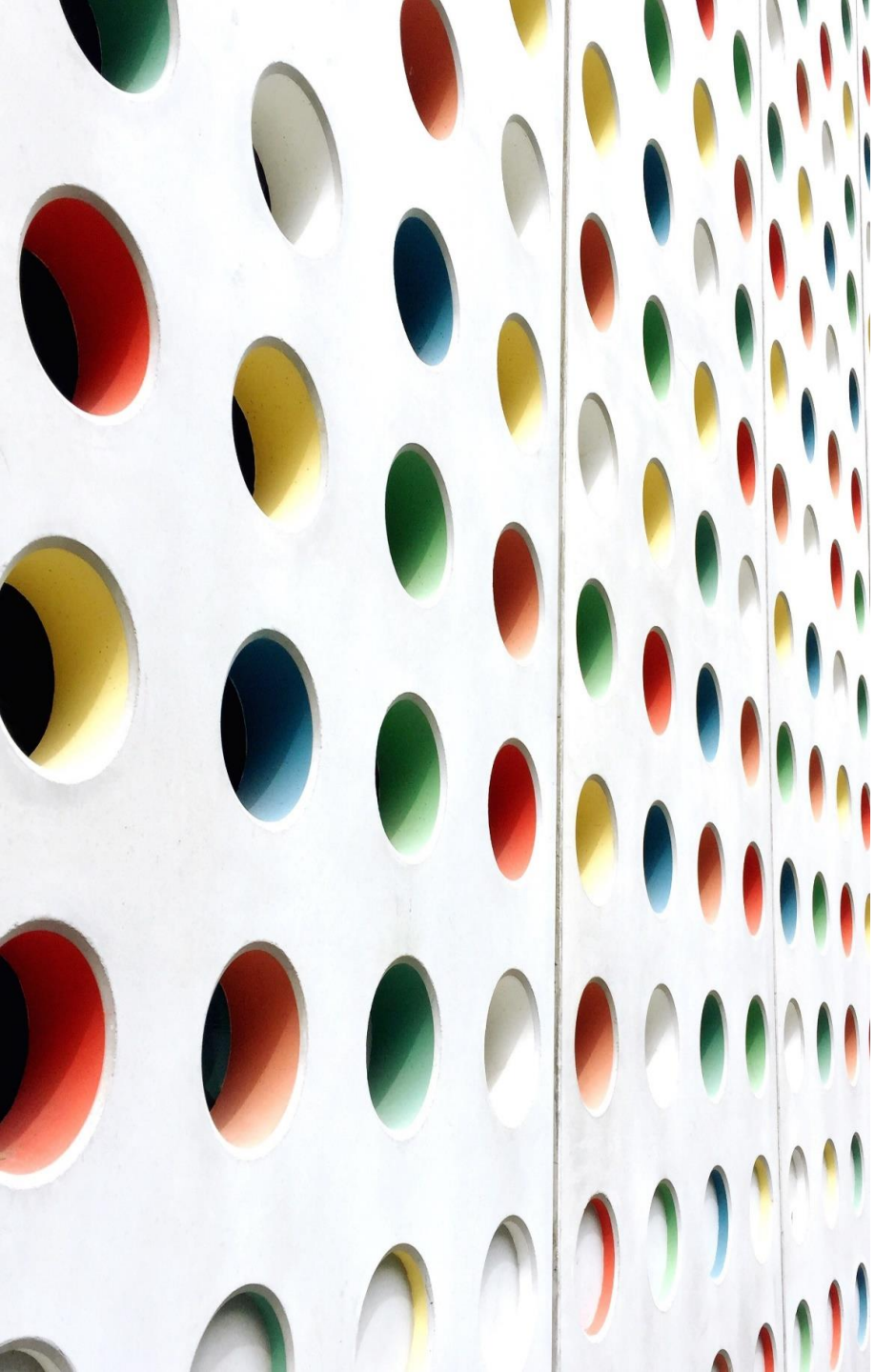


Chapter One

Introduction to Object Oriented Programming

Compiled by: | ***Sinodos G***

Introduction

- ***What is programming Language?***
  - a computer language that is used by programmers (developers) to communicate with computers.
  - It is a set of instructions written in any specific language (C, C++, Java, Python, PHP, JS, …) to perform a specific task.
  - mainly used to develop desktop applications, Enterprise, websites, and mobile applications.
  - In general it is used to design and implement different types of software's.

Programming Paradigm's

- a way to classify programming languages based on their style and approach to solving problems.
- Different paradigms provide different ways of thinking about and structuring code.
- Paradigm's a style, or "way," of programming.
- Some languages make it easy to write in some paradigms but not others.
- different ways or styles in which a given program or programming language can be organized.
- Each paradigm consists of certain structures, features, and opinions about how common programming problems should be tackled.

Cont'd ...

- Different programming languages follow different approaches to solving programming problems
- A programming paradigm is an approach to solving programming problems
- Some of the common programming paradigms
  - Procedural Programming
  - Structured Programming
  - Functional Programming
  - Imperative Programming
  - Declarative Programming
  - Object-Oriented Programming

Cont'd ...

- ***Procedural Programming***
  - focuses on functions and procedures that manipulate data.
  - follows a top-down approach during the designing of a program.
  - It gives importance to the concept of the function and divides the large programs into smaller parts or called as functions.
  - straightforward.
  - It follows a step-by-step approach in order to break down a task into a set of variables and routines via a sequence of instructions.
  - ***Examples:***
    - ***ALGOL, COBOL, BASIC, PASCAL, FORTRAN, C.***

Cont'd ...

Example:

```
public class ProceduralEx {
    public static void main(String[] args) {
        int a = 5;
        int b = 3;
        int sum = add(a, b);
        System.out.println("Sum: " + sum);
    }

    static int add(int x, int y) {
        return x + y;
    }
}
```

Cont'd ...

- ***Structured Programming***
  - Also known as modular programming.
  - characterized by the use of procedures or functions, control flow constructs, and well-defined, modular structures.
  - It improve code readability, maintainability, and reliability by avoiding unstructured practices like goto statements.
  - intends to optimize the code by using the program control flow constructs , decision making (If , If Then , Else) constructs and the iteration constructs (For , while loops), blocks and the functions.
  - code will execute the instruction by instruction one after the other.
  - ***Example:*** C, C++, Java, C#

Cont'd ...

Example:

```
public class StructuralEx {
    public static void main(String[] args) {
        int number = 10;
        if (number > 0) {
            System.out.println("The number is positive.");
        }
    else {
            System.out.println("The number is not positive.");
        }
        for (int i = 1; i <= 5; i++) {
            System.out.println("Iteration " + i);
        }
    }
}
```

Cont'd ...

- ***Declarative Programming***
  - focuses on describing what the program should do rather than how it should be done.
  - Programming by specifying the result you want, not how to get it.
  - SQL is an example in the context of databases
- ***Functional Programming***
  - Functional programming emphasizes immutability and the use of pure functions.
- ***Imperative Programming***
  - Programming with an explicit sequence of commands that update state.

Cont'd ...

Object-oriented Programming

- OOP is based on objects and classes, promoting the organization of data and methods into objects that interact with each other.
- It is based on the concept of object.
- An object contains data in the form of fields that are known as attributes and the procedures are known as methods.
- programs are divided into what are known as objects.
- It follows the bottom-up flow of execution.
- It introduces concepts like data abstraction, inheritance, and overloading of functions and operators overloading.
- ***Example:*** Java, C++, Python, C#, Perl, Kotlin, Ruby

Cont'd ...

Example:

```
class Dog {
    String name;

    void bark() {
        System.out.println(name + " barks!");
    }
}
public class OOPEx {
    public static void main(String[] args) {
        Dog myDog = new Dog();
        myDog.name = "Buddy";
        myDog.bark();
    }
}
```

Cont'd ...

Some Advantages of OOP Paradigms

Java

- What is Java?
- What is the difference between java and C++

- Java is not only a Programming language but also a programming atmosphere to develop and deploy enterprise applications.

Cont'd ...

- Java:
  - Programming language and a platform.
  - Developed by sun microsystems (James Gasoling)
  - a high level, robust, secured and object-oriented programming language.
  - based C/C++
  - widespread acceptance
- Platform:
  - Any hardware or software environment in which a program runs, is known as a platform.
  - Since Java has its own runtime environment (JRE) and API, it is called platform.

Where it is used?

- According to Sun, 3 billion devices run java.
- There are many devices where java is currently used. Some of them are as follows:
  - Desktop Applications such as acrobat reader, media player, antivirus etc.
  - Web Applications
  - Enterprise Applications such as banking applications.
  - Mobile
  - Embedded System
  - Smart Card
  - Robotics
  - Games etc.

Types of Java Applications

- There are mainly 4 type of applications that can be created using java programming:

1. Standalone Application
   - It is also known as desktop application or window-based application.
   - An application that we need to install on every machine such as media player, antivirus etc.
   - AWT and Swing are used in java for creating standalone applications.
2. **Web Application**
   - runs on the server side and used to create dynamic pages
   - Currently, servlet, JSP, struts, JSF etc. technologies are used for creating web applications in java.

Cont'd ...

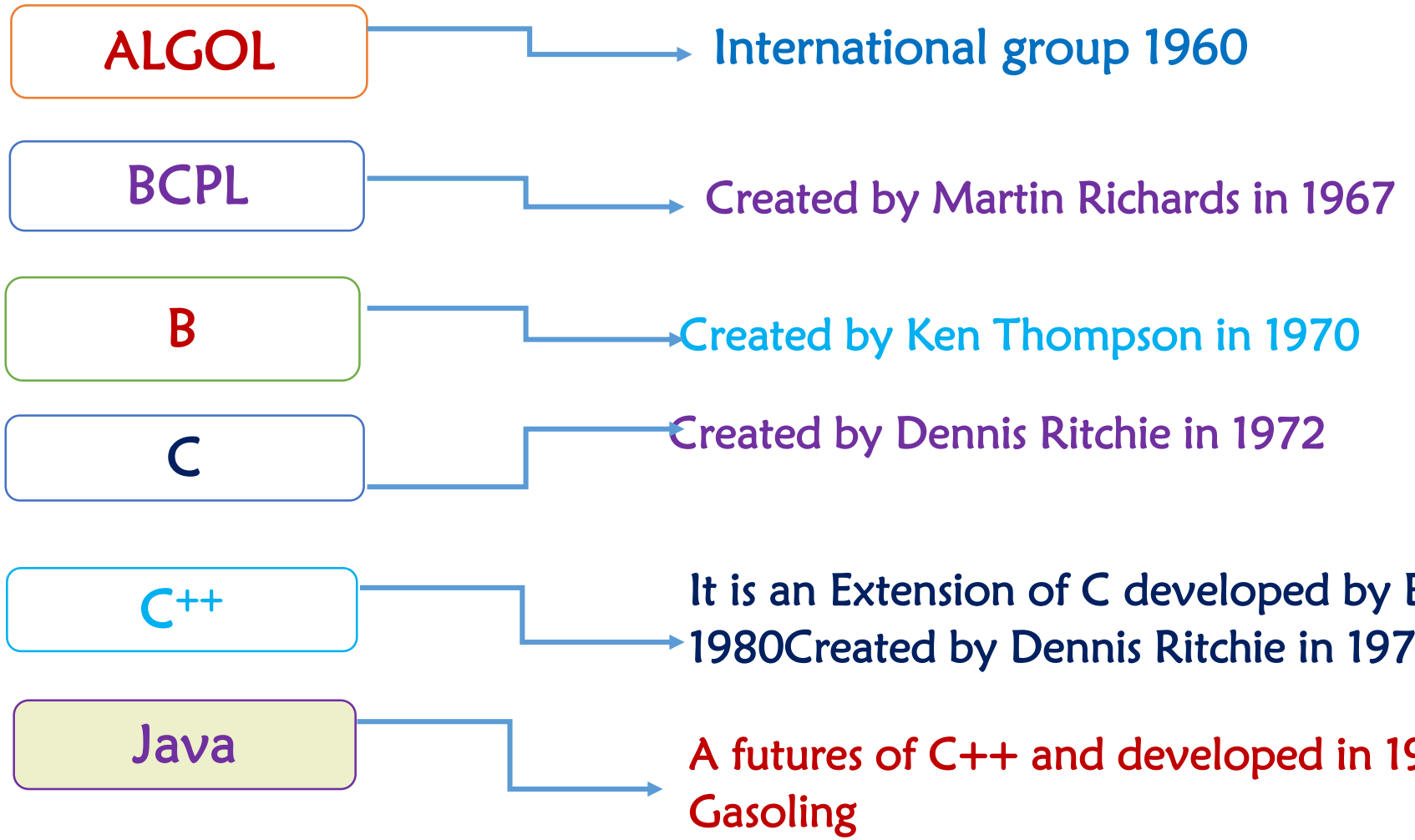
3. Enterprise Application

- An application that is distributed in nature, such as banking applications etc.
- It has the advantage of high level security, load balancing and clustering.
- In java, EJB is used for creating enterprise applications.

4. Mobile Application

- An application that is created for mobile devices.
- Currently Android and Java ME are used for creating mobile applications.

History of Programming



Cont'd …

- ALGOL:
  - Algol is a computer programming language
  - The root of all modern languages (introduce in 1958).
  - Named for the algorithmic process of definition of a programming problem.
  - Short for Algorithmic Language.
  - ALGOL uses a structure programming.
  - ALGOL is popular in Europe

Cont'd …

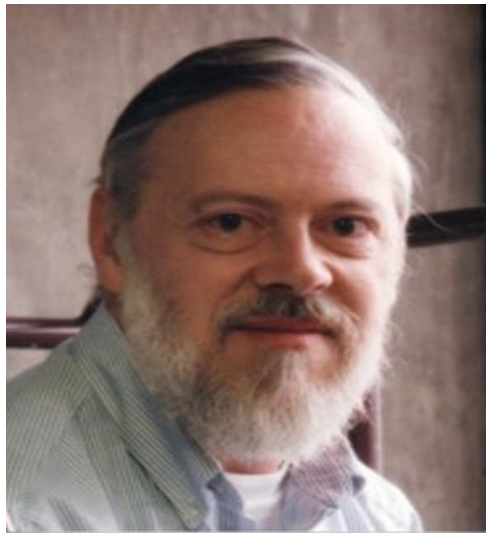
- **BCPL:**
  - In 1967, Created by Martin Richards in 1967
  - Basic Combined Programming Language)
  - Primarily BCPL is developed for system software
    - Operating systems and compilers
  - high portability.
  - It is the successor to the CPL programming language.

B:

- Created by Ken Thompson In 1970
- created for UNIX OS at Bell Laboratories.
- Both BCPL and B were "type less" languages
- It was derived from BCPL
- Designed for primarily non-numeric applications.

History of C

- During 1970 *Dennis Ritchie* created C Programming language to develop the UNIX operating system at Bell Labs.
- C is a general-purpose, high-level language.
- C was originally first implemented on the PDP-11 computer in 1972.



Dennis Ritchie

- *He is an* American computer scientist.
- He created the C programming language and, with long-time-colleague ken Thompson, the UNIX OS.

Cont'd ...

- C was evolved from ALGOL, BCPL and B.
- Added new features and concepts like "data types".
- Developed along with the UNIX operating system.
  - In 1983 American National Standards Institute (ANSI) appointed a technical committee to define a standard for C.
    - approved a version of C in December 1989 which is now known as ANSI C.
- In 1990 International Standards Organization (ISO) has approved C and this version of C is referred to as C89.

History of C++

- C++ Development started in 1979.
- It is an extension of C language.
- During the creation of Ph.D. thesis, *Bjarne Stroustrup* worked with language called Simula.
- Simula is programming language basically useful for the simulation work.

Bjarne Stroustrup

Cont'd ...

- Simula was first language to support object-oriented programming language (OOP).
- OOP is a formal programming approach that combines data and associated actions (methods) into logical structures (objects).
- *Bjarne Stroustrup* identified that this OOP features can be included in the *software development*, however the Simula language was far too slow for practical use.

Cont'd ...

- After that Bjarne Stroustrup started working on the C language and added more extra OOP features to the classic C.
- He added features in such a fashion that the basic flavor of C remains unaffected.
- C++ is an object oriented & hybrid language.
  - Possible to program as a c programming language and as an Object Oriented Programming style.
- In mid 2011 the new C++ standard C++11 was published.

History of Java

- Java started out as a research project.
- James Gosling is generally credited as the inventor of the Java programming language.
- He was the first designer of Java and implemented its original compiler and virtual machine.
- He is also known as the Father of Java.

James Goslimg

Cont'd ...

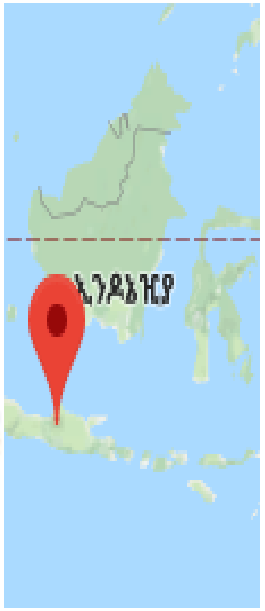
- Research began in 1991 as the Green Project at Sun Microsystems, Inc.
- Research efforts birthed a new language, OAK.
  - A tree outside of the window of James Gosling's office at Sun.
- Java is available as JDK (Java Development Kit) and it is an open source software.

- Oak is a symbol of strength and chosen as a national tree of many countries like U.S.A., France, Germany, Romania etc.

Cont'd ...

- Java language was created with 5 main goals:
  - an object oriented.
  - A single representation of a program could be executed on multiple operating systems. (write once, run anywhere)
  - fully support network programming.
  - execute code from remote sources securely.
  - easy to use.
- In 1995, Oak was renamed as "Java" because it was already a trademark by Oak Technologies.
- Now Sun Microsystems is a subsidiary of Oracle Corporation.

Cont'd ...



Java Logo

- Java is not an abbreviation.
- Java is name of
  an island of Indonesia, south of Borneo,
  from which it
  is separated by the Java Sea.
- politically the most
  important island of Indonesia
- Originally a kind of coffee grown on *Jav a* and nearby islands of modern Indonesi a.

Java Version History

- There are many java versions that has been released. Current stable release of Java is Java SE 8.

- JDK Alpha and Beta (1995)
- JDK 1.0 (23rd Jan, 1996)
- JDK 1.1 (19th Feb, 1997)
- J2SE 1.2 (8th Dec, 1998)
- J2SE 1.3 (8th May, 2000)
- J2SE 1.4 (6th Feb, 2002)
- J2SE 5.0 (30th Sep, 2004)
- Java SE 6 (11th Dec, 2006)
- Java SE 7 (28th July, 2011)
- Java SE 8 (18th March, 2014)

Java Platforms

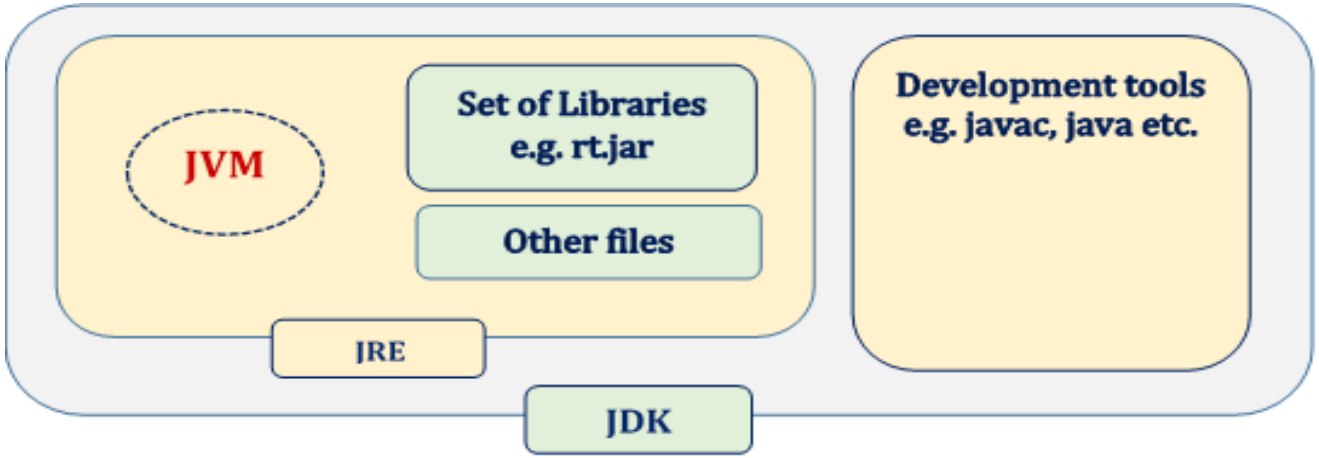
There are three main platforms for Java:

- Java SE (Java Platform, Standard Edition)
  - runs on desktops and laptops.
- Java ME (Java Platform, Micro Edition):
  - runs on mobile devices such as cell phones.
- Java EE (Java Platform, Enterprise Edition)
  - runs on servers.

Java Terminology

Java Development Kit

- It contains one (or more) JRE's along with the various development tools like
  - Java source compilers,
  - Bundling and deployment tools,
  - Debuggers, development libraries, etc.



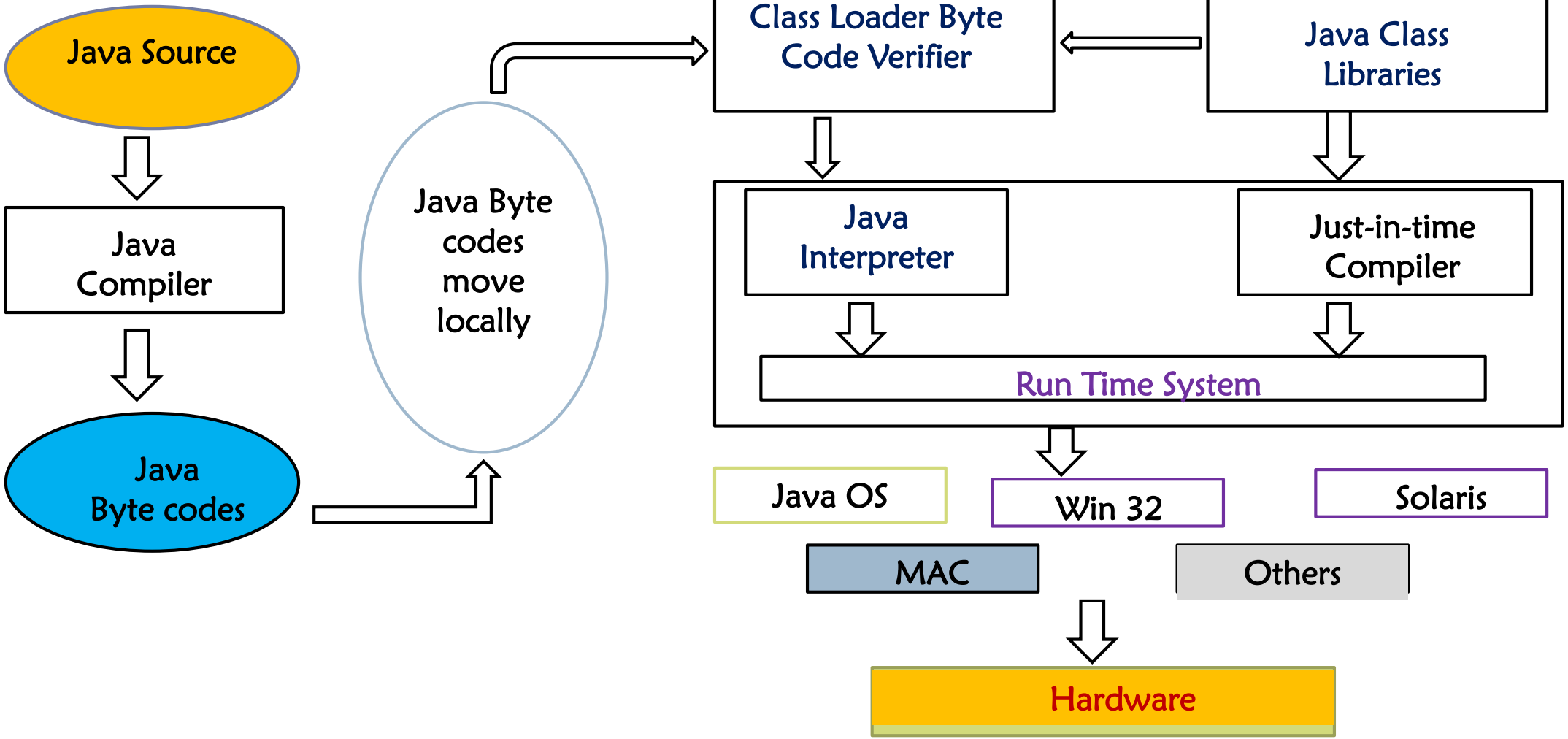
Cont'd ...

- Java Virtual Machine:
  - An abstract machine architecture specified by the Java Virtual Machine Specification.
  - It interprets the byte code into the machine code depending upon the underlying OS and hardware combination.
  - JVM is platform dependent. (It uses the class libraries, and other supporting files provided in JRE)

Java Runtime Environment:

- implements Java Virtual Machine, and provides all class libraries and other facilities necessary to execute Java programs.
- This is the software on your computer that actually runs Java programs.
- JRE = JVM + Java Packages Classes (like util, math, lang, awt, swing etc) + runtime libraries.

Java execution procedure



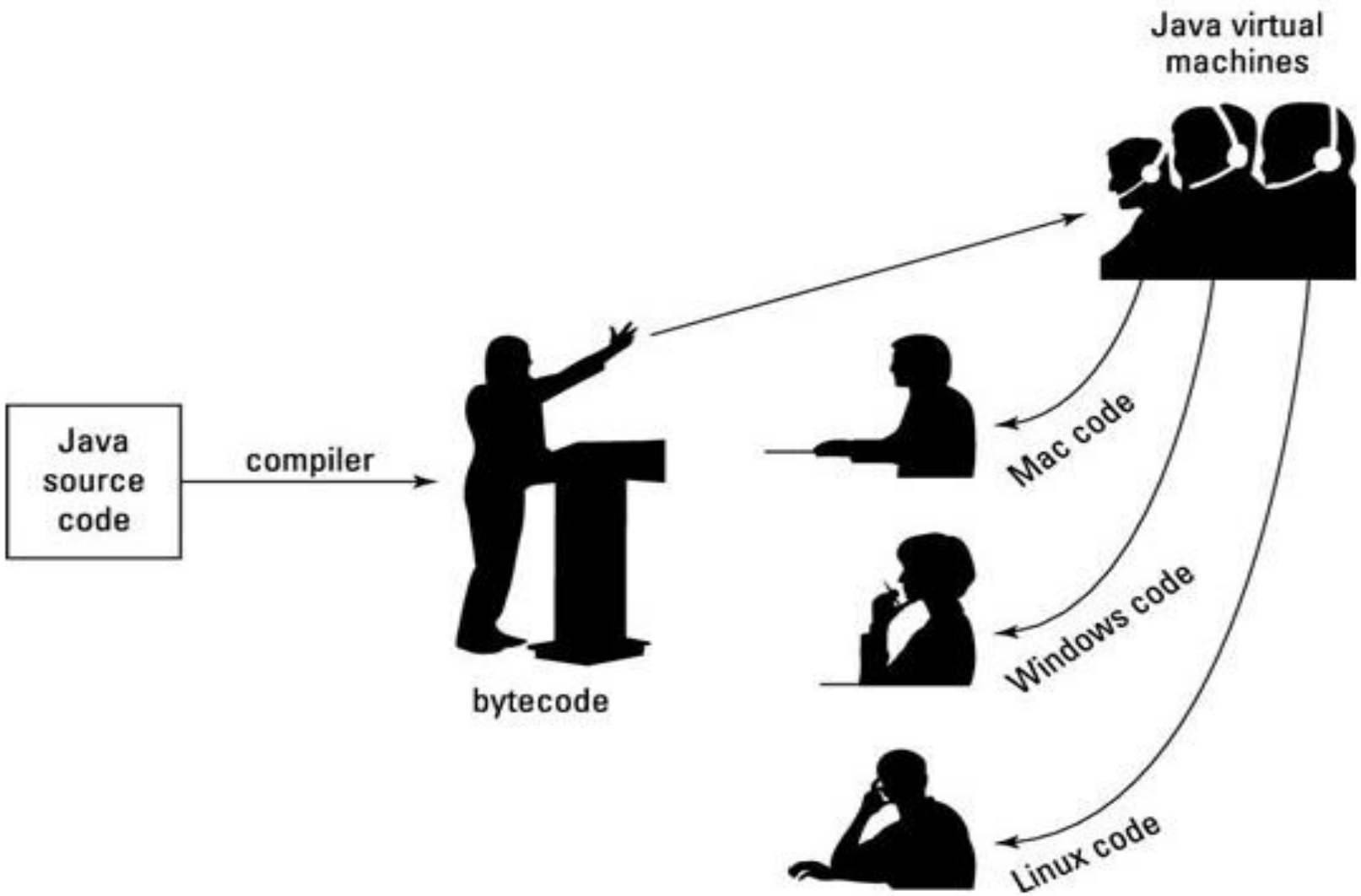
Java Virtual Machine

- JVM is an abstract machine.
- It is called virtual machine because it doesn't physically exist.
- It is a specification that provides runtime environment in which java bytecode can be executed.
- It can also run those programs which are written in other languages and compiled to Java bytecode.
- Each kind of computer processor has its own set of executable instructions, and each computer operating system uses the processor's instructions in a slightly different way.

Cont'd ...

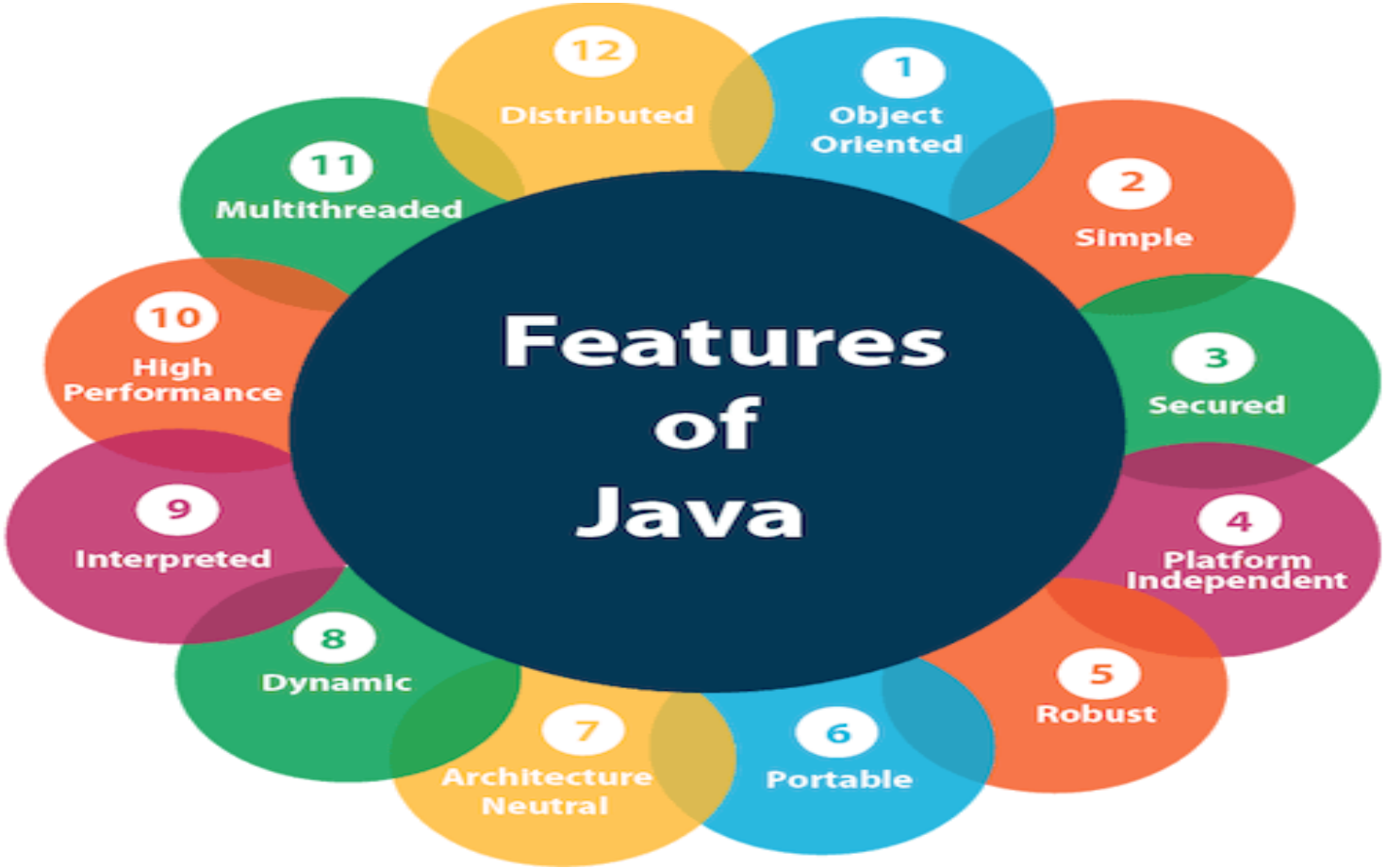
- JVM, JRE and JDK are platform dependent
- There are three notions of the JVM:-
  - Specification
  - Implementation, and
  - Instance.
- The JVM performs following main tasks:-
  - Loads code
  - Verifies code
  - Executes code
  - Provides runtime environment

Cont'd ...


Java virtual machines
Java source code
compiler
bytecode
Mac code
Windows code
Linux code

Characteristics of Java

- The following are characteristics of Java



Simple Java program

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

Output:

Hello Ethiopia!

Valid java main method signature

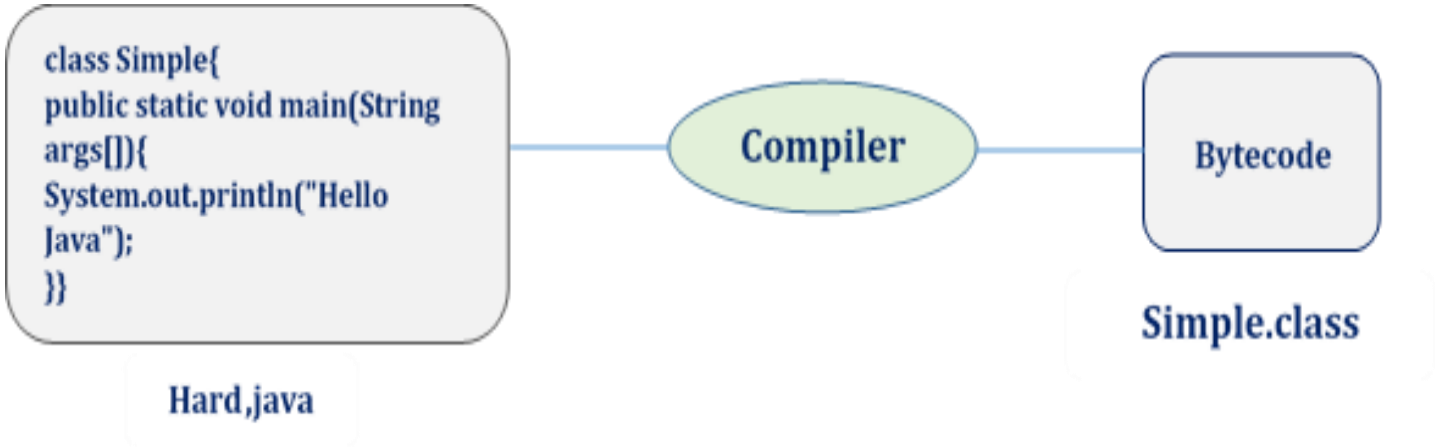
- public static void main(String[] args)
- public static void main(String []args)
- public static void main(String args[])
- public static void main(String... args)
- static public void main(String[] args)
- public static final void main(String[] args)
- final public static void main(String[] args)
- final strictfp public static void main(String[] args)

Invalid java main method signature

- public void main(String[] args)
- static void main(String[] args)
- public void static main(String[] args)
- abstract public static void main(String[] args)

Question

- Can you save a java source file by other name than the class name?
  - Yes: if the class is not public. It is explained in the figure given below



To compile: javac Hard.java

To execute: java Simple

Cont'd ...

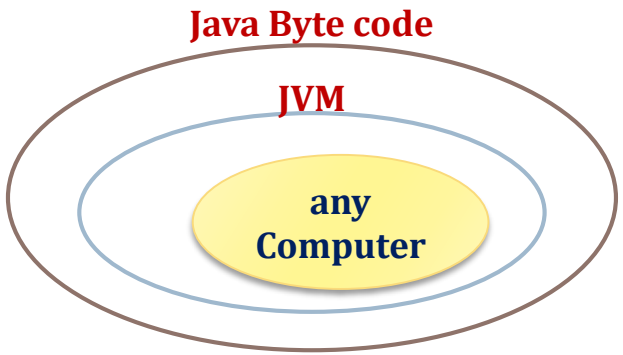
- What is the meaning of System.out.println()?
  - System is a class in Java's java.lang package which is the main (root) package in Java.
  - out is a static member of System class and represents output buffer.
  - The keyword println is an overloaded function used for printing the output.

Cont'd …

- **Can we write a Java program without Class?**
  - No!
  - Eevry Java program is going to have at least one class.
  - The class that contains the main function is often referred to as the main class. We always declare the main function inside a class.
- Why is string args used in Java?
  - String args [] is used to pass string arguments to the main function.

Compiling Java Source Code

- 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 byte-code can then run on any computer with a Java Virtual Machine
- Java Virtual Machine is a software that interprets Java byte-code.



Exercise

- Write a java program to print:
  - "Your Name, Id number, and Department" Class Year and Section on the command prompt (→ use notepad)
  - *Compile the program*
  - *Run the program*

Question