Programming Assignment 10 (100 Points)
Due: 11:59pm Thursday, December 1

README (10 points)

You are required to provide a text file named **README,** NOT Readme.txt, README.pdf, or README.doc, with your assignment in your pa10 directory. There should be no file extension after the file name "**README**". Your README should include the following sections:

Short Response (10 points) : Answer the following questions: (it may be easier to answer these questions after you have completed this assignment)

1. Describe how you chose and used sources of help and how they helped you all within the bounds of academic integrity.

2. How would you test whether the copy constructors in the shape classes are doing a deep copy instead of a shallow copy?

   For example, given:

   ```
   CSE11_Line line1 = new CSE11_Line();
   CSE11_Line line2 = new CSE11_Line(line1);
   ```

   How would you write a test to determine if CSE11_Line's copy constructor is doing a deep copy?

3. On a similar note, how would you test for the equals() method in CSE11_Line to determine if it is doing a deep comparison vs. a shallow reference comparison?

   For example, given:

   ```
   Point point1 = new Point(0, 0);
   Point point2 = new Point(100, 100);
   CSE11_Line line1 = new CSE11_Line(point1, point2);
   CSE11_Line line2 = new CSE11_Line(point1, point2);
   ```

   How would you write a test to determine if CSE11_Line's equals() method is doing a deep comparison?

STYLE (20 points)

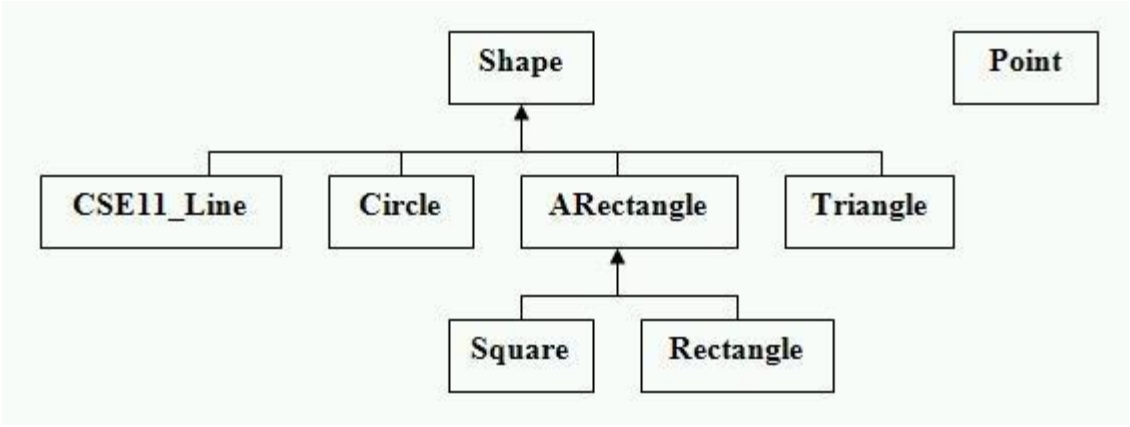
Please see previous programming assignments; especially PA2's writeup.
You will be specifically graded on commenting, file headers, class and method headers, meaningful variable names, judicious use of blank lines, not having more than 80 characters on a line, perfect indentation, no magic numbers/hard-coded numbers other than -1, 0, +1, **using setters and getters**, etc.

CORRECTNESS (70 points)

All files related to this HW need to be in a directory named pa10 in your cs11 course-specific account on ieng6.ucsd.edu

Shape Hierarchy

Write a set of classes to implement a simple hierarchy of Shapes as follows:




```
import java.awt.*;
import objectdraw.*;

public abstract class Shape
   private String name;

   public Shape() { ... }
   public Shape( String name ) { ... }
   public String getName() { ... }
   private void setName( String name ) { ... }

   /* Copy this as is in your Shape.java */
   @Override
   public boolean equals( Object o ) {
       String s = "\n**********************************************************\n"
              + "This should never print. If it does print, then\n"
              + "you did not override equals() properly in class "
              + this.getClass().getName() + "\n"
              + "**********************************************************\n";
       System.out.println( s );
       return this == o;
   }

   public abstract void move( int xDelta, int yDelta );
   public abstract void draw( DrawingCanvas canvas, Color c, boolean fill );



import java.awt.*;
import objectdraw.*;

public class CSE11_Line extends Shape
   private Point start;
```

```
   private Point end;

   public CSE11_Line() { ... }
   public CSE11_Line( Point start, Point end ) { ... }
   public CSE11_Line( CSE11_Line line ) { ... }
   public void move( int xDelta, int yDelta ) { ... }

   @Override
   public String toString() { ... }

   @Override
   public boolean equals( Object o ) { ... }

   @Override
   public int hashCode() { ... }

   public void draw( DrawingCanvas canvas, Color c, boolean fill ) { ... }
   and appropriate public get/accessor methods - for example: public Point getStart() ...
   and private set/mutator methods - for example: private void setStart( Point p ) ...



import java.awt.*;
import objectdraw.*;

public class Circle extends Shape
   private Point center;
   private int radius;

   public Circle() { ... }
   public Circle( Point center, int radius ) { ... }
   public Circle( Circle c ) { ... }
   public void move( int xDelta, int yDelta ) { ... }

   @Override
   public String toString() { ... }

   @Override
   public boolean equals( Object o ) { ... }

   @Override
   public int hashCode() { ... }

   public void draw( DrawingCanvas canvas, Color c, boolean fill ) { ... }
   and appropriate get/accessor methods - for example: public Point getCenter() ...
   and private set/mutator methods - for ex: private void setCenter( Point center ) ...
```

```
public abstract class ARectangle extends Shape
   private Point upperLeft;      // Upper left corner - Common to all rectangular shapes

   public ARectangle() { ... }
   public ARectangle( String name, int x, int y ) { ... }
   public ARectangle( String name, Point upperLeft ) { ... }
   public ARectangle( ARectangle r ) { ... }
   public void move( int xDelta, int yDelta ) { ... }

   @Override
   public String toString() {  ... }           // getName() + upperLeft

   @Override
   public boolean equals( Object o ) { ... }   // std checks + upperLeft

   @Override
   public int hashCode() { ... }

   and appropriate get/accessor method - for example: public Point getUpperLeft() ...
   and private set/mutator method - for example: private void setUpperLeft( Point p ) ...
```

```
import java.awt.*;
import objectdraw.*;

public class Rectangle extends ARectangle
   private int width;
   private int height;

   public Rectangle() { ... }
   public Rectangle(int x, int y, int width, int height) { ... }
   public Rectangle(Point upperLeft, int width, int height) { ... }
   public Rectangle(Rectangle r) { ... }

   @Override
   public String toString() { ... }       // super.toString() + width + height

   @Override
   public boolean equals(Object o) { ... } // super.equals() + width + height

   public void draw( DrawingCanvas canvas, Color c, boolean fill ) { ... }
   and appropriate get/accessor methods - for example: public int getWidth() ...
   and private set/mutator methods - for example: private void setWidth( int w ) ...
```

NOTE: upperLeft Point, move(), and hashCode() inherited from ARectangle

```
import java.awt.*;
import objectdraw.*;

public class Square extends ARectangle
   private int side;

   public Square() { ... }
   public Square( int x, int y, int side ) { ... }
   public Square( Point upperLeft, int side ) { ... }
   public Square( Square r ) { ... }

   @Override
   public String toString() { ... }            // super.toString() + side

   @Override
   public boolean equals( Object o ) { ... }    // super.equals() + side

   public void draw( DrawingCanvas canvas, Color c, boolean fill ) { ... }
   and appropriate get/accessor methods - for example: public int getSide() ...
   and private set/mutator methods - for example: private void setSide( int side ) ...
```

NOTE: upperLeft Point, move(), and hashCode() inherited from ARectangle

```
import java.awt.*;
import objectdraw.*;

public class Triangle extends Shape
   private Point p1;
   private Point p2;
   private Point p3;

   public Triangle() { ... }
   public Triangle( Point p1, Point p2, Point p3 ) { ... }
   public Triangle( Triangle tri ) { ... }
   public void move( int xDelta, int yDelta ) { ... }

   @Override
   public String toString() { ... }

   @Override
   public boolean equals( Object o ) { ... }

   @Override
   public int hashCode() { ... }
```

```
public void draw( DrawingCanvas canvas, Color c, boolean fill ) { ... }
and appropriate get/accessor methods - for example: public Point getP1() ...
and private set/mutator methods - for example: private void setP1( Point p1 ) ...
```

******** Not part of the Shape hierarchy ********

```
public class Point
   private int x;
   private int y;

   public Point(){ ... }
   public Point( int x, int y ) { ... }
   public Point( Point point ) { ... }
   public int getX() { ... }
   public int getY() { ... }
   private void setX( int x ) { ... }          // Private! so Points are immutable
   private void setY( int y ) { ... }          // Private! so Points are immutable
   public void move( int xDelta, int yDelta ) { ... }

   @Override
   public String toString() { ... }

   @Override
   public boolean equals( Object o ) { ... }

   @Override
   public int hashCode() { ... }
```

Because the objectdraw library already has a Line type, we name our Line type CSE11_Line as to not confuse/conflict with the objectdraw library's Line. The draw() method in our CSE11_Line will use the objectdraw library's Line type.

Most of the above constructors and methods are self-explanatory. The **move()** method adjusts the shape xDelta pixels in the X direction and yDelta pixels in the Y coordinate. Just add these deltas to the shape's current X and Y location depending on how that shape's location is represented -- CSE11_Line: both start and end Points; Circle: center Point; Rectangle: upperLeftCorner Point; Triangle: all 3 Points.

All accessing of private data in each class must be made through the appropriate get/accessor and set/mutator methods; do not directly access data, including in constructors. The only place where direct access is allowed is in the actual accessor/mutator methods

The draw() method should create the appropriate objectdraw library object to draw on the *canvas* parameter. The boolean parameter *fill* indicates whether the graphical object should be filled or not (for example, for Circle whether a FilledOval or a FramedOval should be created). This has no meaning in CSE11_Line. If the Color parameter is null, use Color.BLACK (default).

Copy constructors initialize the instance variables from an existing object of the same type to this newly created object. If the variable is a primitive data type, just copy the value of this primitive type from the existing object to this object (assignment through mutator method). If the variable is a reference to an object, create a new copy of the object this variable is referencing (by invoking that variable's copy ctor) and assign this resulting new copy of the object to this object's instance variable. This should result in a deep copy.

For example, in class Center's copy ctor,

```
public Circle( Circle c )
```

to set the center instance variable properly to a new Point based on the parameter's center Point:

```
this.setCenter( new Point( c.getCenter() ) );
```

Test files are provided in ~/../public/PA10/

`TestMickey.java`

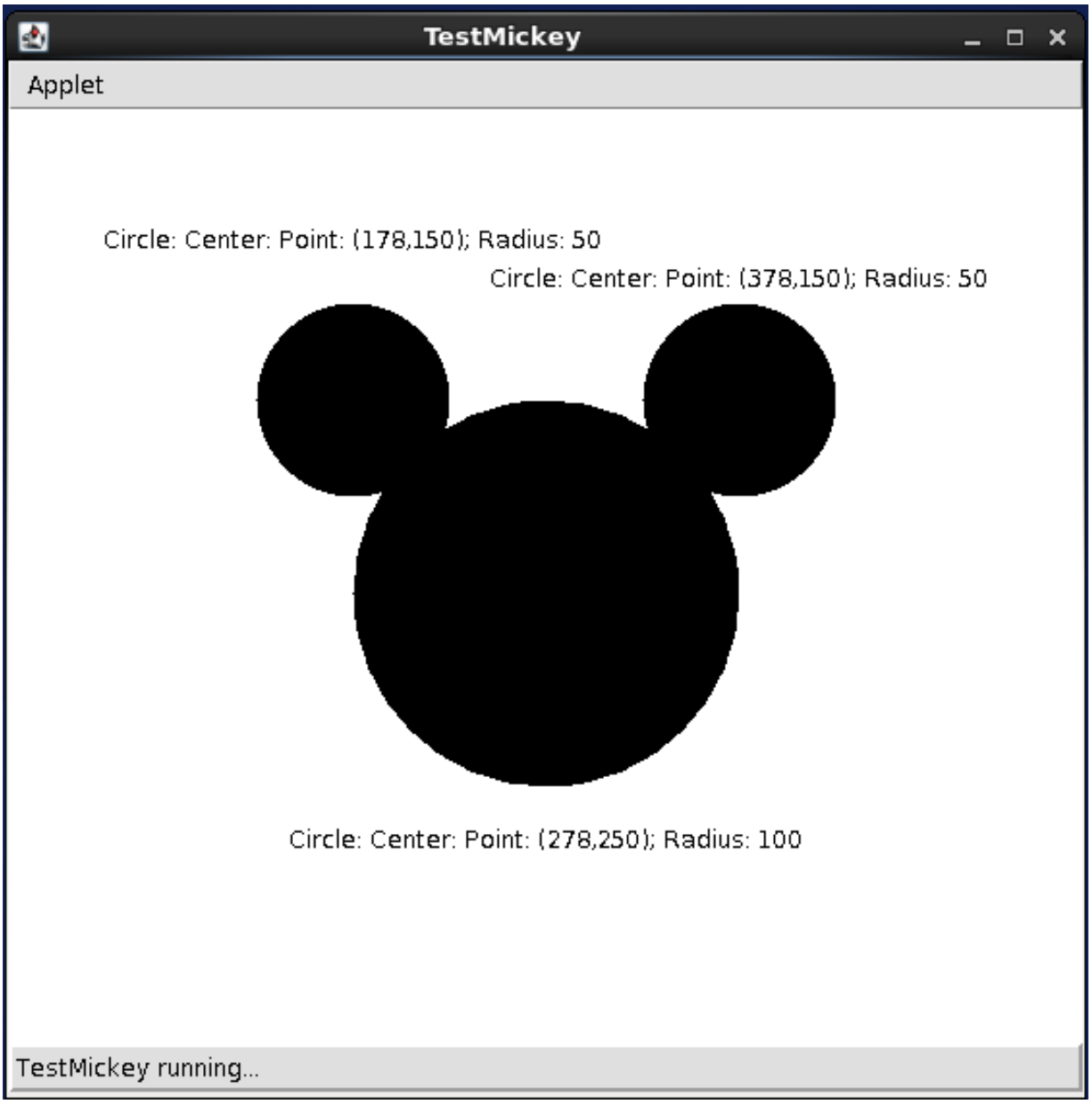
`TestHouseWithDelays.java` and `TestHouseWithDelaysController.java`

TestMickey uses class Shape, class Point, and class Circle. This is a good one to start with to test your class Shape, Circle, and Point.

TestHouseWithDelays draws a house using all the various shapes in a delayed fashion so you can see the different objects being drawn.

We will compile and use these test programs against your shapes sources to grade this assignment (in addition to using some of our own test cases).

Example screen shots:

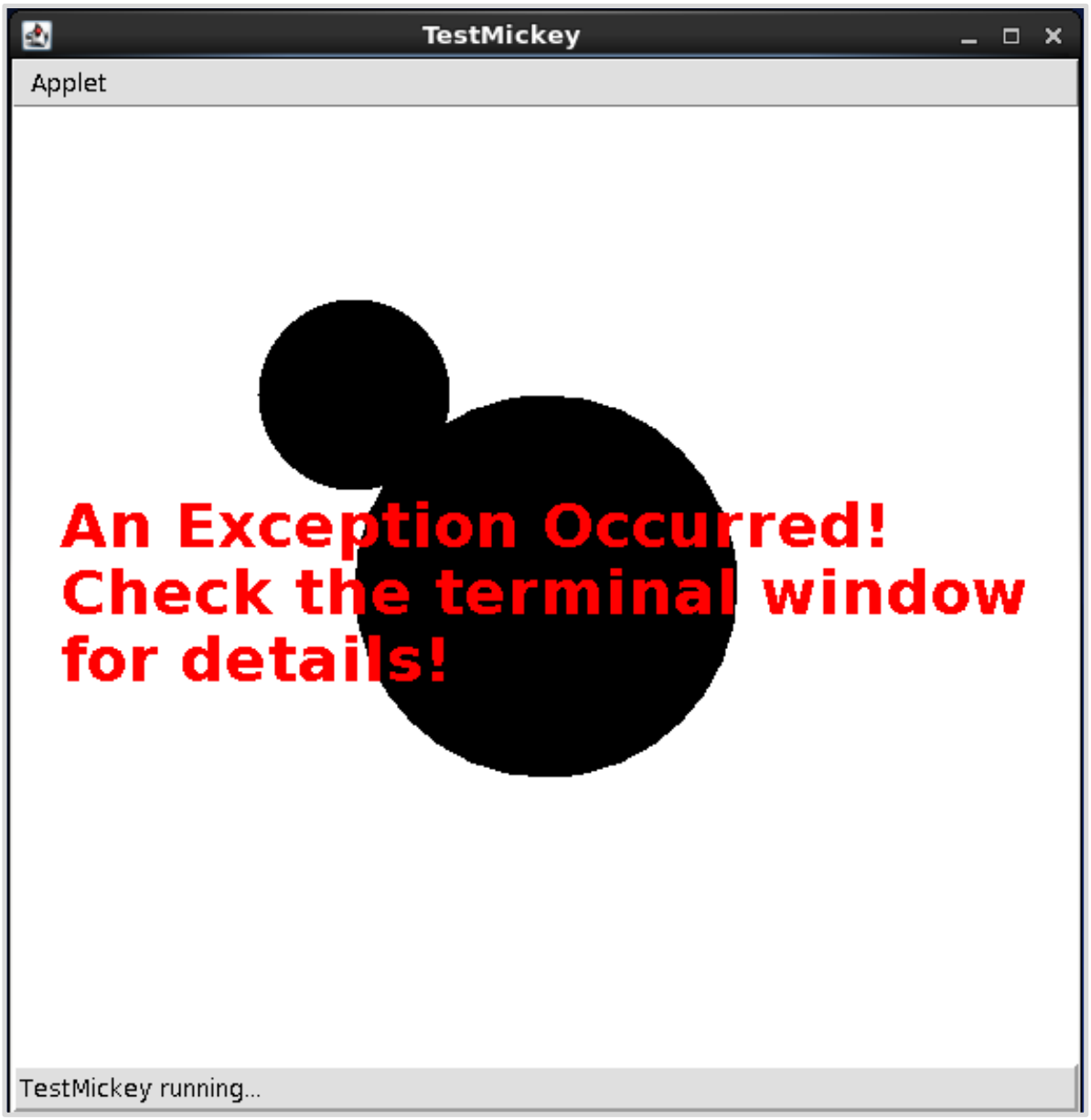

TestMickey
Applet
Circle: Center: Point: (178,150); Radius: 50
Circle: Center: Point: (378,150); Radius: 50
Circle: Center: Point: (278,250); Radius: 100
TestMickey running...

If you have problems with this test, you are allowed to comment out parts of TestHouseWithDelays.java to draw only certain sections of the house at a time to make debugging easier. But in the end all of this test case should work properly.

Note: The last Point coordinate represents the value of the last Point to draw a filled Triangle (roof) with multiple (framed) Triangles with a changing Y value of the upper Point. You will see this value change as you run the test program as the roof is filled in

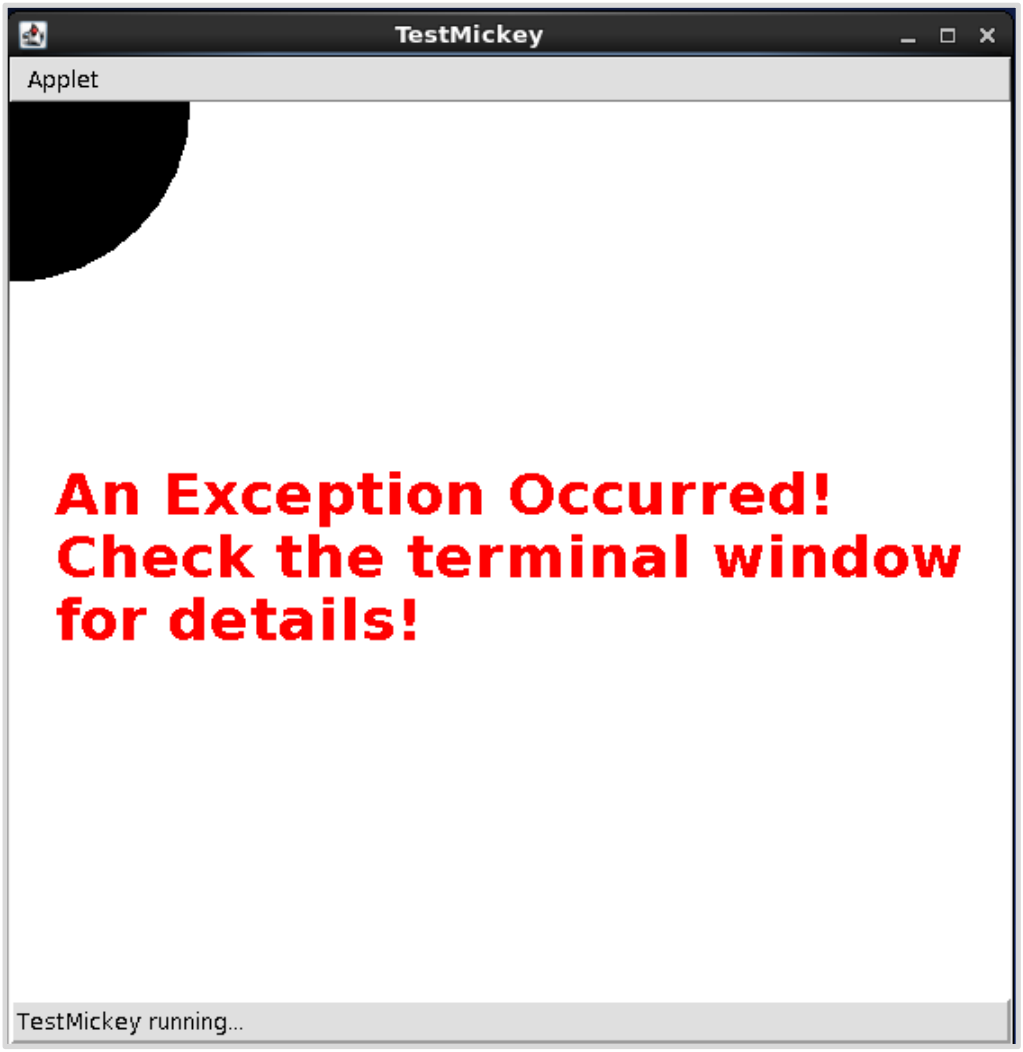
If any exceptions are thrown when you run your program, an error message will pop up in your window. The error message indicates that some sort of exception has been thrown in your terminal. **You must fix these exceptions!** To understand and fix what these exception in the terminal are telling you, you can use the same logic that was on the midterm and discussed in class.

Here are two examples of error messages and exceptions you may see:



Terminal Says:

```
>java -cp ./Acme.jar:./objectdraw.jar:. TestMickey
java.lang.NullPointerException
      at Point.equals(Point.java:62)
      at TestMickey.makeMickey(TestMickey.java:107)
      at TestMickey.begin(TestMickey.java:21)
      at objectdraw.WindowController.helpinit(WindowController.java:70)
      at objectdraw.Controller.init(Controller.java:82)
      at Acme.MainFrame.run(MainFrame.java:267)
      at java.lang.Thread.run(Thread.java:745)
```



Terminal says:

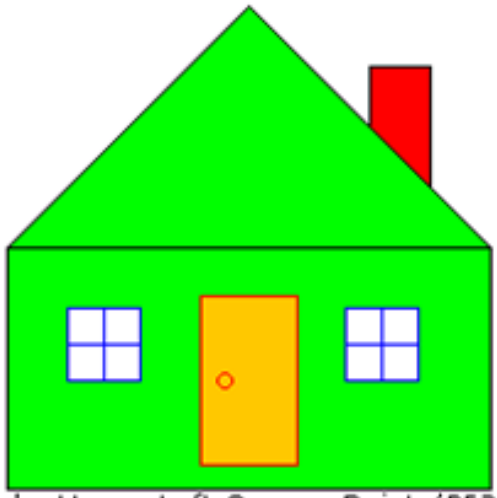
```
>java -cp ./Acme.jar:./objectdraw.jar:. TestMickey
java.lang.IllegalStateException:
You implemented the Point equals() incorrectly.
Make sure you overrode equals() correctly (vs. overload).
And should check contents of the two Points.

      at TestMickey.makeMickey(TestMickey.java:129)
      at TestMickey.begin(TestMickey.java:21)
      at objectdraw.WindowController.helpinit(WindowController.java:70)
      at objectdraw.Controller.init(Controller.java:82)
      at Acme.MainFrame.run(MainFrame.java:267)
      at java.lang.Thread.run(Thread.java:745)
```

Files to be turned in:

- Point.java
- Shape.java
- CSE11_Line.java
- Circle.java
- ARectangle.java
- Square.java
- Rectangle.java
- Triangle.java
- objectdraw.jar
- Acme.jar
- README

Don’t forget to pay attention to the detail on TestHouseWithDelays. Some objects are outlined and have specific colors. Also, ensure that your strings are exactly the same as those in the output example pictures.



Drawing the house - Rectangle: Upper Left Corner: Point: (253,275) Width: 200 Height: 100
Drawing the chimney - Rectangle: Upper Left Corner: Point: (403,200) Width: 25 Height: 75
Drawing the roof frame - Triangle: Point: (253,275), Point: (453,275), Point: (353,175)
Drawing the left window - Square: Upper Left Corner: Point: (278,300) Sides: 30
Drawing 1st window pane - CSE11_Line: Point: (293,300) to Point: (293,330)
Drawing 2nd window pane - CSE11_Line: Point: (278,315) to Point: (308,315)
Drawing the right window - Square: Upper Left Corner: Point: (393,300) Sides: 30
Drawing the door - Rectangle: Upper Left Corner: Point: (333,295) Width: 40 Height: 70
Drawing the door knob - Circle: Center: Point: (343,330); Radius: 3
Filling in the roof - Triangle: Point: (253,275), Point: (453,275), Point: (353,275)

****Note, the above image is provided so that commas, colons, and all the other characters are bigger so that you can check for typos in your toString() methods.**

Extra Credit (5 points)

Add a new shape class named CSE11_Polygon. Class CSE11_Polygon should inherit from class Shape. It should have 3 constructors: a no-arg ctor (basically an empty polygon), a copy ctor (to perform a deep copy), and a ctor that takes an array of Points. This array of Points defines the closed polygon shape such that a CSE11_Line is drawn between the Points specified in the array with a line between the last Point and the first Point to close the polygon shape. Make sure to copy the array to a private instance variable (do not just perform a simple assignment; you need a full copy of the array so any changes to the actual argument array will not affect the polygon).

Override toString(), equals(), and hashCode() similar to the other shapes in this assignment.

Provide an appropriate implementation for draw() and move(). You can ignore the fill parameter -- just implement a framed polygon in the specified color.

Write a test driver program to test all the constructors and methods in this new class. Create several polygons with different number of Points, move them, copy them, draw them, check for equality, check that the copy ctor performs a deep vs. shallow copy, etc. For example, multi-point stars, parallelograms, pent/hex/octagons, trapezoids, non-symmetrical polygons, origami shapes, Pokemon Polygon, etc.

In your README file, explain your extra credit implementation and your test driver (what it is supposed to display and what parts of the new class it tests) and how to run your extra credit code.

Files:
CSE11_Polygon.java
TestCSE11_Polygon.java

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