Sahar K Hussain
CAP3027
Section 1925
October 12th, 2015
HW07

The work submitted is my own and the honor code was neither bent nor broken.

Sahar K Hussain

The easiest part of the homework was to bring back old concepts of using a scanner and reading in the lines of the input file and setting up the whole application. The hardest point was to do the transforming because I wasn't entirely sure how to go about flipping my image. I believe the assignment's educational objective was to help us practice using affine transform matrices in an applied java sense and see how our fractals can come to life using them!

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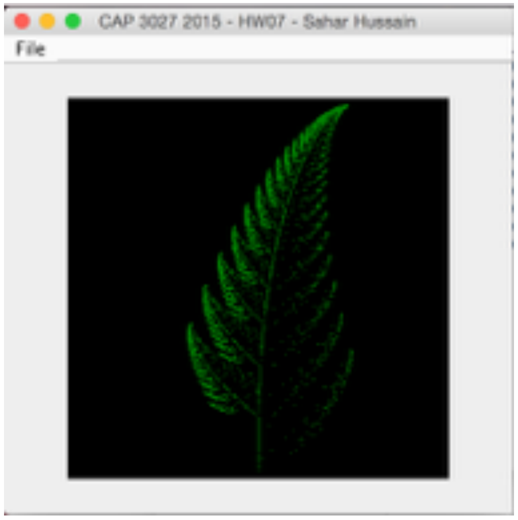
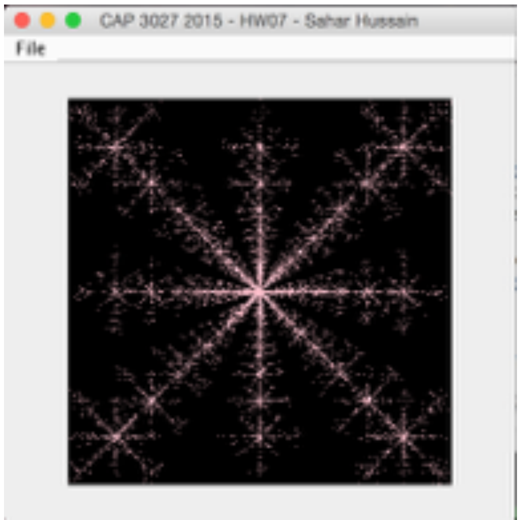
Standard Program Deliverables:
1) Yes, the program compiles without errors.
2) Yes, the program compiles without warnings.
3) Yes, the program runs without crashing.
4) I tested the program on my personal laptop and utilized xCode for inputting the code and the terminal for compiling and running the program.
5) The program does meet assignment's specifications - N/A
6) No known and suspected bugs.
7) Yes, the program runs correctly.

Screenshots:

Barnsley's Fern (Black background - Green Foreground):



Snow-flake Crystal from Pg 107 of the Computational Beauty of Nature book (input file provided):



Source Code:

```
//DisplayImage.java

//Allows a user to select and display images

//illustrates how to create a JFrame with a menubar,

//define ActionListeners,

//use a JFileChooser,

//open and display an image inside a JScrollPane


//by Dave Small

//HW07 Modification to original HW00 code and work by Sahar KH


/**For this assignment, I shall be implementing one of the Affine Transform Fractal
Techniques

as described in Lecture: IFS.

**/


// Import the libraries

import java.awt.Color;

import java.awt.Graphics2D;

import java.awt.List;

import java.awt.Rectangle;

import java.awt.Shape;

import java.awt.geom.AffineTransform;

import java.awt.geom.Line2D;

import java.awt.geom.Point2D;
import java.awt.*;

import java.awt.event.*;

import java.awt.image.*;

import java.io.*;

import javax.imageio.*;

import javax.swing.*;

import java.util.*;

import java.util.ArrayList;

import java.io.IOException;

import java.io.FileReader;

import java.io.BufferedReader;



public class DisplayImage

{

    private static final int WIDTH = 400;

    private static final int HEIGHT = 400;


    // Our worker thread called by the EDT to run the program in a safe way

    public static void main(String[] args)

    {

        SwingUtilities.invokeLater( new Runnable()

                                   {

            public void run()

            {
```

```
            createAndShowGUI();
          }
        });
    }

    public static void createAndShowGUI()
    {
        JFrame frame = new ImageFrame( WIDTH, HEIGHT );
        frame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
        frame.setVisible( true ); // frame.show(); was deprecated as of Java 1.5
    }
}

class ImageFrame extends JFrame
{
    private final JFileChooser chooser;
    private BufferedImage image = null;
    private static int lineCounter = 0;
    private static ArrayList<String> linesInFile = new ArrayList<String>();
    private static ArrayList<AffineTransform> transform = new
ArrayList<AffineTransform>();
    private static ArrayList<Double> seventhProbability = new ArrayList<Double>();
    private static ArrayList<Double> determinantArray = new ArrayList<Double>();
    private static boolean probability = false;
    private static int newBackgroundColor;
    private static int newForegroundColor;
    private static String backgroundColor = "0xFFFFFFFF";
    private static String foregroundColor = "0xFFFFFFFF";
    private static Graphics2D g2d = null;
    private static BufferedImage theNewImage = null;
    private static double sumOfDeterminants = 0;
    private static Point2D.Double firstPoint;
    private static Point2D.Double secondPoint;
    private static double x = 0;
    private static double y = 0;
    private static int width;
    private static int height;

    //constructor

    public ImageFrame(int width, int height)
    {
        //setup the frame's attributes

        this.setTitle( "CAP 3027 2015 - HW07 - Sahar Hussain" );
        this.setSize (width, height);

        //add a menu to the frame
        addMenu();
```

```
        //setup the file chooser dialog


        chooser = new JFileChooser();

        chooser.setCurrentDirectory( new File( "." ) );


    }


      //--------------------------------- Methods that Implement the
Menu-----------------------------------------//


    private void addMenu()

    {

        //setup the frame's menu bar

        // === file menu


        JMenu fileMenu = new JMenu( "File" );


        // The JMenuItem that will load the IFS description


        JMenuItem loadOurIFS = new JMenuItem( "Load IFS description" );

        loadOurIFS.addActionListener( new ActionListener()

                                {

            public void actionPerformed(ActionEvent event)

            {

                loadTheImage();
    }
} );

fileMenu.add( loadOurIFS );

// The JMenuItem that will configure the image

JMenuItem configureOurIFS = new JMenuItem( "Configure image" );
configureOurIFS.addActionListener( new ActionListener()
                          {
    public void actionPerformed(ActionEvent event)
    {
        configureTheImage();
    }
} );

fileMenu.add( configureOurIFS );

// The JMenuItem that will display the image

JMenuItem dispOurImage = new JMenuItem( "Display IFS" );
dispOurImage.addActionListener( new ActionListener()
                          {
    public void actionPerformed(ActionEvent event)
    {
        displayTheImage();
    }
} );

fileMenu.add( dispOurImage );

// The JMenuItem that will save the image

JMenuItem saveOurImage = new JMenuItem( "Save image" );
saveOurImage.addActionListener( new ActionListener()
                           {
    public void actionPerformed(ActionEvent event)
    {
        saveTheImage();
    }
} );

fileMenu.add( saveOurImage );

//exit

JMenuItem exitItem = new JMenuItem( "Exit" );
exitItem.addActionListener( new
                           ActionListener()
                           {
```

```
    {

        public void actionPerformed(ActionEvent event)

        {

            System.exit( 0 );

        }

      }  );



      fileMenu.add ( exitItem );


      //attach menu to a menu bar


      JMenuBar menuBar = new JMenuBar();

      menuBar.add(fileMenu);

      this.setJMenuBar(menuBar);

   }


   //-----------------------------------------------------------------------------------------------
----------//


   // Method that opens the image selected by the user

   // Prompts the user for the file containing the IFS's description (JFileChooser)

   // Loads IFS description from configuration file


   private void loadTheImage()

   {
```

```
File info = null;


if (chooser.showOpenDialog(this) == JFileChooser.APPROVE_OPTION)
{
    info = chooser.getSelectedFile();
}


String line = "";


try
{
    // Takes in the IFS file and reads the lines


    BufferedReader reader = new BufferedReader(new FileReader(info));


    while( (line = reader.readLine() ) != null)
    {
        lineCounter++; // the number of lines
        linesInFile.add(line); // adds the lines read to our array list


    }


    MatrixCalculator(); // Goes to calculating the affine matrix
    reader.close();
}
```

```
        // If there is nothing in the file, Display our error message
        catch (IOException exception)
        {
            JOptionPane.showMessageDialog(ImageFrame.this, "Error loading IFS
description file", "oops!", JOptionPane.ERROR_MESSAGE );
        }
    }


    public void MatrixCalculator()
    {
        for (int m = 0; m < lineCounter; m++) // goes through the number of lines
        {
            Scanner scanner = new Scanner(linesInFile.get(m)); // gets the lines from the
File from our array list


            // Initalizes values for the 6 Inputs given
            double m00 = scanner.nextDouble();
            //System.out.println(m00);
            double m01 = scanner.nextDouble();
            //System.out.println(m01);
            double m10 = scanner.nextDouble();
            //System.out.println(m10);
            double m11 = scanner.nextDouble();
            //System.out.println(m11);
            double m02 = scanner.nextDouble();
            //System.out.println(m02);
            double m12 = scanner.nextDouble();
            //System.out.println(m12);

            // Representing the transform matrix
            AffineTransform calculateAffine = new
AffineTransform(m00,m10,m01,m11,m02,m12);
            transform.add(calculateAffine);

            // If we find lines in the file that consists of 7 numbers
            // Initialize a value for the 7th input too (the probability)

            if(scanner.hasNextDouble() == true)
            {
                seventhProbability.add(scanner.nextDouble());
                probability = true;
            }
        }
    }

    //--------------------------------- Methods that get inputs from the
user------------------------------------------//

    // Prompts the user for the desired image's width
    private int userWidth() {
        int promptWidth = 0;
        try {
            String prompt = JOptionPane.showInputDialog("Please input the desired image
width you would like");
            promptWidth = Integer.parseInt(prompt);
        }
        catch(NumberFormatException e) {
            JOptionPane.showMessageDialog(this, "Error, please input the desired image
width you would like");
            String prompt = JOptionPane.showInputDialog("Please enter the desired image
width");
            promptWidth = Integer.parseInt(prompt);
        }
        return promptWidth;
    }


    // Prompts the user for the desired image's height
    private int userHeight() {
        int promptHeight = 0;
        try {
            String prompt = JOptionPane.showInputDialog("Please input the desired image
height you would like");
            promptHeight = Integer.parseInt(prompt);
        }
        catch(NumberFormatException e) {
            JOptionPane.showMessageDialog(this, "Error, please input the desired image
height you would like");
```

```
            String prompt = JOptionPane.showInputDialog("Please enter the desired image
height");

            promptHeight = Integer.parseInt(prompt);

        }

        return promptHeight;

    }



    // Prompts the user for the desired number of generations

    private int userGenerations() {

        int promptGenerations = 0;

        try {

            String prompt = JOptionPane.showInputDialog("Please input the desired
number of generations you would like");

            promptGenerations = Integer.parseInt(prompt);

        }

        catch(NumberFormatException e) {

            JOptionPane.showMessageDialog(this, "Error, please input the desired number
of generations you would like ");

            String prompt = JOptionPane.showInputDialog("Please enter the desired
number of generations");

            promptGenerations = Integer.parseInt(prompt);

        }

        return promptGenerations;

    }



    //----------------------------------------------------------------------------------------------
---------------//
```

```
    // Calls the methods that prompt the user for the desired image's width and height

    // Prompts the user for the desired image's background & foreground colors as
hexadecimal colors

    // Creates a buffered image


    public void configureTheImage()

    {

        // Calls the methods that prompt for the user's desired width and height

        this.width = userWidth();

        this.height = userHeight();


        // Allows the user to enter a desired background and foreground colors

        backgroundColor = (String)JOptionPane.showInputDialog("Enter the desired
background color; Ex. FF2200");

        foregroundColor = (String)JOptionPane.showInputDialog("Enter the desired
foreground color; Ex. FFFFFF");


        // Converts the Colors & parsing

        newBackgroundColor = (int)Long.parseLong( backgroundColor.substring( 0,
backgroundColor.length() ), 16 );

        newForegroundColor = (int)Long.parseLong( foregroundColor.substring( 0,
foregroundColor.length() ), 16 );

        newBackgroundColor = newBackgroundColor | 0xFF000000;

        newForegroundColor = newForegroundColor | 0xFF000000;


        // Creates a new Buffered Image
        image = new BufferedImage(width, height, image.TYPE_INT_ARGB);
        g2d = (Graphics2D) image.createGraphics();

        // Sets the Background and the foreground colors
        Color color = new Color(newBackgroundColor);
        g2d.setColor(color);
        g2d.fill(new Rectangle(0,0,width,height));
        Color secondColor = new Color(newForegroundColor);
        g2d.setColor(secondColor);

    }

    // Displays the Image after Configuration
    // Prompts the user for the number of generations, n
    // Generates the n-th generation image

    public void displayTheImage()
    {
        // Calls the method that prompt for the user's desired number of generations
        int numOfGenerations = userGenerations();

        // Calls the methods that prompt for the user's desired width and height
        //this.width = userWidth();
        //this.height = userHeight();
```

```
        // Gets the inital x and y positions

        x = 0.555;

        y = 0.555;


        firstPoint = new Point2D.Double(x,y);

        secondPoint = new Point2D.Double(x,y);


        // If we weren't given the probability (the 7th input) , we calculate the
probability using the determinant

        // The absolute value of each matrix's determinant and then dividing each by
the sum of all the determinants


        if(probability == false)

        {

            // Calls the determinant calculator method

            getDeterminant();

            for( int i = 0; i < lineCounter; i++)

            {

                seventhProbability.add(determinantArray.get(i)/sumOfDeterminants);

            }

        }


        // For the user's desired number of generations, implement the image
transformation


        for ( int i = 0; i < numOfGenerations; i++)
        {
            transformTheImage();

            // Makes sure y is in the correct direction by flipping the image

            theNewImage = new BufferedImage(width, height, 
theNewImage.TYPE_INT_ARGB);
            for (int k = 0; k < width; k++)
            {
                for (int j = 0; j < height; j++)
                {
                    theNewImage.setRGB( k, j, image.getRGB ( k , height - j - 1));

                }
            }
        }

        displayBufferedImage(theNewImage);

    }

    // Determinant Calculator
    public void getDeterminant()
    {
        for (int i = 0; i < lineCounter; i++)
        {
            if((transform.get(i).getDeterminant()) > 0)
            {
                determinantArray.add(transform.get(i).getDeterminant());
                sumOfDeterminants += transform.get(i).getDeterminant();
            }
            else
            {
                // If the values of the determinant are zero
                determinantArray.add(0.01);
                sumOfDeterminants += .01;
            }
        }
    }

    // Transforms the Image
    public void transformTheImage()
    {
        double random = Math.random();
        double previous = 0;
        for (int i = 0; i < lineCounter; i++)
        {
            double store = seventhProbability.get(i);
            // checks if random value is in range of the probability
            if (random <= store + previous)
            {
                AffineTransform newMatrix = transform.get(i);


                newMatrix.transform(firstPoint, secondPoint);


                if((secondPoint.getX()) <=1 && secondPoint.getY() <= 1 &&
    (secondPoint.getY()) >= 0 && (secondPoint.getX()) >= 0)
                {
                    // //set pixel if in bounds
                    image.setRGB((int)(secondPoint.getX()*this.width),(int)
    (secondPoint.getY()*this.height),newForegroundColor);
                }
                firstPoint = secondPoint;
                break;
            }


            previous += store;
        }
    }


    //displays our end BufferedImage


    public void displayBufferedImage( BufferedImage image )
    {


        //this.setContentPane( new JScrollPane(new JLabel(new ImageIcon (image) ) ) );
```

```
        //this.validate();
        ImageIcon icon = new ImageIcon();
        JLabel label = new JLabel(icon);
        icon.setImage( image );
        label.repaint();
        this.setContentPane(label);
        validate();


    }


    // Saves the Image


    public void saveTheImage()
    {
        // Prompts the user to enter a desired file name


        String savingFileName = (String)JOptionPane.showInputDialog("Enter the desired
name for the PNG file you'd like to save");


        // Saves the file as a png (portable network graphics)
        savingFileName += ".png";


        File outputFile = new File(savingFileName);
        try
        {
            javax.imageio.ImageIO.write( theNewImage, "png", outputFile );
        }
        catch ( IOException e )
        {
            JOptionPane.showMessageDialog( ImageFrame.this,
                                           "Error saving file",
                                           "oops!",
                                           JOptionPane.ERROR_MESSAGE );
        }
    }


}
```