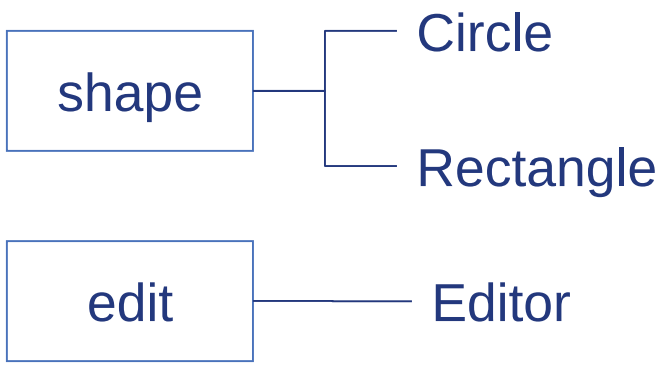
Packages

- ❖Package definition
- ❖Accessing classes in a package
- ❖The keyword “import”
- ❖Default package
- ❖public class and non-public class
- ❖Protected fields/methods
- ❖Static import
- ❖Class path

Package

- Package is a group of classes and interfaces.
- Package is like directory ! In other words,
  - A package contains multiple classes, even sub-packages.
  - Classes can have the same name as long as they are within different packages.



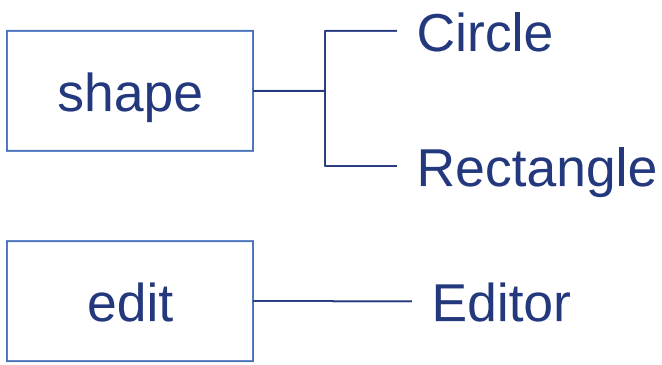
Package: Definition

- The keyword "package" is used to define the package for all the classes in a file.

```
// Circle.java
package shape;
public class Circle {
    ...
}
```

```
// Editor.java
package edit;
public class Editor {
    ...
}
```

```
// Rectangle.java
package shape;
public class Rectangle {
    ...
}
```



Accessing classes in a package

- A class in a package should be accessed with its package name

```
// Editor.java
package edit;
public class Editor {
    Circle c = new Circle() ;
    Rectangle r = new Rectangle() ;
}
```

Circle cannot be resolved to a type

```
// Editor.java
package edit;
public class Editor {
    shape.Circle c = new shape.Circle() ;
    shape.Rectangle r = new shape.Rectangle() ;
}
```

Accessing classes in the same package

- You can omit the package name if the class is in the same package.

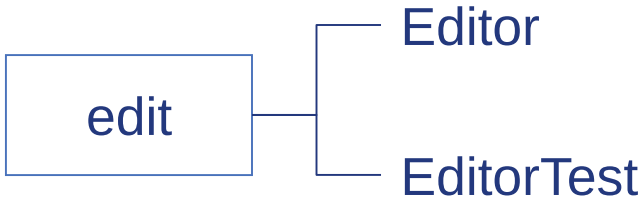
```
// EditorTest.java
package edit;

public class EditorTest {

    public static void main(String[] args) {

        Editor ed = new Editor() ;
        // edit.Editor ed = new ed.Editor() ;

        shape.Circle c = new shape.Circle() ;
        shape.Rectangle r = new shape.Rectangle() ;
    }
}
```



The package of class Editor is the same with EditorTest

import

- The keyword "import" provides a convenient method for using classes in other packages
- You can access all the classes in the imported package without the package name

```
// Editor.java
package edit;
public class Editor {
    shape.Circle c = new shape.Circle() ;
    shape.Rectangle r = new shape.Rectangle() ;
}
```

Without import

```
// Editor.java
package edit;
import shape.*; // import all the classes in the shape package
public class Editor {
    Circle c = new Circle() ;
    Rectangle r = new Rectangle() ;
}
```

With import

import

- Each class can be imported individually.

```
// Editor.java
package edit;
import shape.*; // import all the classes in the shape package
public class Editor {
    Circle c = new Circle() ;
    Rectangle r = new Rectangle() ;
}
```

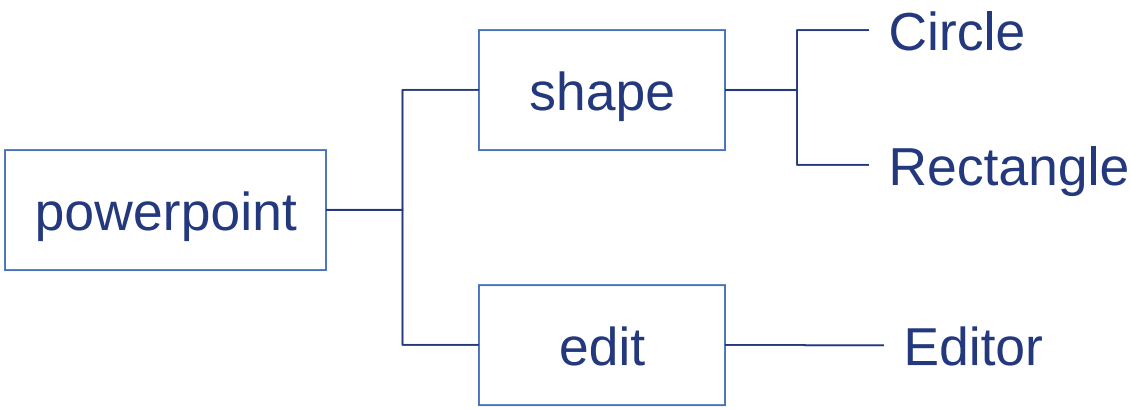
Importing all the classes in a package

```
// Editor.java
package edit;
import shape.Circle;
import shape.Rectangle;
public class Editor {
    Circle c = new Circle() ;
    Rectangle r = new Rectangle() ;
}
```

Importing an individual class

Sub-packages

- A package can contain another packages (sub-packages) as well as classes.



Sub-packages

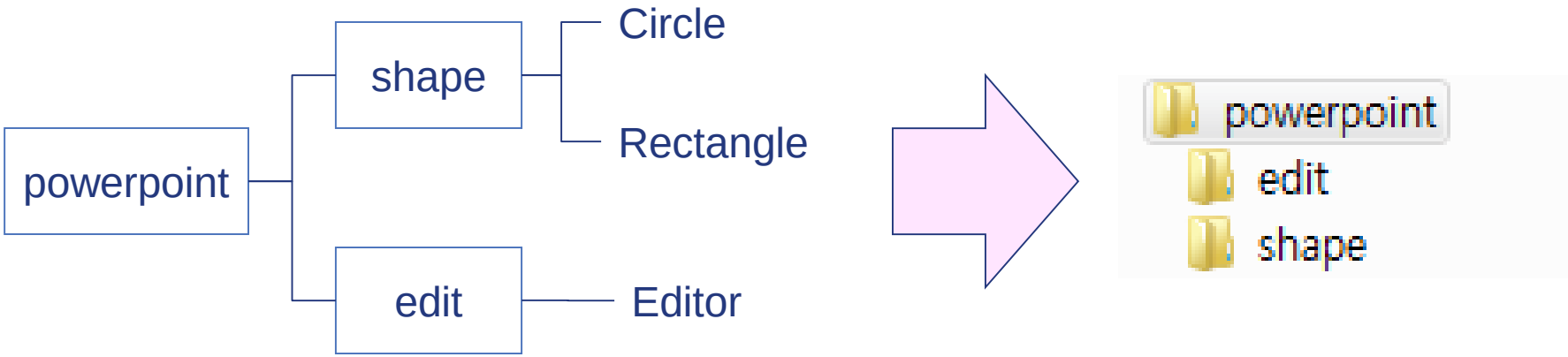
```
// Circle.java
package powerpoint.shape;
public class Circle {
    ...
}
```

```
// Rectangle.java
package powerpoint.shape;
public class Rectangle {
    ...
}
```

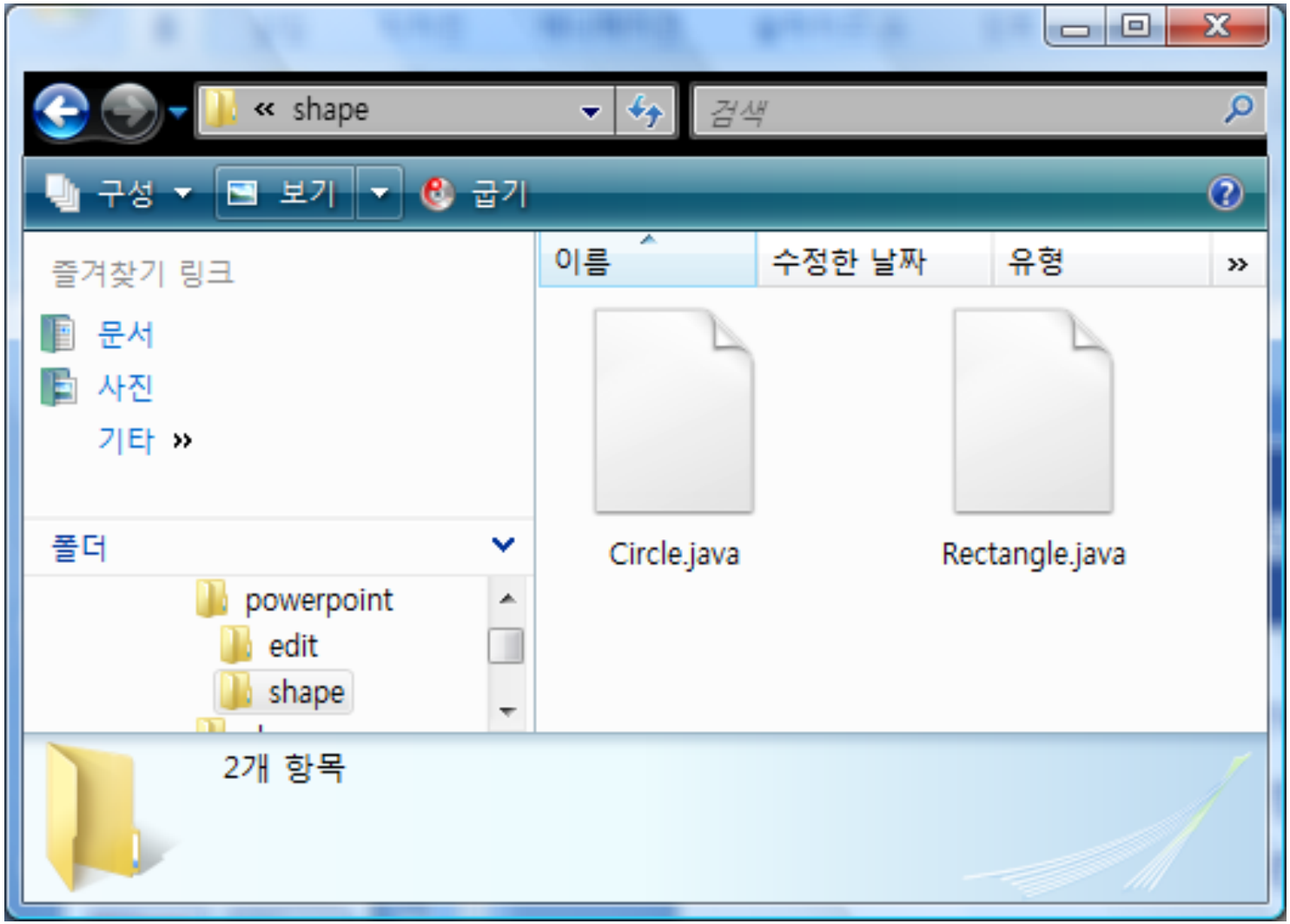
```
// Editor.java
package powerpoint.edit;
import powerpoint.shape.*;
public class Editor {
    Circle c = new Circle() ;
    Rectangle r = new Rectangle() ;
}
```

Package and Directory

- The packages are implemented with directory structures.
- In other words, the packages should have the same structures with its directories.

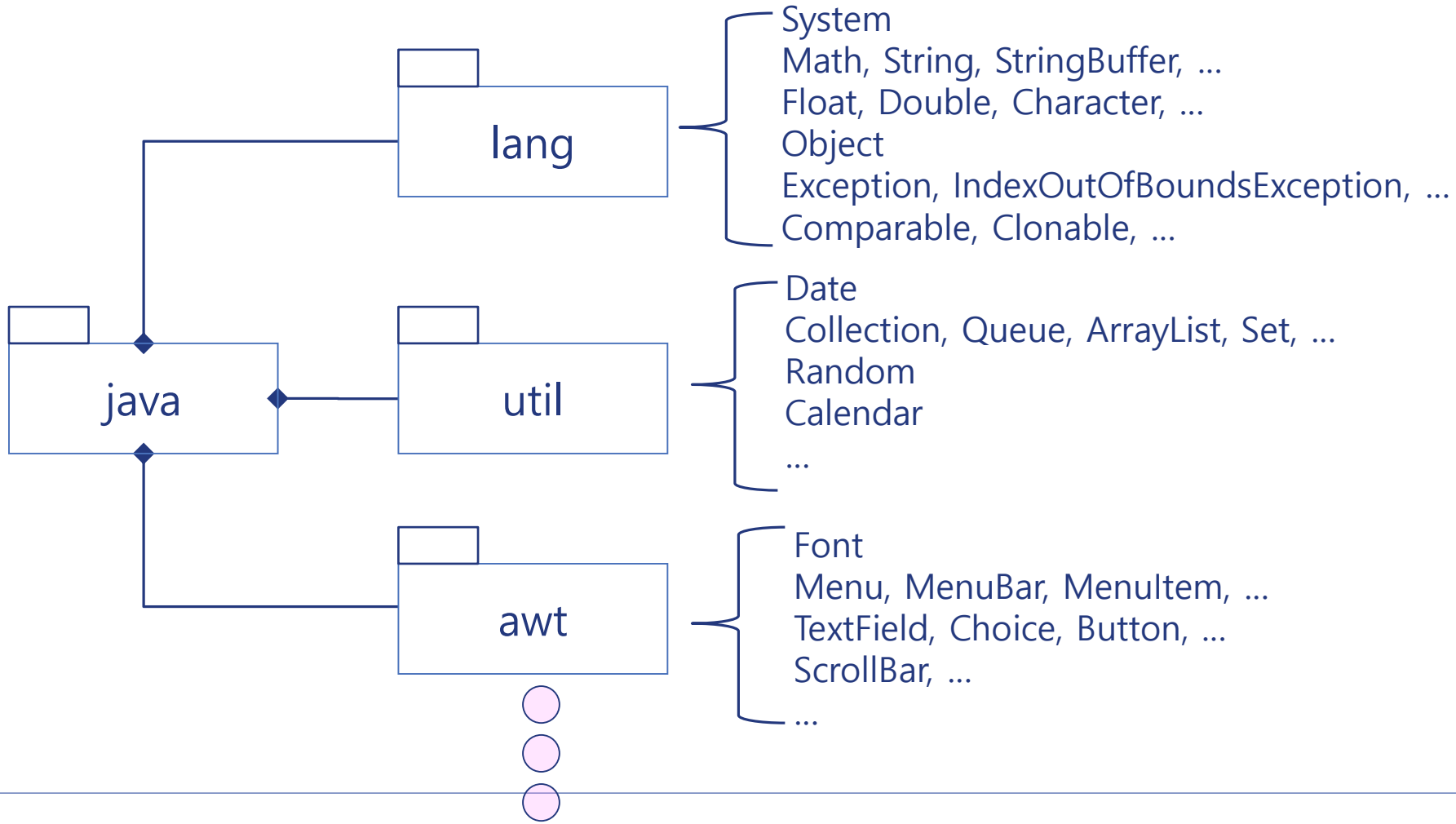


Package and Directory

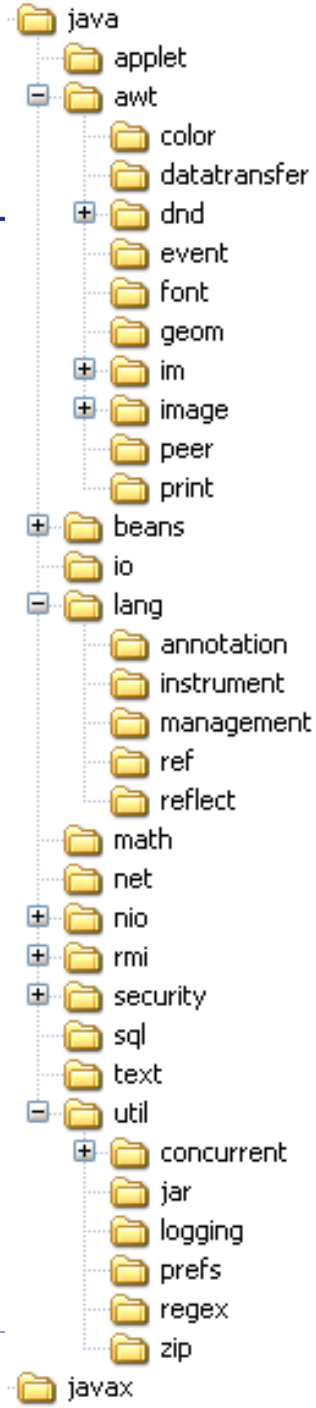


Package Hierarchy

- The standard Java library is distributed over a number of packages.



More Java Packages



java.lang package

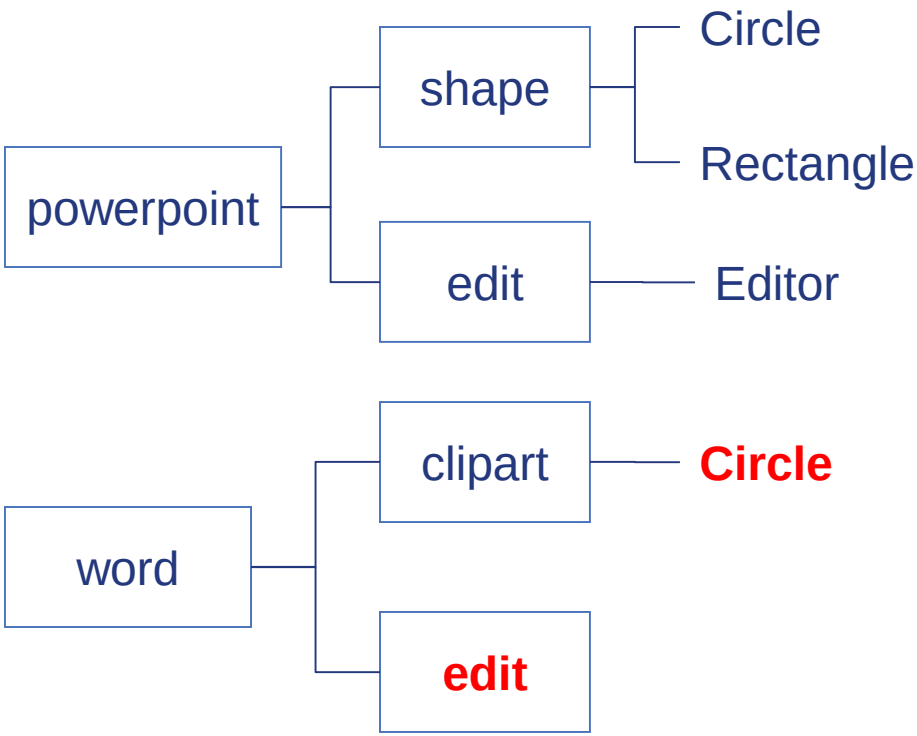
- Many basic classes and interfaces are in package java.lang
- They are automatically imported; You don't need to import it.

```
// import java.lang.* ; // defines System, String, ...
import java.util.* ; // defines Scanner, ArrayList

public class JavaLangPackageTest {
    public static void main(String[] args) {
        Scanner scannerObject = new Scanner(System.in) ;
        List<String> strs = new ArrayList<String>() ;
        while ( true) {
            String word = scannerObject.next() ;
            if ( word.equals("quit") ) break ;
            strs.add(word) ;
        }
        for ( String str: strs ) System.out.println(str) ;
    }
}
```

Package: Uniqueness of name

- You can define multiple classes/packages with the same name in different packages.



Package: Benefits

- Packages are usually used to avoid name conflict!
- Assuming that you develop a ArrayList<T> with better performance than in the JDK Library

```
public class MyArrayList<Comparable T> {
    ...
}
```

Without package, we have to give different name

```
package edu.pnu.OOP2019;
public class ArrayList<Comparable T> {
    ...
}
```

You can use the same name ArrayList with you own package.

Package: Benefits

- Program can be evolved by indicating different packages.
- Assuming that the my ArrayList is better than the JDK version.

```
import java.util.* ;
public class MyPowerPoint {
    private ArrayList<Circle> circles ;
    ...
}
```

MyPowerPoint used ArrayList in JDK.

```
import edu.pnu.OOP2019.* ;
public class MyPowerPoint {
    private ArrayList<Circle> circles ;
    ...
}
```

Now, better ArrayList in my package is used.

Default package

- Each class with no package definition is assumed to belong to the default package.

```
public class MyRectangle {
    ...
}
```

```
public interface MyComparable {
    ...
}
```

```
public class Circle
    implements MyComparable  {
    ...
}
```

All of them belong to the **default** package

Visibility of classes in packages

- Public class or non-public(default) class

```
// Circle.java
package powerpoint.shape;
public class Circle {
    ...
}
```

Circle is a public class

```
// Point.java
package powerpoint.shape;
class Point {
    ...
}
```

Point is NOT a public class

Visibility of classes in packages

- Only public classes can be accessed from outside of the package
- Non-public classes can be accessed from the class in the same package.

```
// Editor.java
package powerpoint.edit;
import powerpoint.shape.*;
public class Editor {
    Circle c = new Circle() ;
    Point p = new Point() ;
}
```

```
// Circle.java
package powerpoint.shape;
public class Circle {
    private Point center ;
}
```

```
// Point.java
package powerpoint.shape;
class Point {
    private int x, y ;
}
```

One public class in a file

- Only one public class can be defined in a source file.
- You cannot define multiple public classes in a source file.

```
// Shape.java
package powerpoint.shape;
public class Circle {
    private Point center ;
}

public class Rectangle {
    private Point leftTop, rightBottom;
}
```

```
// Circle.java
package powerpoint.shape;
public class Circle {
    private Point center ;
}
```

```
// Rectangle.java
package powerpoint.shape;
public class Rectangle {
    private Point leftTop, rightBottom;
}
```

One public class in a file

- Each file does not need to define a public class. It can only include non-public classes.

```
// Point.java
package powerpoint.shape;
class Point {
    private int x, y ;
}
```

No public class in the Point.java

Package visibility

- Package(default visibility) fields/methods can be accessed from **EVERY** class in the same package.

```
// Point.java
package powerpoint.shape;
class Point {
    int x, y ;
}
```

allows

```
// Circle.java
package powerpoint.shape;
public class Circle {
    private Point center ;
    void setCenter(int x, int y) {
        center.x = x ;
        center.y = y ;
    }
}
```

- Change in class Point can cause the change in Circle.
- Therefore, you should not use package fields/methods.

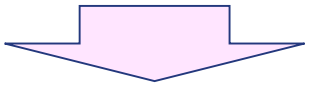
static import

- Starting with JDK 5.0, static import has been introduced to permit the importing of static methods and fields, not just classes.

```
import static java.lang.System.*;
// Note that System is a class, not a package
public class StaticImportTest {
    public static void main(String args[]) {
        out.println("Hello World"); // java.lang.System.out
        exit(0) ; // java.lang.System.exit()
    }
}
```

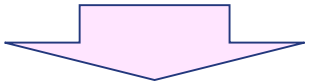
static import

```
Math.sqrt(Math.pow(x, 2)+ Math.pow(y,2))
```



```
import static java.lang.Math.*;
sqrt(pow(x, 2)+ pow(y,2))
```

```
if ( d.get(Calendar.DAY_OF_WEEK) == Calendar.MONDAY )
```



```
import static java.util.Calendar.* ;
if ( d.get(DAY_OF_WEEK) == MONDAY )
```

How the JVM locates classes?

- **Class Path**: directories and archive files for locating classes.
  - -classpath or –cp option in java command
  - CLASSPATH environment variable

  Note: there is no default on the current directory.

- Let's consider a class path: **C:₩java;.;C:₩java₩lib₩archive.jar**
- Suppose the JVM searches for the class file of the edu.pnu.shape.Circle
  1. Looks in the system class files that are stored in archives in the **jre/lib and jre/lib/ext**
  2. **According to the specified CLASSPATH**
     1. **C:₩java₩**edu₩pnu₩shape₩Circle.class
     2. edu₩pnu₩shape₩Circle.class starting from **the current directory**
     3. edu₩pnu₩shape₩Circle.class **inside c:₩java₩lib₩archive.jar**

More on Class Path

- -classpath or –cp option in java command; used for the particular program
  - % java –cp C:₩jdk1.0 MyRectangleTest
  - % java –cp C:₩jdk1.5 MyCircleTest
- CLASSPATH environment variable; shared by all Java programs
  - SET CLASSPATH=C:₩jdk1.0
  - % java MyRectangleTest
  - % java MyCircleTest
- -cp has priority over CLASSPATH
  - SET CLASSPATH=C:₩jdk1.0
  - % java MyRectangleTest
  - % java –cp C:₩jdk1.5 MyCircleTest
- Current directory
  - The current directory is not automatically included in the class path
  - You have to add the current directory in the class path
  - SET CLASSPATH=C:₩jdk1.0;.
  - % java –cp C:₩jdk1.5;. MyCircleTest