Ryan Reynolds

2693018

CIS 457

Homework 3

Question 1: What are the main four rules used by Sutherland-Hogman polygon clipping algorithm?

Vector Edge SP has both start point, S, and end point, P, inside the clipping square. Output vector P

Vector edge SP has start point S inside and end point, P, outside the clipping square. Output S' where S is the start point and the end point of is the intersection of SP and the clipping square.

Vector edge SP has both start point, S, and end point, P, outside of the clipping square. Output nothing (ie vector is clipped)

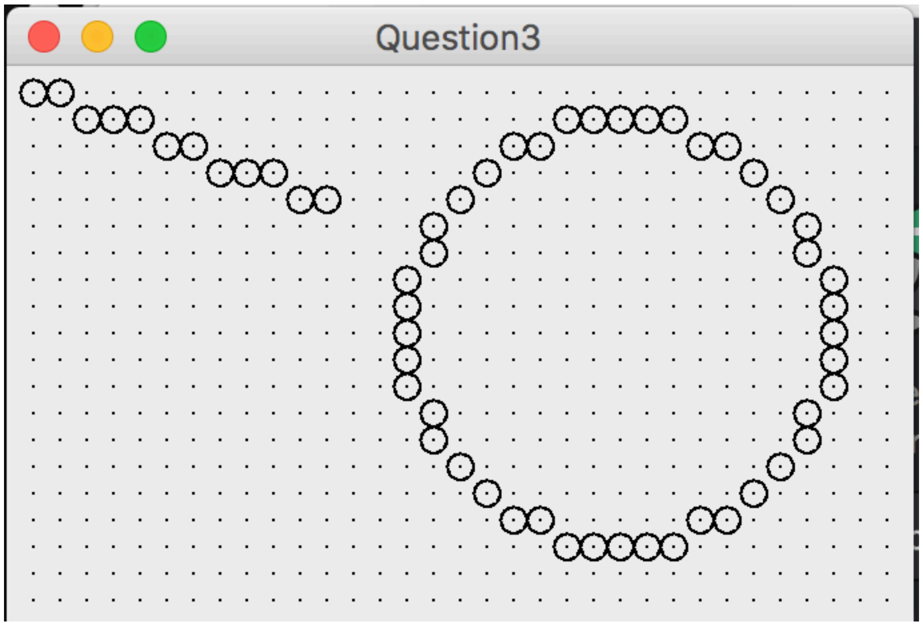
Vector Edge SP has start point, S, outside and end point, P, inside the clipping square. Output vector S'P where S' is the start point representing the intersection of SP with the the edge of the clipping square.

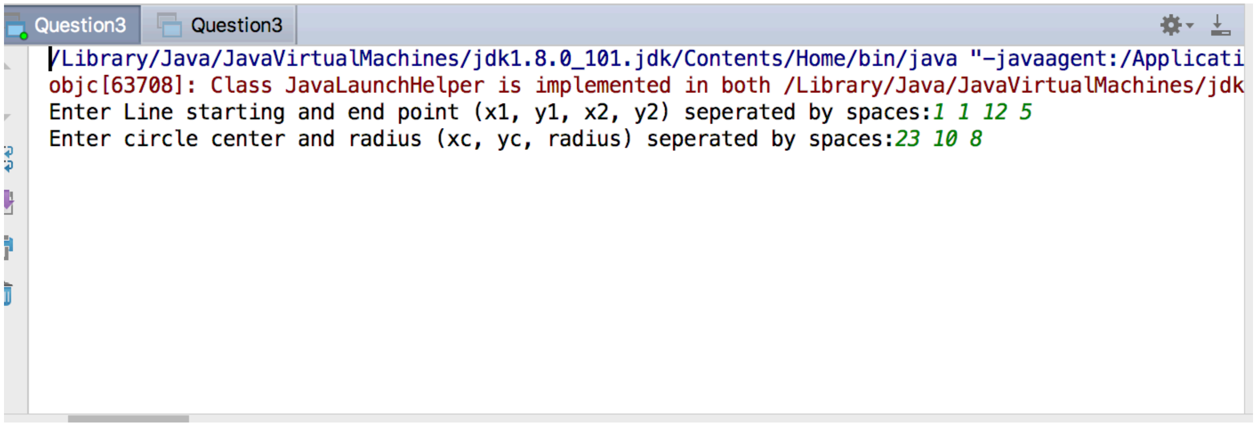
Question 2: What are the main difference between Beizer and B-Spline curves?

A Bezier curve is formed using four points,2 end points and 2 control points. Points one and two represent the end points and points zero and three represent the start and end points of the curve that is formed within the space inside the polygon formed by *P0P1P2P3P4.* B-Spline on the other hand draws a curve segment between point P(n-1) and Pn for all values greater 3. Essentially Beizer curves are defined by a particular polynomial. A B-spline is defined by piece wise polynomials. Each curve of a B-spline represents a Beizer curve.

Question 3:

Output:





```
/Library/Java/JavaVirtualMachines/jdk1.8.0_101.jdk/Contents/Home/bin/java "-javaagent:/Applicati
objc[63708]: Class JavaLaunchHelper is implemented in both /Library/Java/JavaVirtualMachines/jdk
Enter Line starting and end point (x1, y1, x2, y2) seperated by spaces:1 1 12 5
Enter circle center and radius (xc, yc, radius) seperated by spaces:23 10 8
```

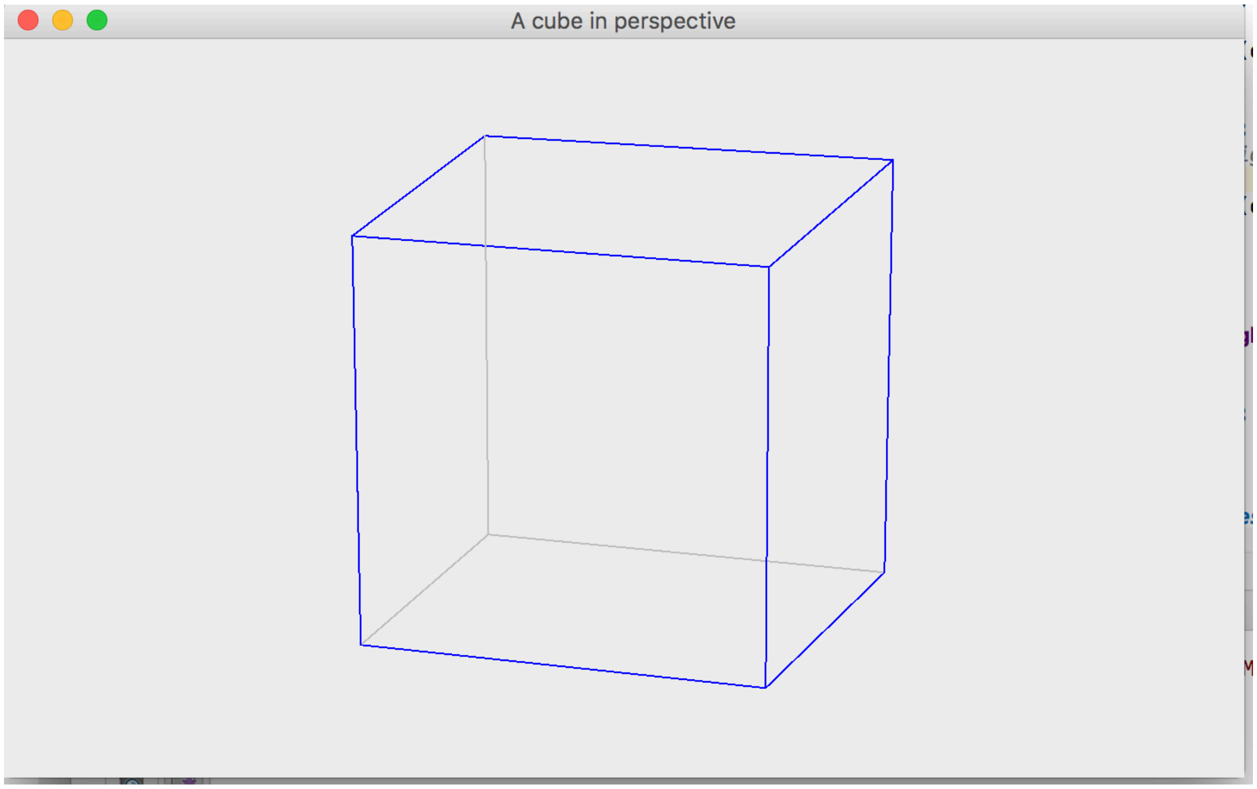
Source:

```java
import javax.management.loading.MLet;
import java.awt.*;
import java.awt.event.*;
import java.util.*;
public class Question3 extends Frame {
    public static void main(String[] args) {
        new Question3();
    }

    Question3() {
        super("Question3");
        addWindowListener(new WindowAdapter() {
            public void windowClosing(WindowEvent e) {
                System.exit(0);
            }
        });
        setSize(340, 230);
        add("Center", new CvQuestion3());
        show();
    }
```

```java
}
    class CvQuestion3 extends Canvas {
        float rWidth = 10.F, rHeight = 7.5F, pixelSize;
        int centerX, centerY, dGrid = 10, maxX, maxY;

        void initgr() {
            Dimension d;
            d = getSize();
            maxX = d.width - 1;
            maxY = d.height - 1;
            pixelSize = Math.max(rWidth / maxX, rHeight / maxY);
            centerX = maxX / 2;
            centerY = maxY / 2;
        }

        int iX(float x) {
            return Math.round(centerX + x / pixelSize);
        }

        int iY(float y) {
            return Math.round(centerY - y / pixelSize);
        }

        void putPixel(Graphics g, int x, int y) {
            int x1 = x * dGrid, y1 = y * dGrid, h = dGrid / 2;
            g.drawOval(x1 - h, y1 - h, dGrid, dGrid);
        }

        void drawLine(Graphics g, int xP, int yP, int xQ, int yQ) {
            int x = xP, y = yP, D = 0, HX = xQ - xP, HY = yQ - yP, c, M, xInc = 1,
yInc = 1;
            if (HX < 0) {
                xInc = -1;
                HX = -HX;
            }
            if (HY < 0) {
                yInc = -1;
                HY = -HY;
            }
            if (HY <= HX) {
                c = 2 * HX;
                M = 2 * HY;
                for (; ; ) {
                    putPixel(g, x, y);
                    if (x == xQ) break;
                    x += xInc;
                    D += M;
                    if (D > HX) {
                        y += yInc;
                        D -= c;
                    }
                }
            }
            else {
                c = 2 * HX;
                M = 2 * HY;
                for (; ; ) {
                    putPixel(g, x, y);
                    if (y == yQ) break;
                    y += yInc;
                    D += M;
                    if (D > HY) {
                        x+= xInc;
                        D -= c;
                    }
                }
            }

        }

        void drawCircle(Graphics g, int xC, int yC, int r) {
            int x = 0, y = r, u = 1, v = 2 * r - 1, E = 0;
            while (x < y) {

                putPixel(g, xC + x, yC + y);
                putPixel(g, xC + y, yC - x);
                putPixel(g, xC - x, yC - y);
                putPixel(g, xC - y, yC + x);
                x++;
                E += u;
                u += 2;
                if (v < 2 * E) {
                    y--;
                    E -= v;
                    v -= 2;
                }
                if (x > v) break;
                putPixel(g, xC + y, yC + x);
                putPixel(g, xC + x, yC - y);
                putPixel(g, xC - y, yC - x);
                putPixel(g, xC - x, yC + y);
            }
        }

        void showGrid(Graphics g) {
            for (int x = dGrid; x <= maxX; x += dGrid) {
                for (int y = dGrid; y <= maxY; y += dGrid) {
                    g.drawLine(x, y, x, y);
                }
            }
        }

        public void paint(Graphics g) {
            initgr();
            int x1, y1, x2, y2, xc, yc, r;
            System.out.print("Enter Line starting and end point (x1, y1, x2, y2)
seperated by spaces:");
            Scanner input= new Scanner(System.in);
            x1=input.nextInt();
            y1=input.nextInt();
            x2=input.nextInt();
            y2=input.nextInt();
            System.out.print("Enter circle center and radius (xc, yc, radius)
seperated by spaces:");
            xc=input.nextInt();
            yc=input.nextInt();
            r=input.nextInt();

            showGrid(g);
            drawLine(g, x1, y1, x2, y2);
            drawCircle(g, xc, yc, r);
        }
    }
```

Question 4:

Output:



Source Code:

```
// CubePers.java: A cube in perspective.

// Copied from Section 5.4 of
//    Ammeraal, L. and K. Zhang (2007). Computer Graphics for Java Programmers, 2nd Edition,
//       Chichester: John Wiley.

// Uses: Point2D (Section 1.5), Point3D (Section 3.9).

import javafx.geometry.Point3D;

import java.awt.*;
import java.awt.event.*;


public class CubePers extends Frame {
    public static void main(String[] args) {new CubePers();}

    CubePers() {
        super("A cube in perspective");
        addWindowListener(new WindowAdapter() {
            public void windowClosing(WindowEvent e) {System.exit(0);}
        });
        setLayout(new BorderLayout());
        add("Center", new CvCubePers());
        Dimension dim = getToolkit().getScreenSize();
        setSize(dim.width / 2, dim.height / 2);
        setLocation(dim.width / 4, dim.height / 4);
        setVisible(true);
    }
}

class CvCubePers extends Canvas {
    int centerX, centerY;
    Obj obj = new Obj();

    int iX(float x) {
        return Math.round(centerX + x);
    }

    int iY(float y) {
        return Math.round(centerY - y);
    }

    void line(Graphics g, int i, int j) {
        Point2D p = obj.vScr[i], q = obj.vScr[j];
        g.setColor(Color.BLUE);
        g.drawLine(iX(p.x), iY(p.y), iX(q.x), iY(q.y));
    }
    void line2(Graphics g, int i, int j){
        Point2D p = obj.vScr[i], q = obj.vScr[j];
        //set the stroke of the copy, not the original
        g.setColor(Color.LIGHT_GRAY);
        g.drawLine(iX(p.x), iY(p.y), iX(q.x), iY(q.y));

    }
    public void paint(Graphics g) {
        Dimension dim = getSize();
        int maxX = dim.width - 1, maxY = dim.height - 1,
                minMaxXY = Math.min(maxX, maxY);
        centerX = maxX / 2; centerY = maxY / 2;
        obj.d = obj.rho * minMaxXY / obj.objSize;
        obj.eyeAndScreen();
        // Horizontal edges at the bottom:
        line(g, 0, 1);
        //TODO, draw the line for 3 other vertices
        line2(g,0,3 );
        line(g, 1,2);
        line2(g,2, 3);

        // Horizontal edges at the top:
        line(g, 4, 5);
        //TODO, draw the line for 3 other vertices
        line(g, 4,7);
        line(g,5,6);
        line(g, 6,7);


        // Vertical edges:
        line(g, 0, 4);
        //TODO, draw the line for 3 other vertices
        line(g,6,2);
        line2(g, 7,3);
        line(g, 5,1);
    }
}

class Obj { // Contains 3D object data
    float rho, theta = 0.3F, phi = 1.3F, d, objSize,
            v11, v12, v13, v21, v22, v23, v32, v33, v43;
    // Elements of viewing matrix V
    Point3D[] w;    // World coordinates
    Point2D[] vScr; // Screen coordinates

    Obj() {
        w = new Point3D[8];
        vScr = new Point2D[8];
        // Bottom surface:
        w[0] = new Point3D(1, -1, -1);

        //TODO
        // Write 3D coordinates of vertices w1, w2, w3
        w[1]= new Point3D(1,1,-1);
        w[2]= new Point3D(-1,1,-1);
        w[3]= new Point3D(-1,-1,-1);

        // Top surface:
        w[4] = new Point3D(1, -1, 1);
        // Write 3D coordinates of vertices w5, w6, w7
        w[5]= new Point3D(1,1,1);
        w[6]= new Point3D(-1,1,1);
        w[7]= new Point3D(-1,-1,1);


        objSize = (float) Math.sqrt(12F);
        // = sqrt(2 * 2 + 2 * 2 + 2 * 2)
        // = distance between two opposite vertices.
        rho = 5 * objSize; // For reasonable perspective effect
    }

    void initPersp() {
        float costh = (float) Math.cos(theta),
                sinth = (float) Math.sin(theta),
                cosph = (float) Math.cos(phi),
                sinph = (float) Math.sin(phi);
        v11 = -sinth;
        v12=-(cosph*costh);
        v13=sinph*sinth;
        v21=costh;
        v22=-(cosph*sinth);
        v23=sinph*sinth;
        v32=sinph;
        v33=cosph;
        v43=-rho;




        //TODO, calculate other elements of viewing matrix

    }

    void eyeAndScreen() {
        initPersp();
        for (int i = 0; i < 8; i++) {
            Point3D p = w[i];

            float x = v11 * (float) p.getX() + v21 * (float)p.getY(),
                    y= v12*(float)p.getX()+v22*(float)p.getY()+v32*(float)p.getZ(),
                    z=v13*(float)p.getX()+v23*(float)p.getY()+v33*(float)p.getZ()+v43;

            //TODO, write for y and z

            vScr[i] = new Point2D(-d * x / z, -d * y / z);
        }
    }

}
// Point2D.java: Class for points in logical coordinates.

// Copied from Section 1.5 of
//    Ammeraal, L. and K. Zhang (2007). Computer Graphics for Java Programmers, 2nd Edition,
//       Chichester: John Wiley.
```

```
class Point2D {
    float x, y;
    Point2D(float x, float y) {this.x = x; this.y = y;}
}
```