Objective: To gain more experience using recursion and recursive data structures.

This week, you will be implementing a program we call “Scribbler.” This is a more sophisticated version of the scribble class you’ve seen in lecture as a demo. While no design is required for this lab, we strongly recommend that you show up with a plan for at least steps 1 and 2 in the “How to Proceed” section.

You are encouraged to work in pairs on this program. You must do all of the design and coding together. Only turn in one copy of the program, but make sure both of your names are on the folder and at the top of each class.

The online version has a working version of the program.

The Scribbler program has three modes: Draw mode, Move mode, and Color mode. The program starts in Draw mode. Draw mode, Move mode, and Color mode are selected by pressing buttons, and the color used by Color mode is selected by choosing a color from a choice component filled with color names. The modes behave as follows:

**Draw mode:** Drag to draw a new Scribble on the canvas.

**Move mode:** Drag a Scribble by pressing the mouse on it and dragging.

**Color mode:** Click on any Scribble to change its color to that selected in the color choice component.

The program also has an “Erase Last” button that will erase the most recently drawn Scribble. Unlike our simple version in class, if you press the button repeatedly it will continue to erase Scribbles in the reverse order of which they are drawn.

**How to Proceed** The starter for this lab is a working Scribbler, but it has only the Draw mode and a simplified Move mode that is capable of moving only the most recently drawn Scribble. You will need to add code that will manage your Scribbles to allow the various modes and the “Erase last” button to work correctly.
There are a number of step-by-step approaches you could take to solve this problem, but it is important that you have a plan, and that you add functionality one step at a time. Here is one possible ordering of the tasks. We recommend that you develop and test your program incrementally – make sure you have a working implementation at each step before moving on to the next.

1. Implement a simplified Color mode. This is similar to Move mode, except that you set the color of the Scribble that contains the mouse point instead of moving it. To do this, you will have to add a setColor method to the ScribbleIfc interface, and the Scribble and EmptyScribble classes. For now, you will only be able to set the color of the most recently drawn Scribble.

2. Implement a simplified Erase mode. Here, you respond to the “Erase last” button’s actionPerformed event by deleting the most recently drawn Scribble from the canvas. Again, for now, you will only be able to erase the most recently drawn Scribble. A second button press will do nothing.

3. Since you need to keep track of a number of Scribbles, you will need to define classes representing a collection of Scribbles. The interface for these classes will be called ScribbleCollectionIfc, and the classes implementing that interface will be named EmptyScribbleCollection and ScribbleCollection. This interface and classes will be similar to the ball lists in the ChainReaction example we looked at in class.

Just as we do not know how many line segments will make up a Scribble when we start to draw one, we will not know how many Scribbles will be drawn and stored in our ScribbleCollection. Because of this you may not use an array to keep track of these. Instead, we’re going to do it with recursion.

Look at the ScribbleCollectionIfc interface. Like the ChainReaction method, we’re going to keep track of our collection of Scribbles by keeping a reference to the current Scribble and then the rest of the collection.

In your Scribbler class you will need a variable with type ScribbleCollectionIfc that will be initialized with an object created from EmptyScribbleCollection. You will add new Scribbles to it using the constructor from ScribbleCollection as they are drawn. Consider carefully what methods your scribble collection needs to be able to support the functionality of the four modes. We have provided the skeleton of a ScribbleCollectionIfc interface, and ScribbleCollection and EmptyScribbleCollection classes.

- Draw mode needs to add a new Scribble to the ScribbleCollection when the dragging is done.
- The “Erase last” button needs to remove the most recently drawn Scribble from the canvas and remove it from the ScribbleCollection. This means there is now a new “most recently drawn” Scribble, and a second press would remove that one, and so on. Be careful in the case when there are no Scribbles left.
- Move mode and Color mode need to determine if a mouse click takes place on any of the Scribbles on the canvas, not just the most recently drawn. This requires that your ScribbleCollection be able to search through all of its Scribbles until either a Scribble is located that contains the click point, or it is determined that none of the existing Scribbles contain the point (the base case, which should be handled by the EmptyScribbleCollection class). Once you have determined which Scribble contains the click point, you can move or color that Scribble as you did in the simplified versions of these modes.
Sketch of classes provided for this program  We are providing some classes and interfaces to help you get started. These are almost identical to the Scribbler examples from lecture. Please download the starter to see the classes and interfaces we provide before working on your design. We also include the startup code for the Scribbler class and the ScribbleIfc interface.

Submitting Your Work  The lab is due at 11 PM on Monday. When your work is complete you should drop the folder in the dropbox. Make sure the folder name begins with your name(s) and that it includes the phrase “Lab 11”. Also make sure that your name(s) is (are) included in the comment at the top of each Java source file.

Before turning in your work, be sure to double check both its logical organization and your style of presentation. Make your code as clear as possible and include appropriate comments describing major sections of code and declarations.

Table 1: Grading Guidelines

<table>
<thead>
<tr>
<th>Value</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Style (5 points total)</strong></td>
</tr>
<tr>
<td>2 points</td>
<td>Descriptive comments</td>
</tr>
<tr>
<td>1 point</td>
<td>Good names</td>
</tr>
<tr>
<td>1 point</td>
<td>Good use of constants</td>
</tr>
<tr>
<td>1 point</td>
<td>Appropriate formatting</td>
</tr>
<tr>
<td></td>
<td><strong>Design (6 points total)</strong></td>
</tr>
<tr>
<td>1 point</td>
<td>Good use of boolean expressions, loops, conditionals</td>
</tr>
<tr>
<td>1 point</td>
<td>Not doing more work than necessary</td>
</tr>
<tr>
<td>2 points</td>
<td>Appropriate methods in ScribbleCollection</td>
</tr>
<tr>
<td>2 points</td>
<td>Appropriate recursive structure in ScribbleCollection</td>
</tr>
<tr>
<td></td>
<td><strong>Correctness (9 points total)</strong></td>
</tr>
<tr>
<td>1.5 point</td>
<td>Drawing the GUI components correctly</td>
</tr>
<tr>
<td>1.5 point</td>
<td>Switching among modes correctly</td>
</tr>
<tr>
<td>1.5 point</td>
<td>Draw mode adds correctly to the ScribbleCollection</td>
</tr>
<tr>
<td>1.5 point</td>
<td>Move mode works correctly</td>
</tr>
<tr>
<td>1.5 point</td>
<td>Color mode works correctly</td>
</tr>
<tr>
<td>1.5 point</td>
<td>Erase button works correctly</td>
</tr>
</tbody>
</table>

Sketch of classes provided for this program  We are providing several classes and interfaces to help you get started. We include here printouts of the main program and the classes and interface for a single scribble. These are very similar to the Scribbler examples from lecture. We have also include the starting ScribbleCollectionIfc interface which you will need to modify.

```java
public interface ScribbleCollectionIfc
{
    // returns the scribble that contains the point;
    // if none contain it, returns an empty scribble
    ScribbleIfc scribbleSelected(Location point);
```
Here is the code from the basic Scribbler class. You may need to add additional methods to it:

```java
public class Scribbler extends WindowController implements ActionListener {
    // user modes
    private static final int DRAWING = 1;
    private static final int MOVING = 2;
    private static final int COLORING = 3;

    // empty scribble as placeholder when nothing there.
    private static final EmptyScribble empty = new EmptyScribble();

    // the current scribble
    private ScribbleIfc currentScribble;

    // the collection of scribbles
    private ScribbleCollectionIfc scribbles;

    // stores last point for drawing or dragging
    private Location lastPoint;

    // whether the most recent scribble has been selected for moving
    private boolean draggingScribble;

    // buttons that allow user to select modes
    private Button setDraw, setMove, setErase, setColor;

    // Choice button to select color
    private Choice chooseColor;

    // new color for scribble
    private Color newColor;

    // label indicating current mode
    private Label modeLabel;

    // the current mode -- drawing mode by default
    private int chosenAction = DRAWING;
```
// create and hook up the user interface components
public void begin() {
    setDraw = new Button("Draw");
    setMove = new Button("Move");
    setColor = new Button("Color");

    Panel buttonPanel = new Panel();
    buttonPanel.add(setDraw);
    buttonPanel.add(setMove);
    buttonPanel.add(setColor);

    chooseColor = new Choice();
    chooseColor.addItem("red");
    chooseColor.addItem("blue");
    chooseColor.addItem("green");
    chooseColor.addItem("yellow");

    setErase = new Button("Erase last");
    Panel choicePanel = new Panel();
    choicePanel.add(setErase);
    choicePanel.add(chooseColor);

    Panel controlPanel = new Panel(new GridLayout(3,1));
    modeLabel = new Label("Current mode: drawing");
    controlPanel.add(modeLabel);
    controlPanel.add(buttonPanel);
    controlPanel.add(choicePanel);

    add(controlPanel, BorderLayout.SOUTH);

    // add listeners
    setDraw.addActionListener(this);
    setMove.addActionListener(this);
    setErase.addActionListener(this);
    setColor.addActionListener(this);

    // make the current scribble empty
    currentScribble = empty;
    validate();
}

// if in drawing mode then start with empty scribble
// if in moving mode then prepare to move
public void onMousePress(Location point) {
    if (chosenAction == DRAWING) {

    }
}
// start with an empty scribble for drawing
currentScribble = empty;
}
}

// if in drawing mode, add a new segment to scribble
// if in moving mode then move it
public void onMouseDrag(Location point) {
    if (chosenAction == DRAWING) {
        // add new line segment to current scribble
        Line newSegment = new Line(lastPoint, point, canvas);
        currentScribble =
            new Scribble(newSegment, currentScribble);
    } else if (chosenAction == MOVING) {
        if (draggingScribble) {
            // move current scribble
            currentScribble.move(point.getX() - lastPoint.getX(),
                                  point.getY() - lastPoint.getY());
        }
    }
    // update for next move or draw
    lastPoint = point;
}

public void onMouseRelease(Location point) {
    // Add code when have collection of scribbles
}

// Set mode according to button pressed.
public void actionPerformed(ActionEvent e) {
    if (e.getSource() == setDraw) {
        chosenAction = DRAWING;
        modeLabel.setText("Current mode: drawing");
    } else if (e.getSource() == setMove) {
        chosenAction = MOVING;
        modeLabel.setText("Current mode: moving");
    }
}

Here is the starting code for ScribbleIfc:
public interface ScribbleIfc
{
    // returns whether point is contained in scribble
    boolean contains(Location point);

    // move scribble by dx in x-direction and dy in y-direction
    void move(double dx, double dy);
}

Here is the starting code for Scribble:

// A class to represent a non-empty scribble
public class Scribble implements ScribbleIfc {
    private Line first; // an edge line of the scribble
    private ScribbleIfc rest; // the rest of the scribble

    public Scribble(Line segment, ScribbleIfc theRest) {
        first = segment;
        rest = theRest;
    }

    // returns true iff the scribble contains the point
    public boolean contains(Location point) {
        return (first.contains(point) || rest.contains(point));
    }

    // the scribble is moved xOffset in the x direction
    // and yOffset in the y direction
    public void move(double xOffset, double yOffset) {
        first.move(xOffset, yOffset);
        rest.move(xOffset, yOffset);
    }
}

Here is the starting code for EmptyScribble:

/* Class representing an empty scribble */
public class EmptyScribble implements ScribbleIfc{
    public EmptyScribble() {
    }

    // point is never in an empty scribble!
    public boolean contains(Location point) {
        return false;
    }

    // nothing to move, so do nothing!
    public void move(double dx, double dy) {
    }
}
The start up code for the collection interface and classes is omitted here.