Basis of Computer Programming (java A)
Tutorial 11

[Experimental Objective]

- Learn abstract class.
- Learn interface.
- Learn comparable.

[Before Exercises]

1. Inheritance exercise.

Step1: Download **JavaLab10.zip** from sakai which is reference code of the last exercise. We should find that:

1. There is a public method **draw**() which has no valid code.

```
public void draw(){

}
```

2. The most important thing is that we have no need to instantiate **Shape**. In this case, we should change the **Shape** class to an abstract class.

(1) Add “abstract” before “class”:

```
public abstract class Shape {
```

(2) Change draw() to following code:

```
abstract public void draw();
```

Step2: In **ShapeTest**, we try to write this following code in main():

```
Shape shape = new Shape();
```

There will be an error: Cannot instantiate the type Shape

Step3: Learn how to use Comparable interface.

Suppose we have a lot of circles, which have different radius. We want to sort them from big to small according radius. How can we do?
Comparable is very useful. This interface imposes a total ordering on the objects of each class that implements it. This ordering is referred to as the class's *natural ordering*, and the class's compareTo method is referred to as its *natural comparison method*.
Lists (and arrays) of objects that implement this interface can be sorted automatically by Collections.sort (and Arrays.sort).

(1) Let **Circle** implements **Comparable**

```
public class Circle extends Shape implements Comparable<Circle>
```

(2) Override the method **compareTo** defined in **Comparable**

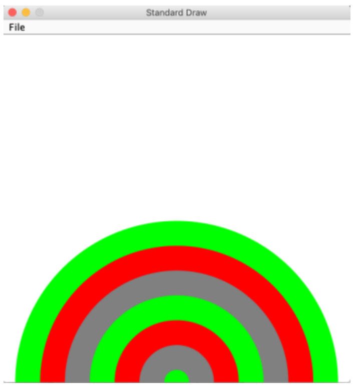
```
@Override
public int compareTo(Circle o) {
        if (this.radius < o.radius){
                return 1;
        }else if (this.radius > o.radius){
                return -1;
        }
        return 0;
}
```

Normally, this method compares this object with the specified object for order. Returns a negative integer, zero, or a positive integer as this object is less than, equal to, or greater than the specified object.
But in this case, we want to order the circles from largest to smallest, so when the radius of this is less than the specified object, we return 1(a positive integer)

(3) Rewrite the **ShapeTest**, using the following code:

```java
List<Circle> circleList = new ArrayList<Circle>();
Shape.setScreenSize(14);
StdDraw.setScale(-Shape.getScreenSize(), Shape.getScreenSize());

for (int i = 1; i < Shape.getScreenSize(); i += 2) {
    circleList.add(new Circle(i, 0, -Shape.getScreenSize()));
}

Collections.sort(circleList);

for (int i = 0; i < circleList.size(); i++) {
    circleList.get(i).setShapeColor(ShapeColor.values()[i%3]);
    circleList.get(i).draw();
}
```

Run result:



Step4: In **Step3**, we can see that the color scheme looks not good and the **ShapeColor** is mainly used to check if the shape is in the boundary. We can define an interface named **ColorDraw**, which has a method **customizedColor**.

(1) Define an interface:

```java
public interface ColorDraw {
   public void customizedColor(ColorScheme colorScheme, int index);
}
```

(2) Implements the **ColorDraw** in **Circle**

```java
@Override
public void customizedColor(ColorScheme colorScheme, int index) {
    Color[] colorList = colorScheme.getColorScheme();
    if (index < 0){
        index = 0;
    }
    if (index >= colorList.length){
        index = index % colorList.length;
    }
    StdDraw.setPenColor(colorList[index]);
    StdDraw.filledCircle(x, y, radius);

}
```

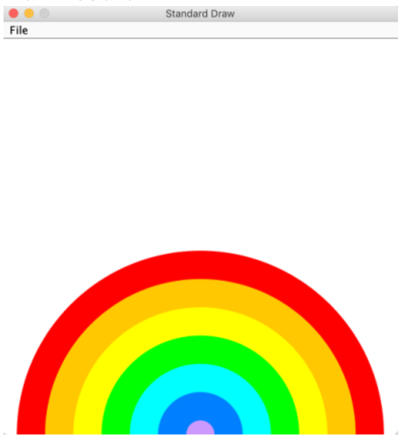
(3) Define an enum class **ColorScheme**:

```java
import java.awt.Color;

public enum ColorScheme {
    SKY(new Color[] {new Color(0, 102, 204),new Color(0, 128, 255),new Color(51, 153, 255),new Color(102, 178, 255),
            new Color(153, 204, 255),new Color(204, 229, 255)}),
    RAINBOW(new Color[] { Color.RED, Color.ORANGE, Color.YELLOW, Color.GREEN, Color.CYAN, new Color(0, 128, 255),
                new Color(204, 153, 255) }),
    GRAY(new Color[] { Color.DARK_GRAY, Color.GRAY, Color.LIGHT_GRAY });

    Color[] colorList;

    private ColorScheme(Color[] color) {
        colorList = color;
    }

    public Color[] getColorScheme() {
        return colorList;
    }
}
```

(4) In **ShapeTest**, we change main method to the following code:

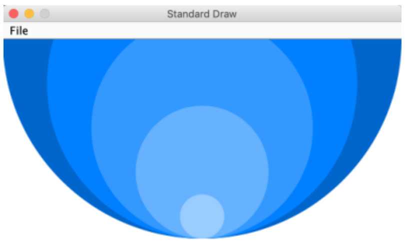
```java
List<Circle> circleList = new ArrayList<Circle>();
Shape.setScreenSize(14);
StdDraw.setScale(-Shape.getScreenSize(), Shape.getScreenSize());

for (int i = 1; i < Shape.getScreenSize(); i += 2) {
    circleList.add(new Circle(i, 0, -Shape.getScreenSize()));
}

Collections.sort(circleList);

for (int i = 0; i < circleList.size(); i++) {
    circleList.get(i).customizedColor(ColorScheme.RAINBOW, i);
}
```

Run result:



[Exercises]

1. Modify the class **ShapeTest,** draw some circles like the following image:



Hint: ColorScheme.Sky

x	y	radius
0	1	1
0	3	3
0	5	5
0	7	7
0	9	9

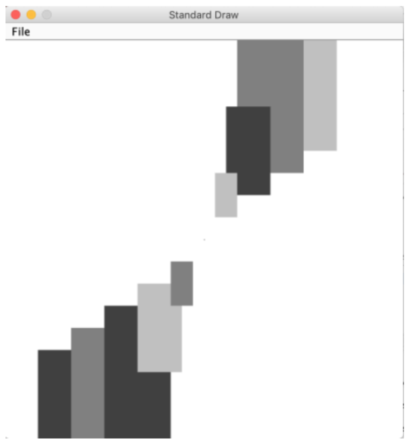
screen size = 9

2. Modify the class **Rectangle** in **JavaLab10.zip**.
   a. Make **Rectangle** implements **Comparable**, override the method **compareTo** to order the rectangles from the largest to smallest according their area. If two rectangles have the same area, order the rectangles from smallest to largest according **x**.
   b. Make **Rectangle** implements **ColorDraw**, override the method **customizedColor** to draw the rectangle according to the specific **ColorScheme** and the index.

3. Create a class **RectangleTest** for test.

```java
import java.util.ArrayList;

public class RectangleTest {

    public static void main(String[] args) {
        Shape.setScreenSize(9);
        StdDraw.setScale(-Shape.getScreenSize(), Shape.getScreenSize());

        List<Rectangle> rectanglList = new ArrayList<Rectangle>();
        for (int i = -5; i < 5; i ++) {
            rectanglList.add(new Rectangle(i,2*i,Math.abs(i), 2*Math.abs(i)));
        }
        Collections.sort(rectanglList);

        for (int i = 0; i < rectanglList.size(); i++) {
            rectanglList.get(i).customizedColor(ColorScheme.GRAY, i);
            System.out.println(rectanglList.get(i));
        }
    }
}
```

Here is a sample run:



4. You can design yourself pattern that contains circles and rectangles, or other yourself defined shapes.