Computer Programming
Java Overview 2nd Lecture

엄현상 (Eom, Hyeonsang)
Department of Computer Science and Engineering
Seoul National University
Outline

- Java Overview
- Java Examples
- C++ vs java
- Q&A
Java Overview

- Object-Oriented Programming Language (OOPL) by Sun in 1991

- Programming with One or More Classes
- Simple Structure
  - w/o header files, preprocessor, struct, operator overloading, multiple inheritance, pointers, etc.
- Garbage Collection
  - No need to delete or return any storage
- Dynamic Loading
  - Classes being loaded as needed
- Platform Independence
  - Java Virtual Machine (JVM)
- Multithreading
  - Support for multiple threads of execution
Some Differences with C/C++

- **Automatic Memory Management**
  - Garbage Collector
  - No Dangling Pointers or Memory Leaks

- **No Pointer Handling**
  - No Explicit Reference/Dereference Operations

- **No Makefiles**

- **No Header Files**
  - cf, imported Packages

- **No Function Declaration (Similar to C)**

- **No Default Function Argument**
Java Platform

- **S/W Platform for Running Java**
  - on Top of any Platforms
- **Java Virtual Machine (JVM)**
- **Java Application Programming Interface (Java API)**

Collection of ready-made software components - grouped into Packages of classes and interfaces
Java Interpreter

- Implementation of the JVM
  - Executing Java Bytecodes
    - Java bytecodes can be considered as intermediate code instructions for the JVM
    - Java programs, once compiled into bytecodes, can be run on any JVM
How a Java Program Runs

Compilation and Interpretation

- Compiler First Translates a Java Program into Java Bytecodes
  - Once
- Interpreter Parses and Runs Each Java Bytecode Instruction
  - Multiple times on different platforms
Java Program

- Saved in Files, Each of Which Has the Same Name as the `public` Class
  - Containing Only One `public` Class
  - Containing Other Non-`public` Classes

```java
public class HelloWorld {
    public static void main(String args[]) {
        System.out.println("Hello, World");
    }
}
```

$ javac HelloWorld.java
compile (create HelloWorld.class; bytecode)

$ java HelloWorld
Hello, World
start the JVM and run the `main` method
Memory Layout of a Java Program

public class MemoryModelTest {
    static int x=0;
    public static void main(String args[]) {
        int a=10, b=20, c;
        c = add(a, b);
    }
    static int add(int a, int b) {
        return(a + b);
    }
}

Sample Program:
MemoryModelTest.java
Class

- **Unit of Programming**
  - Java Program: a Collection of Classes
    - Source code in .java files

- **Description (Blueprint) of Objects (Instances)**
  - Common Characteristics

- **Instances Have These Characteristics**
  - Attributes (Data Fields) for Each Object
  - Methods (Operations) That Work on the Objects
Member Access Control

Way to Control Access to a Class’ Members from Other Classes

- private
  - Accessible only in the class itself

- Default (package or friendly)
  - Accessible in the same-package subclasses of the class or in the classes of the same package

- protected
  - Accessible in the subclasses of the class or in the classes of the same package

- public
  - Accessible everywhere
Object

- Instance of a Class
- Uniquely Identifiable Entity
  - with Its State, Behavior, and Interface
  - Maintaining Data Values in Its Attributes
  - Referenced by a Reference Variable (of Reference Type)
    - Inheriting from the Class Object
      - with a number of methods
        - toString(), equals(), ... & clone()
Managing Objects

- Referencing Objects of Specified Types
  - Objects Created by the `new` Operator

- Creating Objects by Executing the Constructors
  - Constructor (Function) Overloading

String greeting = new String("hello");

greeting String
value = "hello"

- Deleting Objects via Garbage Collection
  - Reference Count for Each Object

Cleanup occurs at the convenience of the Java runtime environment
Java Example: Abstraction

Online Retailer Such as Amazon.Com
- Item: Type, Title, Maker, Price, Availability, etc.

```java
class Item { // Class definition
    public String title; // String is a predefined class
    public double price; // double is a primitive data type
    public double SalePrice() { return (price * 0.9); }
}

Item A = new Item(); // Class object definition and creation
```

- Attribute of the class
- Method of the class
- Variable of reference type

// OKAY: A.title, A.price, and A.SalePrice()
Java Example: Encapsulation

Online Retailer Example Cont’d

class Item {
    public String title;
    public double price;
    private int inStockQuantity;
    public double SalePrice(){ return (price * 0.9);}
    public boolean isAvailable(){
        if(inStockQuantity > 0) return true;
        else return false;
    }
}

Item A = new Item(); // Class object definition and creation

// NOT OKAY: A.inStockQuantity
// OKAY: A.isAvailable()
class MusicCDItem extends Item {
    public String singer_name;
}

// Class object definition and creation
MusicCDItem B = new MusicCDItem;

// OKAY: B.singer_name, B.title, B.price, B.SalePrice(),
// and B.isAvailable()
// NOT OKAY: B.inStockQuantity
Java Example: Polymorphism

Online Retailer Example Cont’d

class Item {
    public String title;
    public double price;
    private int inStockQuantity;
    public double SalePrice() { return (price * 0.9); }
    public boolean isAvailable() {
        if (inStockQuantity > 0) return true;
        else return false;
    }
    public void specificInfo() {
        System.out.println("no info: a base-class object");
    }
}
Java Example: Polymorphism Cont’d

Online Retailer Example Cont’d

class MusicCDItem extends Item {
    public String singer_name;
    public void specificInfo(){
        System.out.println("signer name=\" + singer_name + 
            " : a derived-class object");
    }
}

public class OnlineRetailer {
    static void printSpecificInfo(Item Item){item specificInfo();}
    public static void main(String args[]){ ... }
}

Item A = new Item();
MusicCDItem B = new MusicCDItem();

printSpecificInfo(A); // Call Item.specificInfo()
printSpecificInfo(B); // Call MusicCDItem.specificInfo()
// – Another derived class (e.g., MovieDVDItem) with specificInfo()
Static Modifier

Use: Static Attributes & Static Methods

Features

- All Classes Share Static Members
- It Is Possible to Invoke Static Methods w/o Instantiation
- In Static Methods, It Is Allowed to Access Non-Static Data or Non-Static Methods of Classes after the Instantiation of the Objects

```java
class A {
    private int i = 5;
    public static printI() {
        System.out.println(i); // error!
        System.out.println(new A().i);
    }
}
```
Static Modifier Cont’d

- Differences between C++ and Java
  - Static Method Invocation
    - C++: Class::method();
    - Java: Class.method();
  - Static Data Member Initialization
    - C++: No In-Class Initialization (ANSI/ISO)
    - Java: In-Class Initialization

```cpp
class A{
    public:
        static int i; // declare
        ...
}
int A::i = 0; // define & initialize
```

```java
class A{
    public static int i = 10;
    ...
}
```