Lab #5 – Drawable/scaleable Shapes using interfaces

Total Points: 50

**Introduction**

In this lab you will be working with a project that makes use of *Interfaces* and *polymorphism* to allow the creation of shapes that can be drawn on the screen. The final product of the lab will be an application that draws a picture or performs an animation on the screen. As a really simple example of what is possible, the image below is produced by the Bullseye program included with the lab.

A picture containing vector graphics

Description automatically generated

Before you can get to the point of drawing pictures or creating animations though, you are going to need to implement and test several classes that are needed by the application.

**Getting Started**

1. Create your GitHub repository and import the code into Eclipse as described on the "How to…" webpage, available from the course homepage.
2. As in some previous labs, remove any compilation errors in the starter code by following the instructions for "Adding the JUnit4 library to a project in Eclipse" on the course "How to…" webpage.

**Design**

At the heart of the design of the application created in this lab are two interfaces, Drawable and Scaleable. The definition of these interfaces is provided with the lab.

* The Drawable Interface:

This interface declares methods for drawing the object, getting/setting its color and getting/setting its visibility. Thus, we will know that every object that implements the Drawable interface will provide these methods. In this way it will be possible for the application to handle all Drawable objects in the same way. It will not have to worry about whether the object is a circle, a square, a line or a triangle. Further, any object will be able to declare to the application that it can be drawn on the screen by implementing the Drawable interface. The lab comes with one class Circle that implements the Drawable interface. You will be creating several additional classes that implement Drawable.

* The Scaleable Interface:

This interface declares one method for scaling an object. When an object is scaled it becomes larger or smaller by some factor. For example, if an object is scaled by 2.0 it will become twice as large. If it is scaled by 0.5, it will become half as large. Some objects will be able to be scaled and others will not. Those that can be scaled declare to the application that they can be scaled by implementing the Scaleable interface. The application is then able to handle all Scaleable objects in the same way, again without worrying about whether the object is a circle, a rectangle or a triangle. The Circle class provided with the lab also implements the Scaleable interface. Several of the classes that you create will also implement Scaleable.

These two interfaces are used by the DrawableObjectList class, which is a collection of objects that implement the Drawable interface. This class contains typical collection methods for adding/removing Drawable objects and finding out how many objects are in the collection. It also has methods for drawing and scaling all of the objects in the collection. These methods must rely on interfaces and polymorphism in order to accomplish their tasks. The DrawableObjectList will not know if the objects added are circles, rectangles, lines or triangles. However, it will know that they are all Drawable and thus may invoke any of the methods defined in the Drawable interface on any object in the collection. This includes the method necessary to draw each object. Similarly, any object that can be scaled will implement the Scaleable interface and thus the DrawableObjectList can scale any Scaleable object without knowing its true identity as a circle, square or triangle.

**The Assignment**

Your assignment for this lab can be divided into three tasks. First you will complete and test the implementation of the DrawableObjectList class. Second you will create and test several classes that implement Drawable and possibly the Scaleable interfaces. Finally, you will use the classes that you have implemented to create a picture or animation.

*The DrawableObjectList Class*

You need to implement and test the DrawableObjectList class. The steps below outline an incremental approach to implementing and testing this class.

1. Define the field(s) that will be needed by the DrawableObjectList.
2. Implement the constructor and the getSize() method.
3. Create a JUnit Test Case for the DrawableObjectList class and test the constructor and the getSize() method.
4. Implement and test the addDrawable() method.
5. Implement and test the removeDrawable() method.
6. Implement the drawAll() method. **You are not required to create a JUnit test method for the drawAll method**.
7. Implement and test the scaleAll() method. Hint: You can create and use Circle objects to test scaleAll().

Once you have correctly implemented and tested the DrawableObjectList class you can run the sample programs provided with the lab. The sample programs are Bullseye, which draws the figure shown earlier in the lab, and Annihilation, which performs a simple animation.

*Creating Drawable and Scaleable Objects*

Create a **minimum of two classes** that implement the Drawable interface. **At least one of these classes** must also implement the Scaleable interface. You may wish to study the Circle class before attempting your own classes. You may also wish to look at the methods available in the java.awt.Graphics class to see what it is capable of drawing. You can find the java.awt.Graphics class by following the link to the full Java API Documentation on the course home page or via a web search engine. Finally, you may want to confer with other students so that you each produce different classes. You can later share these classes to help create more interesting pictures and animations.

For each of the classes you choose to create:

1. Decide on a suitable class name and create a new class. Be sure to write a Javadoc comment above the class describing it and listing yourself as the author of the class. You must also include Javadoc comments for all of the methods defined in your class.
2. Define the fields that objects will need.
3. Implement at least one constructor for your class.
4. Add accessors for the fields of your class.
5. Create a JUnit Test Case for your class and test the constructor(s).
6. Add and test any other methods that make sense for your class (e.g. move(), translate() etc...).
7. If your class implements Scaleable, add that to its declaration then implement and test the scale() method.
8. Declare that your class implements Drawable and add stubs for the required methods.
9. Implement and test the get/setColor() and get/setVisibility() methods required by the Drawable interface.
10. Implement the draw method. **You are not required to create a JUnit test for your draw method.**

*Creating a Picture or Animation*

**Create a picture or animation** using the Drawable and Scaleable classes that you have created. You should also feel free to share/borrow classes from others in our COMP132 class. If you do, please be sure that the author information at the top of each file accurately reflects who produced each source file.

The basic approach to creating a picture or animation is to create Drawable objects, then add those to a DrawableObjectList that is part of a DrawingTablet. The DrawingTablet takes care of displaying the window and invoking the drawAll() method to display the objects. Below is the RedLight example included with the lab. It draws a green circle at the center of the window and after 3 seconds turns the circle yellow and then after another second turns the circle red.

public static void main(String[] args) {

/\*\* Create a DrawableObject list and use it to create

\* a DrawingTablet

\*/

DrawableObjectList objList = new DrawableObjectList();

DrawingTablet tablet = new DrawingTablet("Red Light", 200, 200, objList);

// Create a green circle at the center of the screen.

Circle light = new Circle(100, 100, 75, Color.green);

objList.addDrawable(light);

/\*

\* Each time a change is made to the DrawableObjectList or to one of

\* the Drawable objects that it contains you need to invoke repaint()

\* on the DrawingTablet. This causes the Drawing tablet to repaint

\* the screen reflecting the changes.

\*/

tablet.repaint();

/\* sleep is a static method in the AnimationTimer class that causes

\* the program to pause for a specified number of milliseconds when

\* it is invoked. This line sleeps for 3 seconds.

\*/

AnimationTimer.sleep(3000);

// Change the color and repaint!

light.setColor(Color.yellow);

tablet.repaint();

// Sleep for 1 second.

AnimationTimer.sleep(1000);

// Change the color and repaint.

light.setColor(Color.red);

tablet.repaint();

}

You may also want to study the Bullseye and Annihilation programs for other examples of how to create and draw objects and perform animations. You may also want to look at the java.awt.Color class to see what colors are defined and also how you can create your own custom colors. You can find the java.awt.Color class by following the link to the full Java API Documentation on the course home page or via a web search engine.

**Submitting your solution**

As usual, push your code to GitHub regularly for backup purposes and push your final version to submit the assignment. In addition, as usual, submit your lab report via Moodle. The lab report for this lab will consist only of the self-assessment report.