CS205 Object Oriented Programming in Java

Module 3 - **More features of Java (Part 1)**

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Topics

- Introduction:
  - ☑ **Packages** and Interfaces:
    - ☑Defining Package,
    - ☑CLASSPATH,
    - ☑AccessProtection
    - ☑ Importing Packages

Package

- **Packages** ***are containers for classes*****.**
- A package in Java is used to **group** related classes and interfaces.
- They are used to keep the class name space compartmentalized.
  - For example, a package allows us to create a class named **List,** which we can store in our own package and it will not collide with some other class named **List** stored elsewhere.
- Packages are stored in a *hierarchical manner.*
- The package is both a **naming** and a **visibility control mechanism.**

Packages(contd.)

- We can define classes inside a package
  - that are not accessible by code outside that package. (default)

  OR

  - that can be also accessed by subclasses outside the package. (protected)

  OR

  - That can be accessed by all classes in all packages(public)

Defining Package

- To **create a package**, simply include a **package command** <u>as the **first statement** in a Java source file.</u>
  - All classes declared in that file will belong to the specified package.
- The package statement **defines a name space** in which classes are stored.
- If we are <u>**not** writing package statement</u>, the class names are put into the ***default package, which has no name***.

Defining Package(contd.)

- General form for **creating a package :**

  package *packagename;*

  Example: If we write the following statement at the beginning of our java program then it will create a package named **Oop**.

package ***Oop;***

Defining Package(contd.)

- Java uses file system **directories** to store packages.
- Example: Any classes that we declare to be part of the package **Oop** must store their **.class** files in a directory called **Oop.**
- Any file can include the same package statement.
- The package statement simply specifies to which package the classes defined in a file belongs to.

Defining Package(contd.)

- We can create a **hierarchy of packages.**
  - Separate each package name from other using period(dot) symbol.
- General form of a multileveled package statement is :

package *pkg1.pkg2.pkg3;*

This specifies that package pkg3 is inside package pkg2 and pkg2 package is inside pkg1.

- E.g The package declared as

  package java.awt.image;

  - needs to be stored in the path **java\awt\image** in a Windows environment
- We cannot rename a package without renaming the directory in which the classes are stored.

Finding Packages and CLASSPATH

❖ How does the Java run-time system know where to look for packages that we create?

1. By default, the Java run-time system uses the **current working directory** as its starting point.

   →if our package is in a subdirectory of the current directory, it will be found.

2. We can specify a directory path or set paths by setting the **CLASSPATH environmental variable.**

3. We can use the **-classpath** option **with java** and **javac** to specify the path to your classes.

CLASSPATH (contd.)

- Example

package MyPack;

- For a program to find MyPack, one of three things must be true.
  - Either the program can be executed from a directory immediately above **MyPack** **or**
  - the **CLASSPATH** must be set to include the path to **MyPack,** **or**
  - the -**classpath option** must specify the path to MyPack when the program is run via **java**
- To execute the program
  - java MyPack.programname

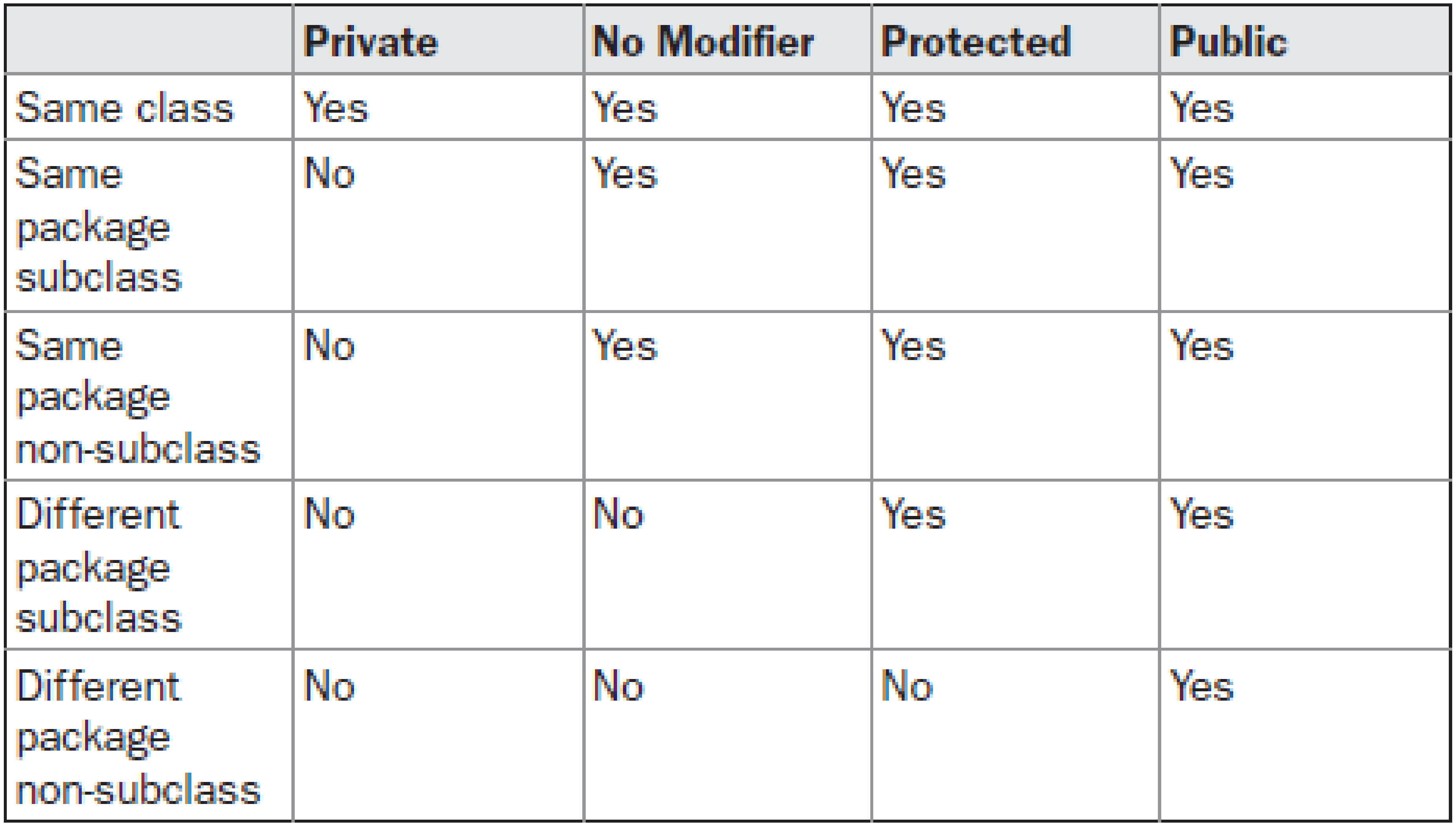
CLASSPATH9contd.)

- In the case of CLASSPATH and –classpath option , the class path *must not include* ***MyPack***, *itself.* It must simply specify the *path to* ***MyPack.***
- Suppose the path of MyPack directory is **C:\MyPrograms\Java**\MyPack
  - Then the **class path** to MyPack is **C:\MyPrograms\Java**

Access Protection

- Addresses four categories of visibility for class members:
  - Subclasses in the same package
  - Non-subclasses in the same package
  - Subclasses in different packages
  - Classes that are neither in the same package nor subclasses

Access Protection(contd.)



	Private	No Modifier	Protected	Public
Same class	Yes	Yes	Yes	Yes
Same package subclass	No	Yes	Yes	Yes
Same package non-subclass	No	Yes	Yes	Yes
Different package subclass	No	No	Yes	Yes
Different package non-subclass	No	No	No	Yes

Access Protection(contd.)

- A **non-nested class** has only two possible access levels:
  - default
  - public.
- When a class is declared as **public,** it is accessible by any other code.

public class A {////

}

- If a class has **default** access, then it can only be accessed by other code within its same package.

class B

{ }

- When a class is public, it must be the only public class declared in the file, and the file must have the same name as the public class.

Importing Packages

- All of the standard classes are stored in some named package.
- If we want to <u>use classes in some other packages</u>, they must be *fully qualified with their package name or names*,. It is **difficult** to type in the long dot-separated package path name for every class we want to use.
  - **TO SOLVE THIS PROBLEM**, we can use **import** statement. The **import** statement helps to bring certain classes, or entire packages, into visibility.

- To use a class or a package from the library, we need to use the **import** keyword

- **import** statements is written **after** <u>the package statement(if exists)</u> and **before** all <u>class definitions.</u>

Importing Packages(contd.)

- General form of the import statement:

  import *pkg1[.pkg2].(classname|*);*

  – Here, *pkg1 is the name of a top-level package, and pkg2 is the name of a subordinate* package inside the package pkg1 separated by a dot (**.**). Here square bracket denotes that it is optional.

- E.g.

import pack1; *// import the package pack1*

import java.io.*; *// import all the classes from the package java.io*

import java.util.Date; *//import the Date class from the package java.util*

Importing Packages(contd.)

- All of the standard Java classes included with Java are stored in a package called **java**
- The basic language functions are stored in a package inside of the java package called **java.lang**
  - it is implicitly imported by the compiler for all programs.

Importing Packages(contd.)

- Using an **import** statement:

```
import java.util.*;
class MyDate extends Date {
//statements , methods,variables
}
```

- Without the import statement looks like this:

```
class MyDate extends java.util.Date
{
}
```

Without Using import statement- we have to use class from other package as packagename.classname (fully quantified)

```
//Program A.java
package pack1;
public class A
 {
int a=100;
public int c=20;
protected int d=50;
    public void msg()
    {
System.out.println("Base class A Hello");
    }
}
```

```
//Program B.java
package pack2;
class B{
public static void main(String args[])
{
     pack1.A obj = new pack1.A();
    obj.msg();
    System.out.println(“c="+obj.c);
//System.out.println("d="+obj.d);
// cannot access protected of
//different package i.e. pack1
    //System.out.println("a="+obj.a);
/ /cannot access private of other class
  }
}
```

Using **import package.*** statement to import all classes in pack1 to program file in pack2

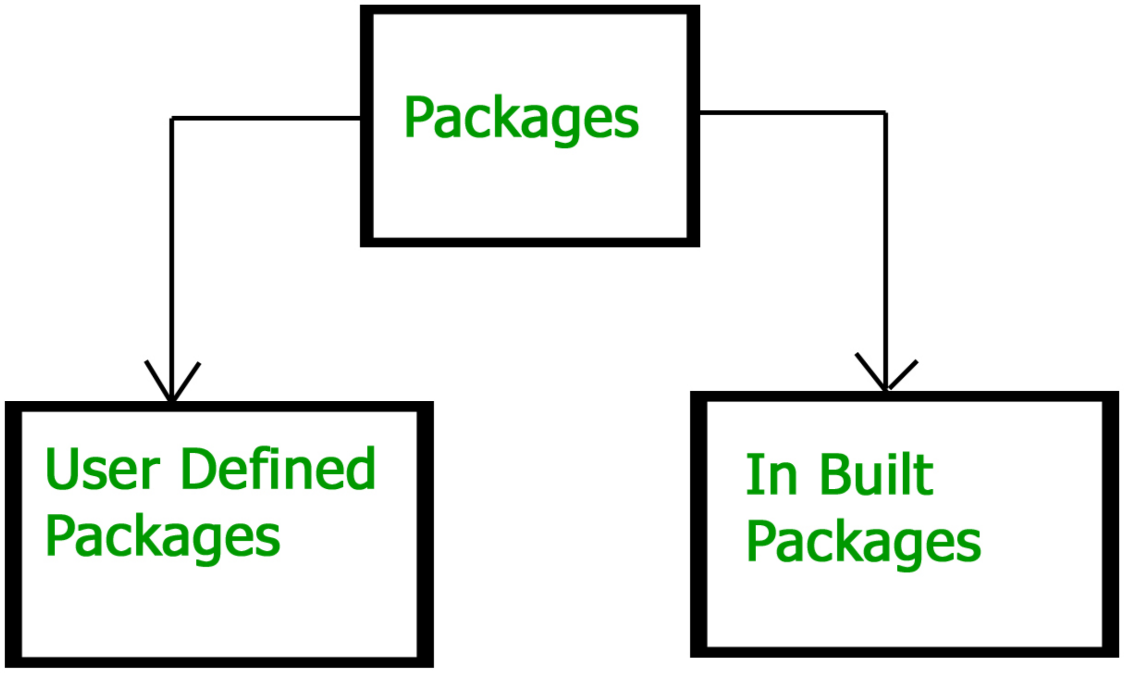
```
//Program A.java
package pack1;
public class A
 {
int a=100;
public int c=20;
protected int d=50;
 public void msg()
    {
System.out.println("Base class A Hello");
    }
}
```

```
//Program B.java
package pack2;
import pack1.*;
class B{
public static void main(String args[])
{
       A obj = new A();
      obj.msg();
      System.out.println(“c="+obj.c);
//System.out.println("d="+obj.d);
// cannot access protected of different package
      pack1
      //System.out.println("a="+obj.a);/
/ /cannot access private of other class
  }
}
```

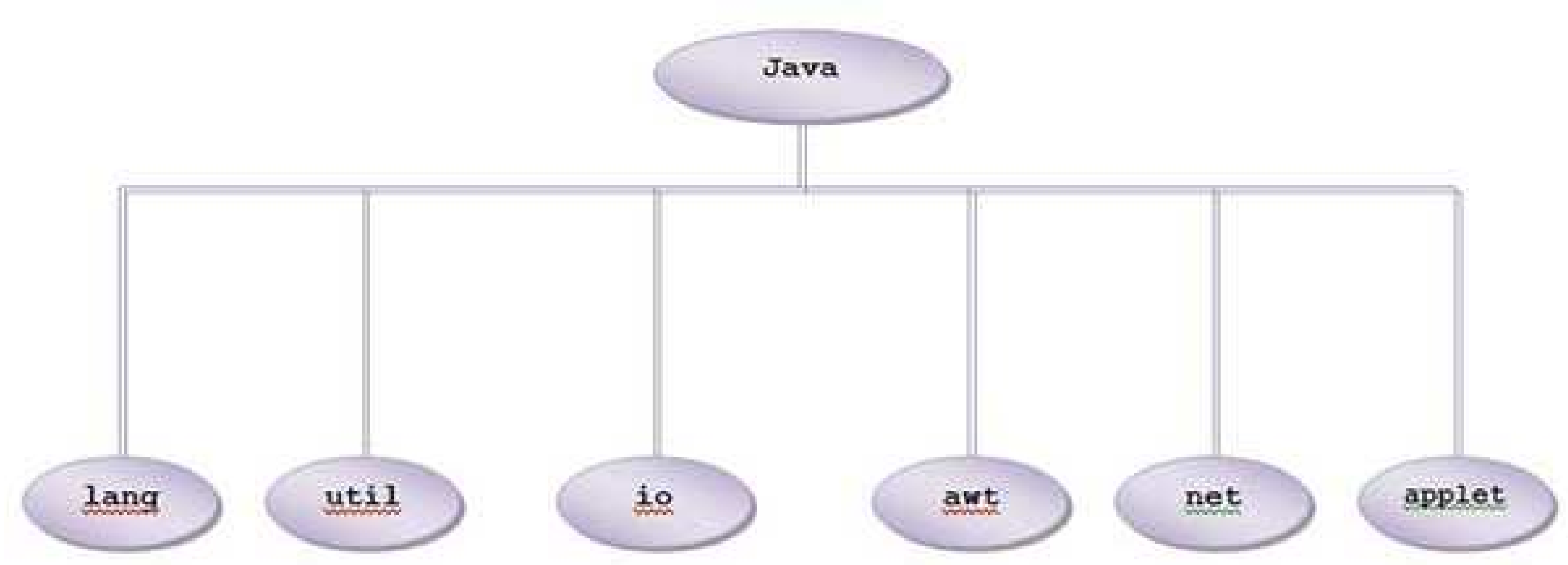
Using **import package.classname** statement to import class A in pack1 to program file in pack2

```
//Program A.java
package pack1;
public class A
 {
int a=100;
public int c=20;
protected int d=50;
 public void msg()
    {
System.out.println("Base class A Hello");
    }
}
```

```
//Program B.java
package pack2;
import pack1. A;
class B{
public static void main(String args[])
{
     A obj = new A();
    obj.msg();
    System.out.println(“c="+obj.c);
//System.out.println("d="+obj.d);
// cannot access protected of different package
    pack1
    //System.out.println("a="+obj.a);/
/ /cannot access private of other class
  }
}
```


Packages
User Defined Packages
In Built Packages

Built-in Packages



Java Foundation Packages

- Java provides a large number of classes grouped into different packages based on their functionality.
- The six foundation Java packages are:
  - java.lang
    - Contains classes for primitive types, strings, math functions, threads, and exception
  - java.util
    - Contains classes such as vectors, hash tables, date etc.
  - java.io
    - Stream classes for I/O
  - java.awt
    - Classes for implementing GUI – windows, buttons, menus etc.
  - java.net
    - Classes for networking
  - java.applet
    - Classes for creating and implementing applets

- Steps and examples for creating and using packages

- Create a folder **pack1** inside D drive
- Create a file A.java

```
package pack1;
public class A
{
     public static void main(String args[] )
    {
    System.out.println("Hello");
    }
    public void show()
    {System.out.println("show in A");
    }
}
```

Method 1

- Take ***path before pack1*** folder in command prompt here it s D drive.
- **Compile** using

```
D:\>javac pack1/A.java
```

- **To run**

```
D:\>java pack1/A
```

Or

```
D:\>java pack1.A
```

Method 2

- Set classpath in command prompt to path to folder before the package pack1

```
C:\Users\USER>set CLASSPATH=;D:\
```

To compile

```
C:\Users\USER>javac  -cp  .  D:\pack1\A.java
```

To run

```
C:\Users\USER>java pack1.A
Hello
```

Method 3:

- Using –classpath option
- Compile using

```
C:\Users\USER>javac  D:\pack1\A.java
```

Or

```
C:\Users\USER>javac  -classpath  .  D:\pack1\A.java
```

- Run using

```
C:\Users\USER>java -classpath D:\  pack1.A
```

E.g using import statement

- Create a folder **pack2** inside D drive
- Create a file B.java in it

```
package pack2;
import pack1.*;
class B{
public static void main(String args[])
{
    A obj = new A();
    obj.show();
    System.out.println("main in class B");
}
}
```

```
D:\>javac pack1\A.java

D:\>javac pack2\B.java

D:\>java pack2.B
show in A
main in class B
```

Reference

- Herbert Schildt, Java: **The Complete Reference, 8/e, Tata McGraw Hill, 2011**.