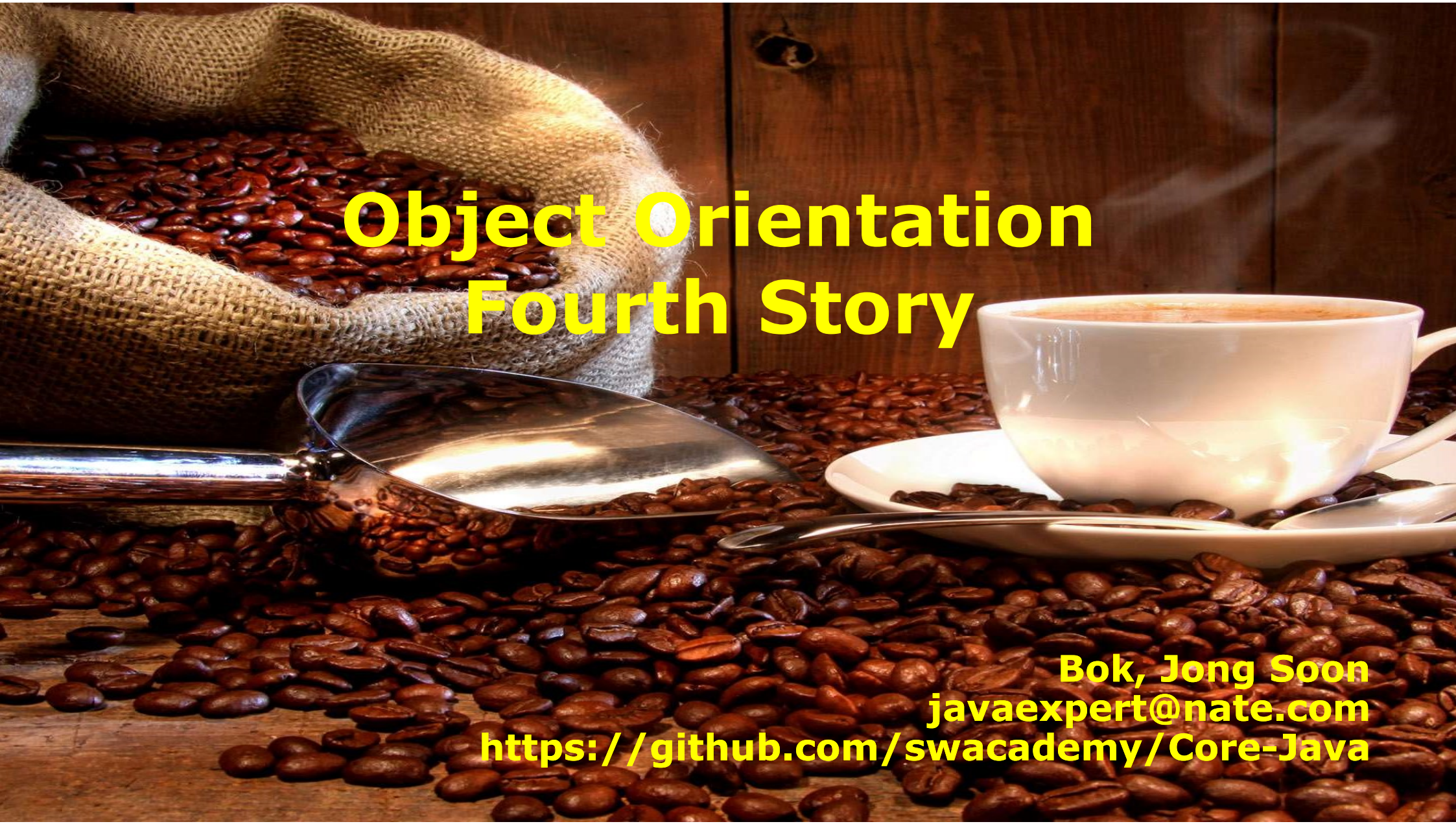

Object Orientation
Fourth Story

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https://github.com/swacademy/Core-Java

`abstract` Methods

- Java allows you to specify that a superclass declares a method that does not supply an implementation.
- The implementation of this method is supplied by the subclasses.
- This is called an **`abstract`** method.

`abstract` Classes

- A class that declares the existence of methods but not the implementation is called **`abstract`** class.
- Any class with one or more abstract methods is called an **`abstract`** class.
- You can declare a class as abstract by marking it with the **`abstract`** keyword.
- An **`abstract`** class can contain member variables and non-abstract methods.
- Use abstract as a modifier on all classes that should never be instantiated.
  - Mammal
  - Vehicle

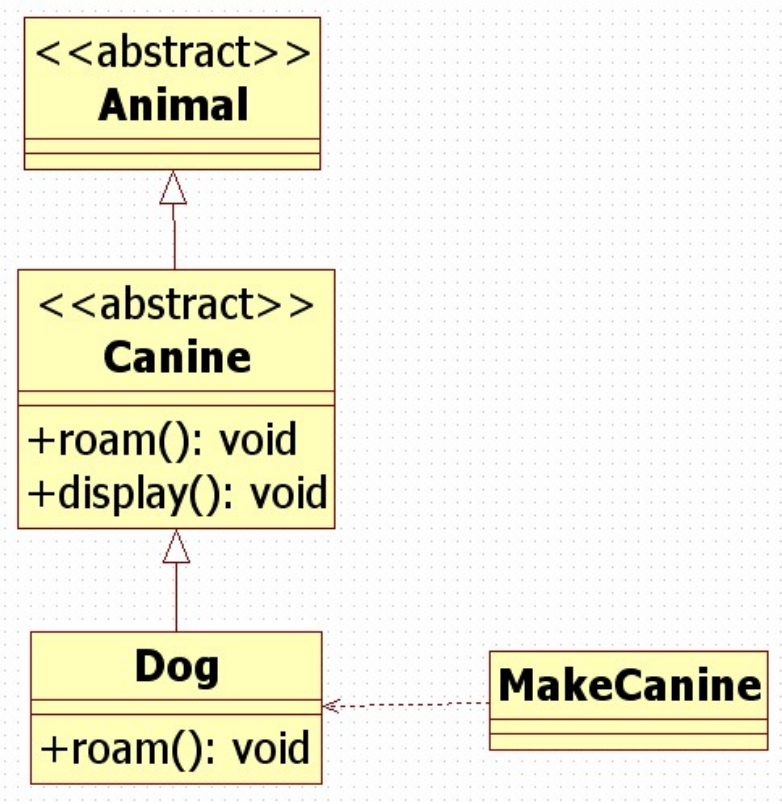
`abstract` Classes (Cont.)

```
1  abstract class Animal{}
2  abstract class Canine extends Animal{
3     public abstract void roam();
4     public void display(){
5        System.out.println("I'm method");
6     }
7  }
8  public class MakeCanine {
9     public void go(){
10       Canine c;
11       c = new Canine();
12       c.roam();
13    }
14 }
```

```
---------- Java Compiler ----------
MakeCanine.java:11: Canine is abstract; cannot be instantiated
        c = new Canine();
                ^
1 error
```

`abstract` Classes (Cont.)

```
1  abstract class Animal{}
2  abstract class Canine extends Animal{
3      public abstract void roam();
4      public void display(){
5          System.out.println("I'm method");
6      }
7  }
8  class Dog extends Canine{
9      public void roam(){
10         System.out.println("I'm a Dog's Method");
11     }
12 };
13 public class MakeCanine {
14     public void go(){
15         Canine c;
16         c = new Dog();
17         c.roam();
18     }
19 }
```



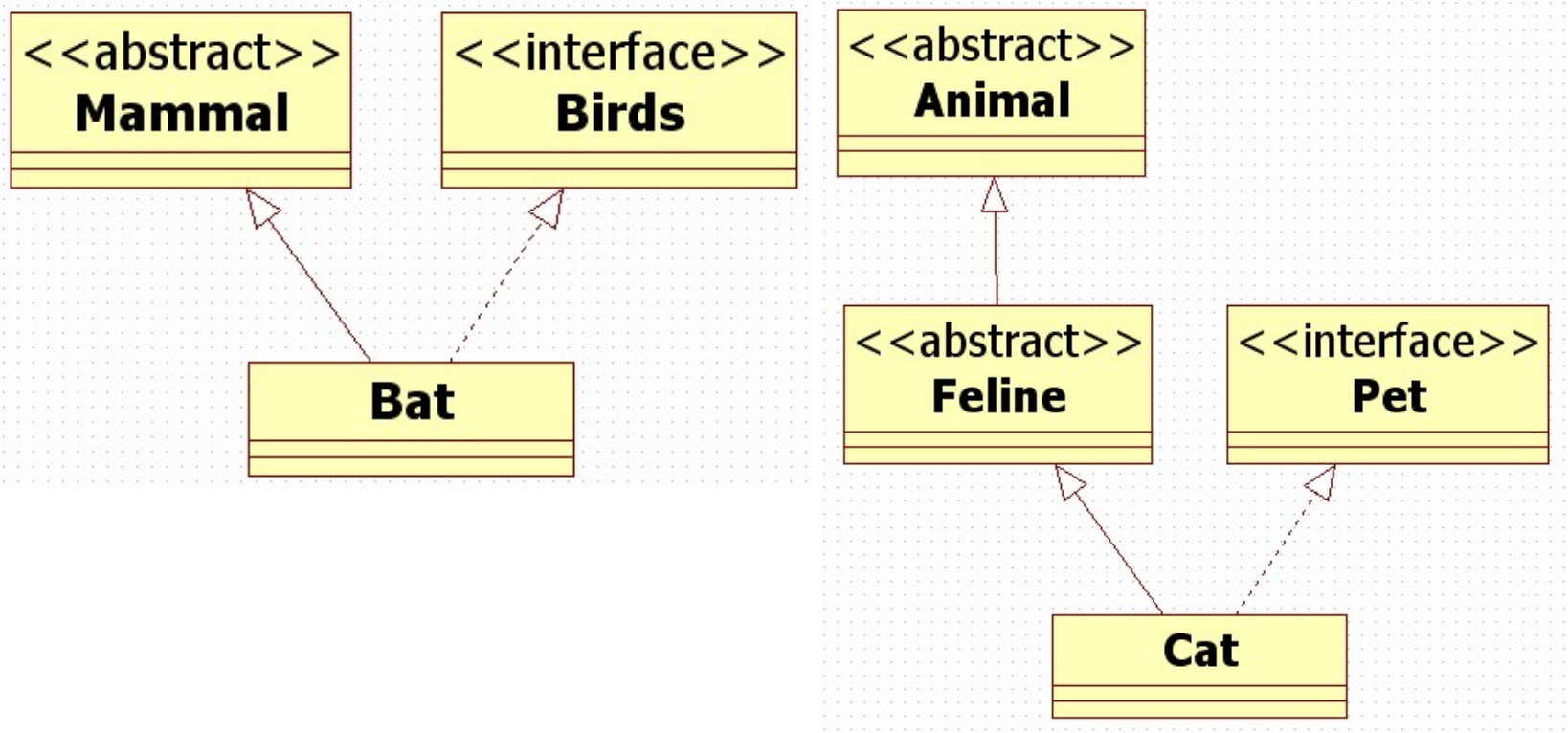
`interfaces`

- An `interface` is a variation on the idea of an abstract class.
- In an `interface`, all the methods are `abstract`.
- In an `interface`, all variables are constant.
- You can simulate multiple inheritance by implementing such interfaces.

`interfaces` (Cont.)

- All override method's access modified is **`public`**.
- You cannot use **`final`**, **`abstract`** together.
- You can implement **`interface`** using **`implements`** keyword.
- You can be initialized using polymorphism instead of using **`new`**.
- You can inherit multiple inheritance interfaces using **`extends`** keyword.
- Interface may use array.

`interfaces` (Cont.)



Polymorphism using `interface`

```
2  public interface Petable {
3      void pet();
4  }
```

```
2  public class Cat implements Petable {
3      private String name;
4      public Cat(String name){
5          this.name = name;
6      }
7      @Override
8      public void pet() {
9          System.out.println("Cat " + this.name + "is very pretty.");
10     }
11 }
```

```
2  public class Dog implements Petable {
3      private String name;
4      public Dog(String name){
5          this.name = name;
6      }
7      @Override
8      public void pet() {
9          System.out.println("Dog " + this.name + " is so cute.");
10     }
11 }
```

Polymorphism using `interface` (Cont.)

```
 2 public class PolymorphismDemo {
 3
 4⊖    public static void main(String[] args) {
 5        PolymorphismDemo pd = new PolymorphismDemo();
 6        Petable dog = pd.create("Dog", "Duncan");
 7        dog.pet();
 8        Petable cat = pd.create("Cat", "Candy");
 9        cat.pet();
10    }
11⊖   public Petable create(String kind, String name){
12        if(kind.equals("Dog")){
13            return new Dog(name);
14        }else{
15            return new Cat(name);
16        }
17    }
18 }
```

```
Dog Duncan is so cute.
Cat Candyis very pretty.
```

Polymorphism using `interface` (Cont.)

```
2  public interface Vehicle {
3      void drive();
4  }
```

```
2  public class Car {
3      public void carDrive(Vehicle v) {
4          v.drive();
5      }
6  }
```

```
2  public class Matiz implements Vehicle {
3      @Override
4      public void drive() {
5          System.out.println("Matiz is driving...");
6      }
7  }
```

```
2  public class Sonata implements Vehicle {
3      @Override
4      public void drive() {
5          System.out.println("Sonata is driving...");
6      }
7  }
```

Polymorphism using `interface` (Cont.)

```
2  public class PolymorphismDemo1 {
3      public static void main(String[] args) {
4          Car car = new Car();
5          car.carDrive(new Matiz());
6          car.carDrive(new Sonata());
7      }
8  }
```

```
Matiz is driving...
Sonata is driving...
```

CLASSPATH Setting

- Placing java class files to another directory.
  - **javac.exe -d <directory>**

```
C:₩JavaRoom>javac -d C:₩temp  Test.java
```

- Referencing another directory java class.
  - Windows Platform
    - **java.exe -classpath .;<directory>**
  - Linux/Unix/Mac Platform
    - **java.exe -classpath .:<directory>**

```
C:₩JavaRoom>java -classpath .;C:₩Temp  ClassPathDemo
name = Duncan
```

Packages

- You must specify package declaration at the beginning of the source file.
- You are permitted only one package declaration per source file.
- Package names must be hierarchical and separated by dots.

```
//class Employee of the Finance department for the ABC Company
 package ABC.financeDept;
 public class Employee {

 }
```

Directory Layout and Package

- Packages are stored in the directory tree containing the package name.

```
package ABC.financedept
public class Employee {

}
```

```
javac  -d  .  Employee.java
```

Packages (Cont.)

```
1  package kr.co.javaexpert.libs.j2se;
2
3  public class PackageDemo {
4      private String name;
5      public PackageDemo(String name){
6          this.name = name;
7      }
8      public void display(){
9          System.out.println("name = " + this.name);
10     }
11 }
```

```
C:₩JavaRoom>javac -d C:₩Temp PackageDemo.java
```

The `import` Statement

- Tells the compiler where to find classes to use.
- Precedes all class declarations:

```
import ABC.financeDept.*;
public class Manager extends Employee {
        String department;
        Employee subordinates [];
}
```

The `import` Statement (Cont.)

```
1  import kr.co.javaexpert.libs.j2se.PackageDemo;
2
3  public class ImportDemo {
4     public static void main(String[] args) {
5        PackageDemo  pd = new PackageDemo("Duncan");
6        pd.display();
7     }
8  }
```

```
C:¥JavaRoom>javac ImportDemo.java
ImportDemo.java:1: error: package kr.co.javaexpert.libs.j2se does not exist
import kr.co.javaexpert.libs.j2se.PackageDemo;
                               ^
ImportDemo.java:5: error: cannot find symbol
                PackageDemo  pd = new PackageDemo(˝Duncan˝);
                ^
  symbol:   class PackageDemo
  location: class ImportDemo
ImportDemo.java:5: error: cannot find symbol
                PackageDemo  pd = new PackageDemo(˝Duncan˝);
                                      ^
  symbol:   class PackageDemo
  location: class ImportDemo
3 errors
```

The `import` Statement (Cont.)

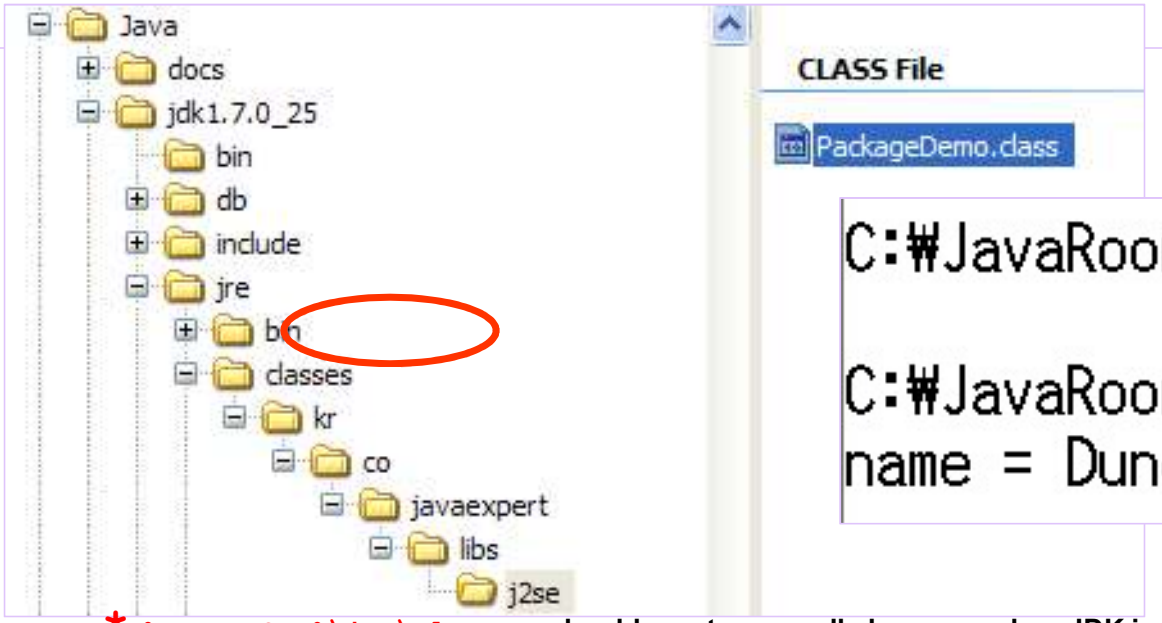
```
1 import kr.co.javaexpert.libs.j2se.PackageDemo;
2
3 public class ImportDemo {
4     public static void main(String[] args) {
5         PackageDemo  pd = new PackageDemo("Duncan");
6         pd.display();
7     }
8 }
```

```
C:₩JavaRoom>javac -cp .;C:₩Temp ImportDemo.java

C:₩JavaRoom>java -cp .;C:₩Temp ImportDemo
name = Duncan
```

The `import` Statement (Cont.)

```
1  import kr.co.javaexpert.libs.j2se.PackageDemo;
2
3  public class ImportDemo {
4      public static void main(String[] args) {
5          PackageDemo  pd = new PackageDemo("Duncan");
6          pd.display();
7      }
8  }
```



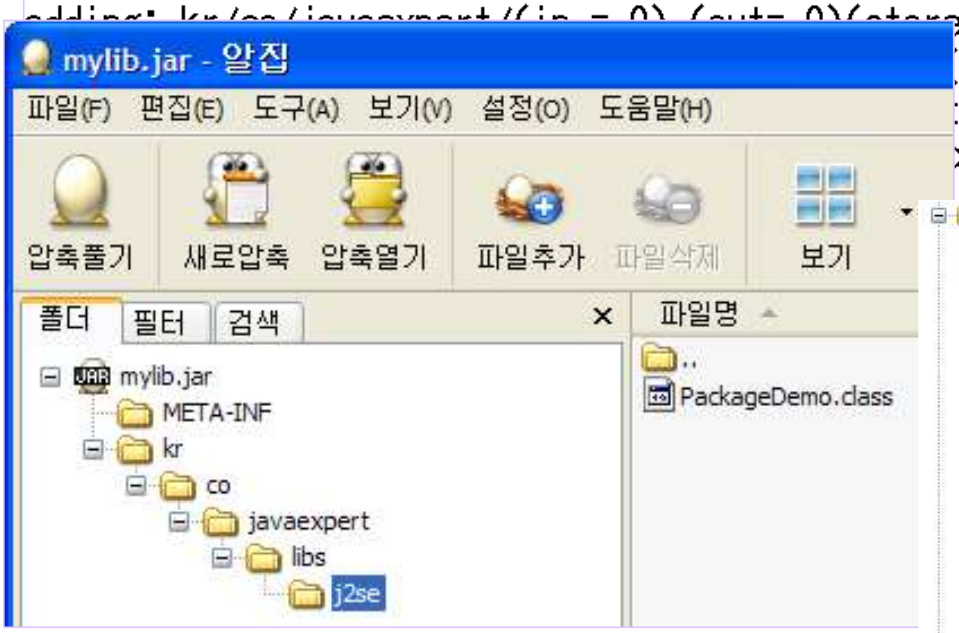

```
C:₩JavaRoom>javac ImportDemo.java

C:₩JavaRoom>java ImportDemo
name = Duncan
```

* `%JAVA_HOME%\jre\classes` should create manually because when JDK install is not created automatically.

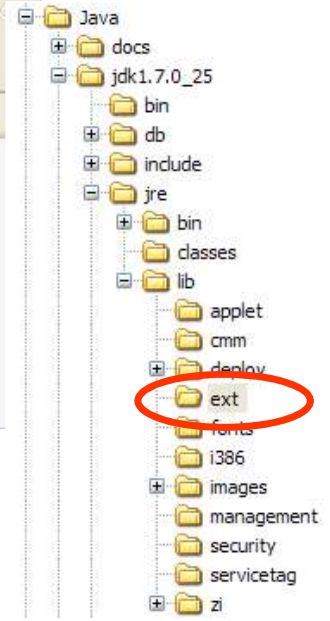
The `import` Statement (Cont.)

```
C:₩Temp>jar cvf mylib.jar kr/
added manifest
adding: kr/(in = 0) (out= 0)(stored 0%)
adding: kr/co/(in = 0) (out= 0)(stored 0%)
```




```
C:₩JavaRoom>javac ImportDemo.java

C:₩JavaRoom>java ImportDemo
name = Duncan
```



Static-Import-on-Demand Declaration

- Allows all accessible `static` members declared in the type named by a canonical name to be imported as needed.
- Syntax :

```
import static TypeName.*;
```

Static-Import-on-Demand Declaration (Cont.)

```
1  import static java.lang.Math.*;
2  import static java.lang.System.out;
3
4  public class StaticImportDemo {
5      public static void main(String[] args) {
6          // TODO Auto-generated method stub
7          int su = (int)(random() * 10 + 1);
8          out.printf("su = %d\n", su);
9      }
10 }
```

Advanced Access Control

Modifier	Same class	Same Package	Subclass	Universe
`public`	Yes	Yes	Yes	Yes
`protected`	Yes	Yes	Yes	
`default`	Yes	Yes		
`private`	Yes			

Class(`static`) Variables

- Are shared among all instances of a class.

```
public class Count {
        private int serialNumber;
        public static int counter = 0;

        public Count() {
                counter++ ;
                serialNumber = counter ;
        }
}
```

Class(`static`) Methods

- You can invoke **`static`** method without any instance of the class to which it belongs.

```
1  class  Test{
2     public static void main(String[] args) {
3        Math  m = new Math();
4        double d = m.random();
5     }
6  }
```

```
---------- Java Compiler ----------
Test.java:3: Math() has private access in java.lang.Math
        Math  m = new Math();
                      ^
1 error
```

`static` Initializers

- A class can contain code in a *static block* that does not exist within a method body.
- Static block code executes only once, when the class is loaded.
- A static block is usually used to initialize static (class) attributes.

`static` Initializers (Cont.)

```
1  class  Test{
2      public static final int SU;
3      public static double interest;
4      static {
5          SU = 5;  //constant initialization
6          interest = 0.35;   //static variable initialization
7      }
8      public static void main(String[] args) {
9
10     }
11 }
```

The `final` Keyword

- You cannot subclass a **`final`** class.
  - e.g. **`String`**, **`System`**, **`Math`** class etc…
- You cannot override a **`final`** method.
  - e.g. **`Math.random()`**
- A **`final`** variable is a constant.
  - e.g. **`Math.PI`**

Modifiers Review

	Available Modifiers
class	public,(default), final, abstract
method	public, protected, private, (default), final, abstract, static
member variable	public, protected, private, (default), final, static
local variable	final

- It cannot use **`static`** and **`abstract`** together in method.
- It cannot use **`final`** and **`abstract`** together in class.
- Access modifier of **`abstract`** method cannot be **`private`**.
- It cannot use **`private`** and **`final`** together in method.

Deprecation

- Deprecation is the obsoleteness of class constructors and method calls.
- Obsolete methods and constructors are replaced by methods with a more standardized naming convention.
- When migrating code, compile the code with the `-deprecation` flag:

```
javac -deprecation  MyFile.java
```

or

```
javac -Xlint:deprecation MyFile.java
```

Deprecation (Cont.)

```
1 class  Test{
2    public static void main(String[] args) {
3       java.util.Date now = new java.util.Date();
4       int year = now.getYear();
5    }
6 }
```

```
---------- Java Compiler ----------
Note: Test.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
```

```
C:₩JavaRoom>javac -deprecation Test.java
Test.java:4: warning: [deprecation] getYear() in java.util.Date has been depreca
ted
                int year = now.getYear();
                               ^
1 warning
```

```
C:₩JavaRoom>javac -Xlint:deprecation Test.java
Test.java:4: warning: [deprecation] getYear() in java.util.Date has been depreca
ted
                int year = now.getYear();
                               ^
1 warning
```

Inner Classes

- Added to JDK1.1
- Allow a class definition to be placed inside another class definition.
- Group classes that logically belong together.
- Have access to their enclosing class's scope.
- Nested Class
- Member Class
- Local Class
- Anonymous Class

Nested Class

- Must be declared static class.
- Nested class's instance have no any relationship Outer class's instance directly.
- Nested class's method is referenced only self's member and Outer class's static member.

```
class NestedTelevision {
     private static int person = 5;          //static member
     static class Television {    //Nested class
         int inch = 20 ;          //Nested class's member
         public void showTelevision() {
              person ;
              inch ;
        }
     }
}
```

```
NestedTelevision.Television tv = new NestedTelevision.Television();
tv.showTelevision();
```

Member Class

- Is a member of Outer class.
- Is referenced self's member and Outer class's all member.

```
class MemberTelevision {
   private int person = 5;          //member variable
      public class Television {     //Member class
         int inch = 20 ;           //Member class's member
         public void showTelevision() {
             person ;
             inch ;
         }
      }
}
```

```
MemberTelevision  member = new MemberTelevision();
MemberTelevision.Televison tv = member.new Television();
tv.showTelevision();
```

Local Class

- Be placed within a Method.
- Is declared only within a method and is used within method. Therefore this class is temporary class. Nothing is declared or used at the outer class.
- Accessed only final local variable.
- Cannot have any access modifier.

```
class LocalTelevision {
    public void showTV(final int person) {
        class Television {   //local class
            int inch = 20 ;
            public void showTelevision() {
                person ;
                inch ;
            }
        Television tv = new Television();
        tv.showTelevision();
    }
}
```

`enum` type

- Are implicitly **`final`**, because they declare constants that should not be modified.
- **`enum`** constants are implicitly **`static`**.
- Any attempt to create an object of an **`enum`** type with operator **`new`** results in a compilation error.
- The **`enum`** constants can be used anywhere constants can be used
  - In the **`case`** labels of **`switch`** statements
  - To control enhanced **`for`** statements.

`enum` type (Cont.)

- Syntax :

  Class_Modifier `enum` identifier{

  enumConstants1, enumConstants2,…,enumConstants*n*

  }

enum type (Cont.)

```
2  public class Example {
3      public enum Season{
4          WINTER, SPRING, SUMMER, FALL
5      }
6      public static void main(String[] args) {
7          // TODO Auto-generated method stub
8          Season  s = Season.SUMMER;
9          System.out.println("s = " + s);
10         System.out.println("SPRING : " + Season.SPRING);
11     }
12 }
```

```
s = SUMMER
SPRING : SPRING
```

```
C:\JavaRoom\JavaTest>dir Ex*.*
 Volume in drive C has no label.
 Volume Serial Number is 2486-E652

 Directory of C:\JavaRoom\JavaTest

09/19/2006  10:29 PM             1,220 Example$Season.class
09/19/2006  10:29 PM               863 Example.class
09/19/2006  10:29 PM               293 Example.java
               3 File(s)          2,376 bytes
               0 Dir(s)   8,548,823,040 bytes free
```

enum type (Cont.)

```
2 public enum Lesson {
3    JAVA, XML, EJB
4 }
```

```
2 public class Example1 {
3    public static void main(String[] args) {
4       // TODO Auto-generated method stub
5       Lesson  le = Lesson.EJB;
6       System.out.println("le = " + le);
7       System.out.println("XML : " + Lesson.XML);
8    }
9 }
```

```
le  =  EJB
XML  :  XML
```

```
09/19/2006  10:36 PM                 1,063 Lesson.class

 Directory of C:\JavaRoom\JavaTest

09/19/2006  10:39 PM                   803 Example1.class
```

`enum` type (Cont.)

```
2  public enum State {
3      INIT, OPENED, CLOSED;
4  }
```

```
 2  public class EnumDemo {
 3      private State state;
 4
 5      private void setState(State state){
 6          this.state = state;
 7      }
 8
 9      public void open(){
10          this.setState(State.OPENED);
11      }
12
13      public void opening(){
14          this.setState(State.OPENING);   //Compile Error
15      }
16  }
```

enum type (Cont.)

All Classes

Lesson

Package Class Tree Deprecated Index Help

PREV CLASS NEXT CLASS

FRAMES NO FRAMES

SUMMARY: NESTED | ENUM CONSTANTS | FIELD | METHOD

DETAIL: ENUM CONSTANTS | FIELD | METHOD

Enum Lesson

java.lang.Object
  └ java.lang.Enum<Lesson>
    └ **Lesson**

All Implemented Interfaces:

java.io.Serializable, java.lang.Comparable<Lesson>

public enum **Lesson**
extends java.lang.Enum<Lesson>

Enum Constant Summary

EJB
JAVA
XML

Method Summary

static Lesson	**valueOf**(java.lang.String name) Returns the enum constant of this type with the specified name.
static Lesson[]	**values**() Returns an array containing the constants of this enum type, in the order they're declared.

Methods inherited from class java.lang.Enum

clone, compareTo, equals, getDeclaringClass, hashCode, name, ordinal, toString, valueOf

`enum` type (Cont.)

```
 2 public class Example2 {
 3    public enum Season {
 4       WINTER, SPRING, SUMMER, FALL
 5    }
 6    public static void main(String[] args) {
 7       // TODO Auto-generated method stub
 8       for(Season s : Season.values())
 9          System.out.println(s);
10    }
11 }
```

```
WINTER
SPRING
SUMMER
FALL
```

`enum` type (Cont.)

```
2  public class Example3 {
3      public enum Season {
4          WINTER, SPRING, SUMMER, FALL
5      }
6      public static void main(String[] args) {
7          // TODO Auto-generated method stub
8          Season s = Season.SUMMER;
9          if(s instanceof Object){
10             System.out.println(s.toString());
11             System.out.println("OK! instnceof Object");
12             System.out.println("Real Value is " + s.ordinal());
13         }
14         Season [] array = Season.values();
15         System.out.println("array.length = " + array.length);
16         for(Season s1 : array)
17             System.out.println(s1 + " ==> " + s1.ordinal());
18     }
19 }
```

```
SUMMER
OK! instnceof Object
Real Value is 2
array.length = 4
WINTER ==> 0
SPRING ==> 1
SUMMER ==> 2
FALL ==> 3
```

enum type (Cont.)

```java
public enum Coin{
    PENNY(1), NICKEL(5), DIME(10), QUARTER(25);
    Coin(int value) {   //constructor
        this.value = value;
    }
    private final int value;
    public int getValue() { return this.value; }
}
```

```java
public class Example4 {
    private enum CoinColor {
        COPPER, NICKEL, SILVER
    }
    private static CoinColor color(Coin c){
        switch(c){
            case PENNY:  return CoinColor.COPPER;
            case NICKEL:   return CoinColor.NICKEL;
            case DIME:
            case QUARTER:  return CoinColor.SILVER;
            default:
                throw new AssertionError("Unknown coin : " + c);
        }
    }
    public static void main(String[] args) {
        // TODO Auto-generated method stub
        for(Coin c : Coin.values())
            System.out.println(c + " :      " + c.getValue() + "cent  " + color(c));
    }
}
```

```
PENNY :       1cent   COPPER
NICKEL :       5cent   NICKEL
DIME :       10cent   SILVER
QUARTER :       25cent   SILVER
```