



Inter American University of Puerto Rico
Bayamon Campus
School of Engineering
Electrical and Computer Engineering Department

**COEN 2310- Discrete Mathematics for Computer
Engineering**

Homework Report N°: Final Project InterCovid

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Name of homework: Proyecto Final

Percent of task complete: 88%

Date: Mayo 12, 2021

Introduction

In this Proyecto is about an intercovid the files must calculated apply in class which is the distance, update, initialize and accuracy. The algorithm will apply each step that professor choose the students which were going to use for example: I was pick using formula Manhattan, initial first elements and average update. This code of my theoretical will use Java programming to use this project. This project has 3 data in files to apply the project. This project will include graph in java using JFrame (GUI) that apply library like arraylist and hashmap.

Program

a) The program I test is using a loop files to read all elements using array list and HashMap. The run program will use class named K_cluster the output will show 3 different consoles is the average, distance, initialize value and accuracy. In this output only show distance Manhattan in class manhattan, average update, initialize first elements and accuracy I include graph based the project that must do the 3 data. The graph class will use a frame will include library class of hashmap and list array will use in padding the coordinate score that read the file that has to do in data 1 to 3.

Data1 results

```
Iterations: 100
Count of Clusters (groups): 3
Distance: 50.0
Accuracy: 1.3333333333333335%
Press 1 if you want to continue or press 0 to exit.....
```

El input the program will ask this question:

1. "Enter the filename with path."

Data1.txt (and hit enter)

2. "Enter the no. of cluster (group"

3 (hit enter)'

3. "Enter the maximum iteration."

100 (or 10,000 hit enter)

This dark letter is the input that need to write to read the file data one and compile feature 1 to 4 and final cluster.

Data2 results

```
Iterations: 100
Count of Clusters (groups): 3
Distance: 29.0
Accuracy: 52.24719101123596%
Press 1 if you want to continue or press 0 to exit.....
```

El input the program will ask this question:

1. "Enter the filename with path."

Data2.txt (and hit enter)

2. "Enter the no. of cluster (group"

3 (hit enter because is 3 group in last column)

3. "Enter the maximum iteration."

100 (or 10,000 hit enter)

This dark letter is the input that need to write to read the file data one and compile feature 1 to 4 and final cluster.

Data3 results

```
Iterations: 100  
Count of Clusters (groups): 2  
Distance: 5136.0  
Accuracy: 7.6%  
Press 1 if you want to continue or press 0 to exit.....
```

El input the program will ask this question:

1. "Enter the filename with path."

Data3.txt (and hit enter)

2. "Enter the no. of cluster (group"

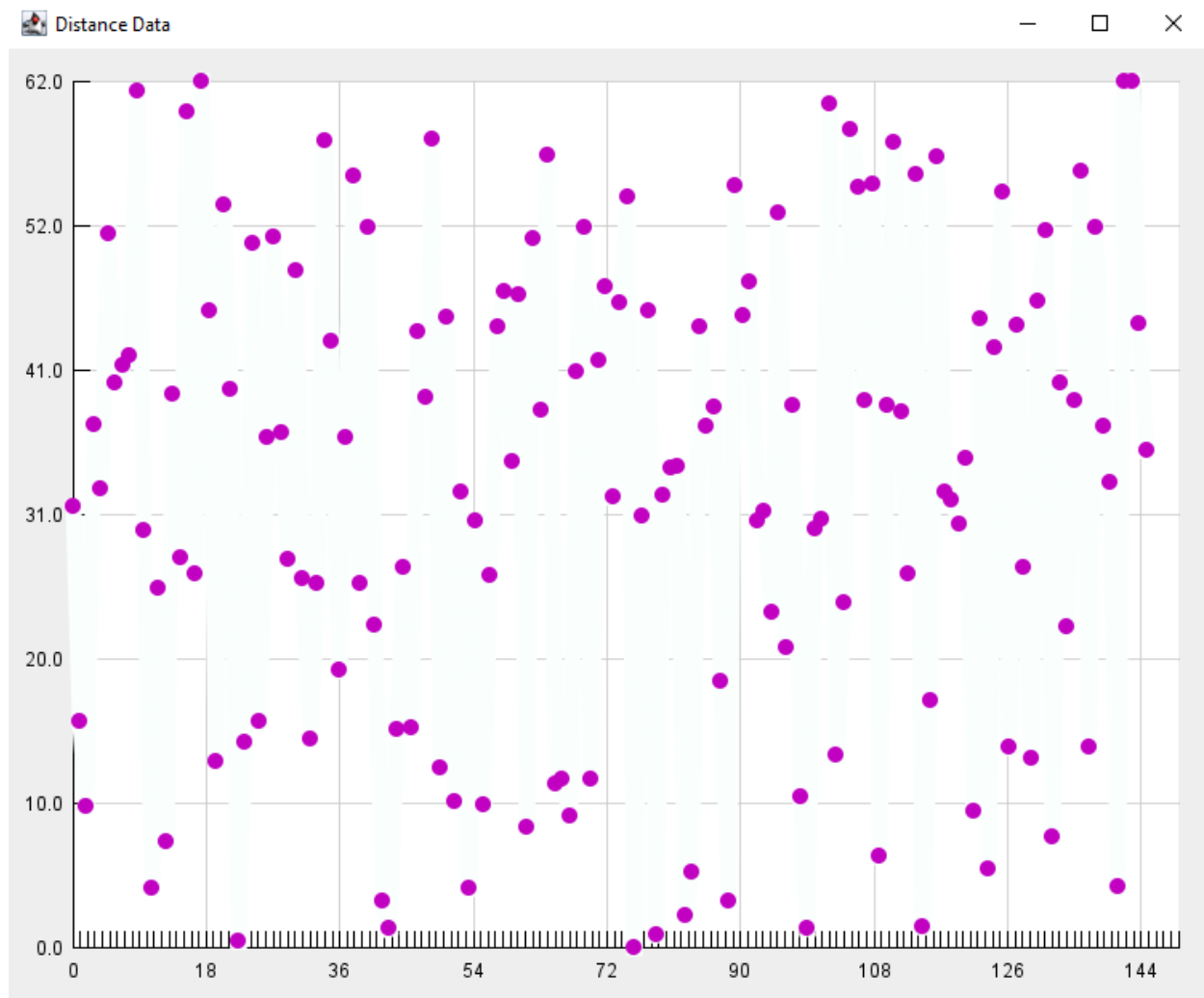
2 (this cluster contains only 2 groups only and hit enter).

3. "Enter the maximum iteration."

100 (or 10,000 hits enter **Note:** 10,000 will take 13 seconds to read all files in data 3 if you enter 10,000 iterations).

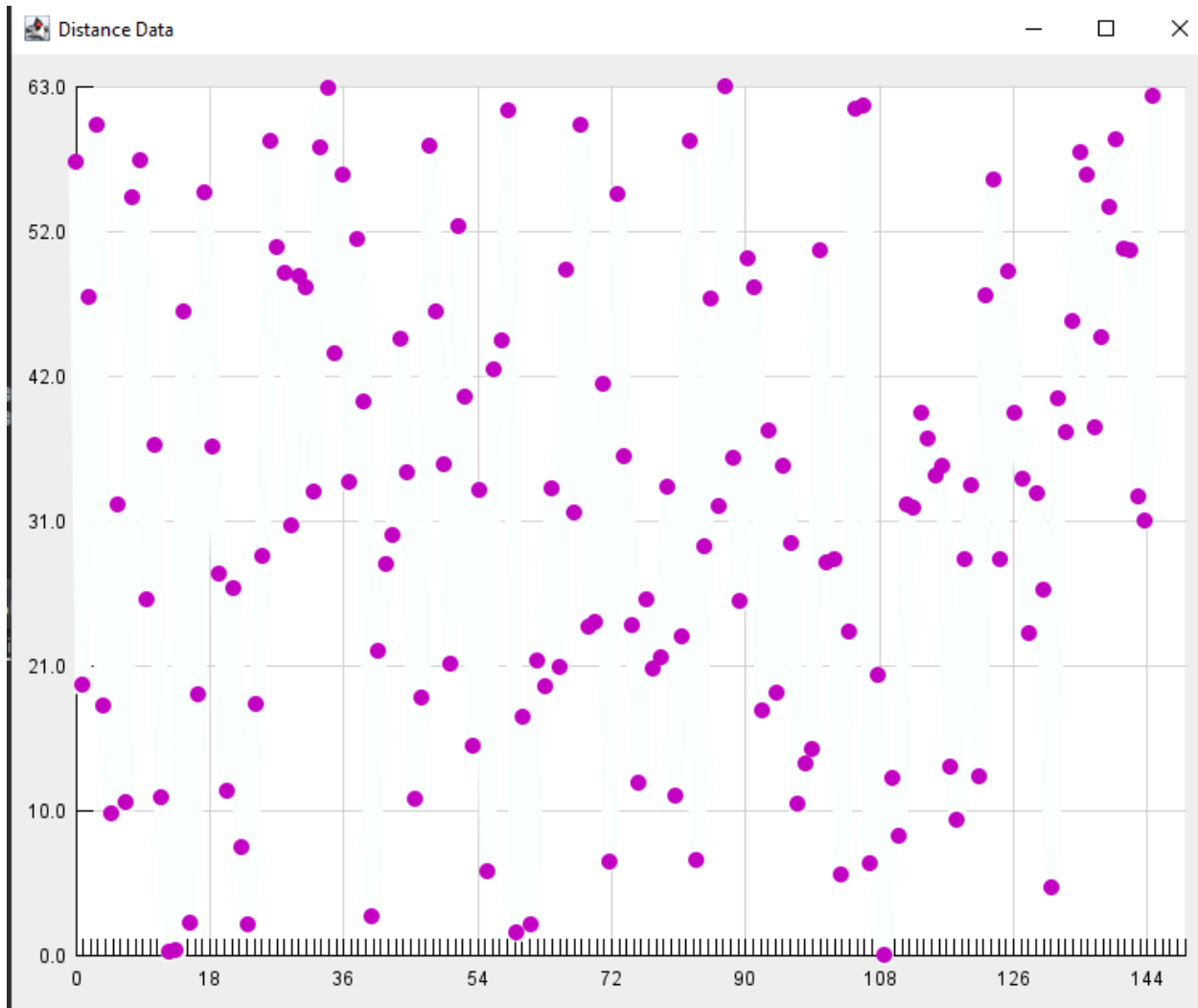
This dark letter is the input that need to write to read the file data one and compile feature 1 to 4 and final cluster.

Data1 graph



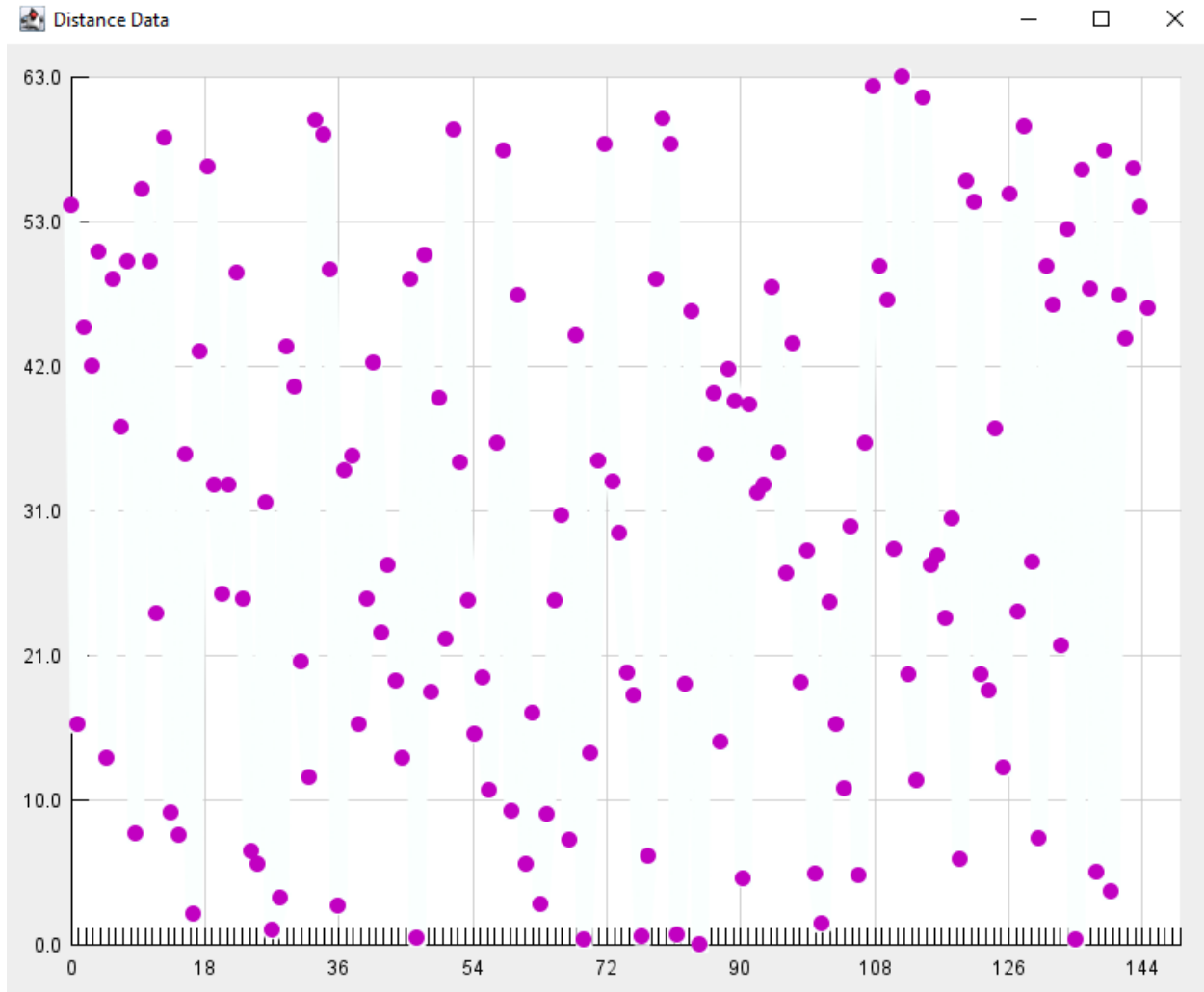
This graph works in line 191 where the main method is, I forgot to put the input the file for graph. The new file Reader are in parenthesis we put "Data1.txt" to output the graph with coordinates based the file read the panel.

Data2 graph



This graph works in line 191 where the main method is, I forgot to put the input the file for graph. The new file Reader are in parenthesis we put "Data2.txt" to output the graph with coordinates based the file read the panel. The graph is different than Data1.txt

Data3



This graph works in line 191 where the main method is, I forgot to put the input the file for graph. The new file Reader are in parenthesis we put “Data3.txt” to output the graph with coordinates based the file read the panel. The graph is different than Data2.txt and Data1.txt.

c) Using a table, list all the created functions. The columns of the table will be name, description, input, output of the function.

1. distance manhattan (minimal)

$$g_1 = |6 - 5.6| + |-0.4 - 0.8|$$

≈ 17.5 distancia mínima

g_1	$6, 5.6 - 0.4, 0.8$
g_2	$3, 4, 8, 7$

2. Element first initialize (center group)

Data:

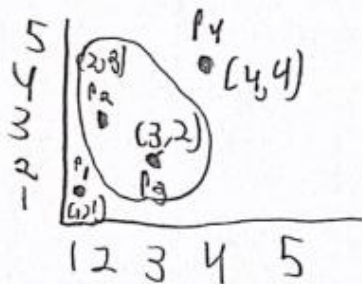
f_1	f_2
8	2
9	8
10	9

9, 8 center groups

3. Update center (average)

$$g_1 = \frac{2+3}{2} = 2.5$$

$$g_2 = \frac{3+2}{2} = 2.5$$



Ends iterator 100 or 10,000

4. Accuracy

$$\text{Accuracy} = \frac{2}{4} \times 100\% = 50\%$$

lines	data read	final cluster
f_1	1	1
f_2	1	0
f_3	2	1
f_4	2	2

Result

a) Table 2: results.

Data1

Distance	50
Updating	N/A
Initialize	5.1, 3.5, 1.4, 0.2 ,1.0

Data2

Distance	3.8
Updating	N/A
Initialize	14.23, 1.71, 2.43, 15.6, 127.0

Data3

Distance	3.8
Updating	N/A
Initialize	5.1, 3.5, 1.4, 0.2 ,1.0

Name files	K	Accuracy
Data1	3	1.33%
Data2	3	52.24%
Data3	2	7.6%

b) The result of this table I think the data 2 us better because the accuracy is higher than data 3 and 1. The accuracy of data 2 is 50% which the theoretical good for solve the groups of cases the Inter covid.

Complexity of time (Big O)

(Find worst case possible)

K_cluster (main)

```
1 package projectFinal;
2 import java.io.IOException;
3
4
5 //class with inheritance readdataset class
6 public class K_Clusterer extends ReadDataset {
7
8
9 //main method
10 public static void main(String args[]) throws IOException {
11
12     //file
13     ReadDataset r1 = new ReadDataset(); +1
14     r1.features.clear();
15     //input scanner
16     Scanner sc = new Scanner(System.in); +1
17     //name file
18     System.out.println("Enter the filename with path");
19     String file = sc.next(); +1
20     r1.read(file); //load data +1
21     int ex = 1; +1
22
23     //creating do while
24     do{
25         //input cluster (group)
26         System.out.println("Enter the no. of clusters (group)");
27         int group = sc.nextInt(); +1
28
29         System.out.println("Enter maximum iterations");
30         int max_iterations = sc.nextInt(); +1
31
32         //HashMap to store center to calculate average
33         Map<Integer, double[]> center = new HashMap<>();
34         // calculating initial centroids
35         double[] x1 = new double[numberOfFeatures];
36         int r = 0; +1
37         for (int i = 0 ; i < group; i++) {
38             x1 = r1.features.get(r ++);
39             center.put(i, x1);
40
41         }
42
43         //HashMap for finding cluster indexes using hashmap
44         Map<double[], Integer> clusters = new HashMap<>(); +1
45
46         clusters = kmeans(r1.features, center, group); +1
47         // initial cluster print
48         double db[] = new double[numberOfFeatures]; +1
49
50         //reassigning to new clusters (group) using nested loop
51         for (int i = 0 ; i < max_iterations; i++) {
52             for (int j = 0 ; j < group; j++) {
53                 //arraylist library
54                 List<double[]> list = new ArrayList<>();
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```

clusters

```

36     for (int j = 0 ; j < group; j++) {
37
38         //arraylist library
39         List<double[]> list = new ArrayList<>(); f1
40         //another loop with
41         for (double[] key : clusters.keySet()) {
42             if (clusters.get(key) == j) {
43                 list.add(key);
44             }
45         }
46         //end for loop cluster
47
48         //calculator average in center update
49         db = centerCalculator(list);
50         center.put(j, db);
51     }
52     //clear cluster to clean output
53     clusters.clear();
54     //
55     clusters = kmeans(r1.features, center, group);
56
57     } //end loop iteration
58
59     //final cluster print line (optional for purpose check)
60     System.out.println("\nFinal Clustering of Data file");
61     System.out.println("Feature1\tFeature2\tFeature3\tFeature4\tCluster");
62
63     //using nested for loop cluster key set
64     for (double[] key : clusters.keySet()) {
65         for (int i = 0; i < key.length; i++) {
66             System.out.print(key[i] + "\t");
67         }
68         System.out.print(clusters.get(key) + "\n");
69     }
70
71     //calculate Accuracy
72     int accrate = 0 , total = 0;
73     for (double[] key : clusters.keySet()) {
74         if (clusters.get(key) + 1 == r1.getLabel().get(key)) {
75             //increment accuraccy
76             accrate ++;
77         }
78         //increment
79         total++;
80     }
81     //accuracy operator calculator
82     double accuracy = (double)accrate / (double)total * 100;
83
84     //end accuracy
85
86     //Calculate manhattan distance
87     double distance = 0;
88
89     for(int i = 0 ; i < group ; i++){

```

Handwritten notes and annotations:

- Next to line 39: $f1$
- Next to line 41: $n+1$
- Next to line 64: $n \times n = n^2$
- Next to line 74: $n+2$
- Next to line 82: $+1$
- Next to line 87: $+1$

13

```

for(int i = 0 ; i < group ; i++){
    double sse = 0;
    for (double[] key : clusters.keySet()) {
        if (clusters.get(key)==1) {
            Distance.manhattanDistance(key, center.get(i));
            //increment sse
            sse++;
        }
        //distance assign sse
        distance = sse;
    }
}
//end manhattan distance

//print final results iteration, groups, distance and accuracy
System.out.println("Iterations: " + max_iterations);
System.out.println("Count of Clusters (groups): " + group);
System.out.println("Distance: " + distance);

System.out.println("Accuracy: " + accuracy + "%");
//print of sentinel zero
System.out.println("Press 1 if you want to continue or press 0 to exit.....");

//input the counter sentinel
ex=sc.nextInt();
} while(ex==1); //while loop ends the do while
}

//method to calculate average to update the cluster
public static double[] centerCalculator(List<double[]> a) {
    //variables of two int and double
    int count = 0;
    double sum=0.0;

    double[] average = new double[ReadDataset.numberOfFeatures];
    for (int i = 0; i < ReadDataset.numberOfFeatures; i++) {
        sum=0.0;
        count = 0;
        //single for loop assign a method variables
        for(double[] x:a){
            count++;
            //math operator average
            sum = sum + x[i];
        }

        average[i] = sum / count;
        //System.out.println("average: " + average);
    }
    return average;
}

//method for putting features to clusters and reassignment of clusters with hashmap, list to assign d

```

$$n \times n = n^2 + 2$$

$$n \times n + 4 = n^2 + 4$$

//method for putting features to clusters and reassignment of clusters with hashmap, list to assign distance minimum

```
public static Map<double[], Integer> kmeans(List<double[]> features, Map<Integer, double[]> centroids, int k) {
```

```
    //create hashmap for cluster
```

```
    Map<double[], Integer> clusters = new HashMap<>();
```

```
    int k1 = 0;
```

```
    double dist=0.0;
```

```
    //nested for loop
```

```
    for( double[] x : features) {  
        double minimum = 999999.0;  
        for (int j = 0 ; j < k ; j ++)
```

```
            //declaring distance minimum
```

```
            dist = Distance.manhattanDistance(centroids.get(j), x);
```

```
            //distance if statements minimum distance
```

```
            if (dist < minimum) {
```

```
                //assign equal minimum to distance
```

```
                minimum = dist;
```

```
                //assign k1 to j colms
```

```
                k1 = j;
```

```
            }
```

```
        }  
        clusters.put(x, k1);
```

```
    }
```

```
    //System.out.println("Distance: " + dist);
```

```
    return clusters;
```

```
} //end method
```

```
nd program
```

$$1) f(n) = 5n^2 + 4n + 37$$

$$f(n) \in O(n^2)$$

$$n \times n + 2 = n^2 + 2$$

Datareadset.java

```
1 package projectFinal;
2
3 import java.io.*;
4
5
6 public class ReadDataset {
7
8     //create protected for inheritance
9     protected List<double[]> features = new ArrayList<>();
10    protected Map<double[], Integer> label = new HashMap<>();
11    //variable using protect with static for center number
12    protected static int numberOfFeatures;
13    private BufferedReader readFile;
14
15    //create method list library feature
16    public List<double[]> getFeatures()
17    {
18        return features;
19    }
20
21    //create map of labels
22    public Map<double[], Integer> getLabel()
23    {
24        return label;
25    }
26
27    //void method read file
28    void read(String s) throws NumberFormatException, IOException {
29
30        File file = new File(s);
31
32        //try catch file read
33        try {
34            readFile = new BufferedReader(new FileReader(file));
35            String line;
36
37            //read file using while loop
38            while((line = readFile.readLine()) != null)
39            {
40
41                String[] split = line.split(",");
42                double[] feature = new double[split.length - 1];
43
44                //number feature of loops will include -1
45                numberOfFeatures = split.length - 1;
46
47                //for loop for split elements
48                for (int i = 0; i < split.length - 1; i++)
49
50                    feature[i] = Double.parseDouble(split[i]);
51                features.add(feature);
52                String labels = split[feature.length];
53                label.put(feature, Integer.parseInt(labels));
54            }
55        }
56        //catch error exception for files
57        catch (FileNotFoundException e) {
58            // TODO Auto-generated catch block
59            e.printStackTrace();
60        }
61    }
62 }
```

+ |
+ |
+ | + C
+ |

} n + 3

```

: //catch error exception for files
: catch (FileNotFoundException e) {
:     // TODO Auto-generated catch block
:     e.printStackTrace();
: }
:
: } //end void method
:
: //disokay for iterator
: void display(){
:     Iterator<double[]> itr = features.iterator(); +1
:
:     while(itr.hasNext()) {
:         //iterate variable with single array
:         double db[] = itr.next();
:         //while loop next the 4 x element axis.
:         for(int i = 0 ; i < 4 ; i++){
:             //output the iterator
:             System.out.print(db[i] + " ");
:         }
:     }
:
: } //end void method display
: } //end program

```

$$n \times n = n^2 + 2$$

$$f(n) = 2n^2 + 12 + 0$$

$$f(n) \in O(n^2)$$

Distance.java

Distance.java

```
@import java.io.File;

//distance class
public class Distance {

    //create static of constant method with return
    public static double manhattanDistance(double point1[], double point2[]){
        double sum = 0.0;
        for(int i = 0; i < point1.length; i++) {
            //math operator manhattan
            sum += (Math.abs(point1[i] - point2[i]));
        }
        return sum;
    }
}

//end method
//end class and program
```

$$f(n) = n + 4$$
$$f(n) \in O(n)$$

Graph (Jframe)

```

1 package projectFinal;
2
3 import java.awt.*;
4
5 //library grapg final project
6 public class GraphFinalProject extends JPanel{
7
8     //instance fields
9
10    //instance fiedls of JFrame
11    private static final long serialVersionUID = 5L;
12
13    //thew line axis x and y extend GUI aplication
14    private int labelPadding = 20;
15
16    //color line
17    private Color lineColor = new Color(250,255,254);
18
19    private Color pointColor = new Color(193,0,193 );
20
21    private Color gridColor = new Color(200, 200, 200, 200);
22
23    private static final Stroke GRAPH_STROKE = new BasicStroke(10f);
24
25    private static int pointWidth = 10;
26
27    private int numberDivisions = 6;
28    //variable coordinateds for points
29    private List<Double> coordinates;
30    //extend padd
31    private int padding = 20;
32
33    public GraphFinalProject(List<Double> scores) {
34        this.coordinates = scores;
35    }
36
37    //paint component with oververdiding method
38    protected void paintComponent(Graphics g) {
39        super.paintComponent(g);
40        Graphics2D g2 = (Graphics2D) g;
41        g2.setRenderingHint(RenderingHints.KEY_ANTIALIASING, RenderingHints.VALUE_ANTIALIAS_ON);
42
43        //create points using math operator with type casting
44        double xScale = ((double) getWidth() - (3 * padding) - labelPadding) / (coordinates.size() - 1);
45        double yScale = ((double) getHeight() - 2 * padding - labelPadding) / (getMaxScore() - getMincoordinates());
46
47        //include pad points between x axis and y axis
48        List<Point> graphPoints = new ArrayList<>();
49        for (int i = 0; i < coordinates.size(); i++) {
50            int x1 = (int) (i * xScale + padding + labelPadding);
51            int y1 = (int) ((getMaxScore() - coordinates.get(i)) * yScale + padding);
52            graphPoints.add(new Point(x1, y1));
53        }
54        //color background
55        g2.setColor(Color.WHITE);
56        //fill the rect
57        g2.fillRect(padding + labelPadding, padding, getWidth() - (2 * padding)
58            - labelPadding, getHeight() - 2 * padding - labelPadding);
59

```

7

```

1
//loop x axis , y axis
for (int i = 0; i < numberDivisions + 1; i++) {
    int x0 = padding + labelPadding;
    int x1 = pointWidth + padding + labelPadding;
    int y0 = getHeight() - ((i * (getHeight() - padding * 2 - labelPadding)) / numberDivisions + padding + labelPadding);
    //assign y1 to y0
    int y1 = y0;
    //size coordinates
    if (coordinates.size() > 0) {
        g2.setColor(gridColor);
        g2.drawLine(padding + labelPadding + 1 + pointWidth, y0, getWidth() - padding, y1);
        g2.setColor(Color.BLACK);
        String yLabel = ((int) (getMincoordinates() + (getMaxScore() - getMincoordinates()) * ((i * 8.0) / numberDivisions)) * 100) / 100.0 + "";
        //metric for lines
        FontMetrics metrics = g2.getFontMetrics();
        int labelWidth = metrics.stringWidth(yLabel);
        g2.drawString(yLabel, x0 - labelWidth - 6, y0 + (metrics.getHeight() / 2) - 3);
    }
    //line with 4 lines
    g2.drawLine(x0, y0, x1, y1);
}
//coordinates size distance
for (int i = 0; i < coordinates.size(); i++) {
    if (coordinates.size() > 1) {
        int x0 = i * (getWidth() - padding * 2 - labelPadding) / (coordinates.size() - 1) + padding + labelPadding;
        int x1 = x0;
        int y0 = getHeight() - padding - labelPadding;
        int y1 = y0 - pointWidth;
        if ((i % ((int) ((coordinates.size() / 10.0)) + 3)) == 0) {
            g2.setColor(gridColor);
            g2.drawLine(x0, getHeight() - padding - labelPadding - 1 - pointWidth, x1, padding);
            g2.setColor(Color.BLACK);
            String xLabel = i + "";
            FontMetrics metrics = g2.getFontMetrics();
            int labelWidth = metrics.stringWidth(xLabel);
            g2.drawString(xLabel, x0 - labelWidth / 2, y0 + metrics.getHeight() + 3);
        }
        g2.drawLine(x0, y0, x1, y1);
    }
}
//end loop coordinates

//creating lines
g2.drawLine(padding + labelPadding, getHeight() - padding - labelPadding, padding + labelPadding, padding);

```

n+5

n+6

```

2 //creating lines
3 g2.drawLine(padding + labelPadding, getHeight() - padding -
4 labelPadding, padding + labelPadding, padding);
5 g2.drawLine(padding + labelPadding, getHeight() - padding -
6 labelPadding, getWidth() - padding, getHeight() - padding - labelPadding);
7
8 //the line color with graph stroke (2D)
9 Stroke oldStroke = g2.getStroke(); //1
10 g2.setColor(lineColor);
11 g2.setStroke(GRAPH_STROKE);
12
13 for (int i = 0; i < graphPoints.size() - 1; i++) {
14     int x1 = graphPoints.get(i).x;
15     int y1 = graphPoints.get(i).y;
16     int x2 = graphPoints.get(i + 1).x;
17     int y2 = graphPoints.get(i + 1).y;
18     g2.drawLine(x1, y1, x2, y2);
19 }
20
21 g2.setStroke(oldStroke);
22 g2.setColor(pointColor);
23 for (int i = 0; i < graphPoints.size(); i++) {
24     int x = graphPoints.get(i).x - pointWidth / 2;
25     int y = graphPoints.get(i).y - pointWidth / 2;
26     int X1 = pointWidth;
27     int Y2 = pointWidth;
28     g2.fillOval(x, y, X1, Y2);
29 }
30
31 //min coordinates.
32 private double getMincoordinates() {
33     double minScore = Double.MAX_VALUE;
34     for (Double score : coordinates) {
35         minScore = Math.min(minScore, score);
36     }
37     return minScore;
38 }
39
40 //apply max score for prevent out of graph
41 private double getMaxScore() {
42     double maxScore = Double.MIN_VALUE; //1
43     for (Double score : coordinates) {
44         maxScore = Math.max(maxScore, score);
45     }
46     return maxScore;
47 }
48
49 //set score of coordinates
50 public void setScores(List<Double> scores) {
51     this.coordinates = scores;
52     invalidate();
53     this.repaint();
54 }
55
56 //return using method like get and set
57 public List<Double> getScores() {
58     return coordinates;
59 }
60
61 //creating the method createAndShowGui in the main method, where we create 1
62 private static void createAndShowGui() {

```

Handwritten notes and annotations:

- Next to line 18: $x+4$
- Next to line 28: $x+5$
- Next to line 35: $+1$
- Next to line 44: $x+1$

```

private static void createAndShowGui() {
    List<Double> scores = new ArrayList<>(); +|
    Random random = new Random(); +|
    int maxDataPoints = 150; +|
    int maxScore = 8; +|
    for (int i = 0; i < maxDataPoints; i++) {
        scores.add((double) random.nextDouble() * maxScore);
    }

    //panel main
    GraphFinalProject mainPanel = new GraphFinalProject(scores);
    mainPanel.setPreferredSize(new Dimension(750, 600));
    //frame display with exit and close
    JFrame frame = new JFrame("Distance Data");
    frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
    frame.getContentPane().add(mainPanel);
    frame.pack();
    frame.setLocationRelativeTo(null);
    frame.setVisible(true);
}

//the main method runs createAndShowGui and
public static void main(String[] args) throws IOException {

    //file exception try catch for files and write manual
    try (BufferedReader in = new BufferedReader(new FileReader("Data3.txt"))) { +|

        //variable string +|
        String str;

        List<String> list = new ArrayList<String>(); +|
        while ((str = in.readLine()) != null) {
            list.add(str);
        }
    } catch (FileNotFoundException e) {
        // TODO Auto-generated catch block
        e.printStackTrace();
    }

    //final output graph
    SwingUtilities.invokeLater(new Runnable() {
        public void run() {
            createAndShowGui();
        }
    });
}

//end graph
}

//end program

```

$$f(n) = 18 + 44 + C$$

$$f(n) \in O(n)$$

Conclusion

a) The design I complete is using a function prototype for each iteration of data that include Manhattan will merge iteration with update average that is why the output it shows the accuracy which is important number of the output for each file. The calculation distance, average, iteration, and accuracy it works.

b) The problem I was facing is accuracy because it gave me error about the arrays out of bounds error which is frustrating the problem until I use library the array list and HashMap that will complete the accuracy and show the console. The second issue I face is the graph library java because is the second time how to use GUI the graph to solve the points that shows in panel and is not showing. The solution I did only is find calculation of width and length with calculation label to output the graph it has 11 operator math for graph to show the screen.

c) I test the graph and it gave me logic error because the graph is not easy for use java. I was trying to solve graph points 3 color for each file of data until the time is running out the deadline that I had no choice but submit the result.

d) Things I learned this project list:

1.hashmap

2. JFrame (for graph with operator for width and length and get without set method)

3. Array list (with List Library)

4. Accuracy formula

5. Iteration

Appendix: adjust here source code.

K_cluster class

```
1 package projectFinal;
2 import java.io.IOException;
3
4
5 //class with inheritance readdataset class
6 public class K_Clusterer extends ReadDataset {
7
8
9 //main method
10 public static void main(String args[]) throws IOException {
11
12     //file
13     ReadDataset r1 = new ReadDataset();
14     r1.features.clear();
15     //input scanner
16     Scanner sc = new Scanner(System.in);
17     //name file
18     System.out.println("Enter the filename with path");
19     String file = sc.next();
20     r1.read(file); //load data
21     int ex = 1;
22
23     //creating do while
24     do{
25         //input cluster (group)
26         System.out.println("Enter the no. of clusters (group)");
27         int group = sc.nextInt();
28
29         System.out.println("Enter maximum iterations");
30         int max_iterations = sc.nextInt();
31
32
33         //HashMap to store center to calculate average
34         Map<Integer, double[]> center = new HashMap<>();
35         // calculating initial centroids
36         double[] x1 = new double[numberOfFeatures];
37         int r =0;
38         for (int i = 0 ; i < group; i++) {
39
40             x1 = r1.features.get(r ++);
41             center.put(i, x1);
42
43         }
44
45
46         //HashMap for finding cluster indexes using hashmap
47         Map<double[], Integer> clusters = new HashMap<>();
48
49         clusters = kmeans(r1.features, center, group);
50         // initial cluster print
51         double db[] = new double[numberOfFeatures];
52
53         //reassigning to new clusters (group) using nested loop
54         for (int i = 0 ; i < max_iterations; i++) {
55
56             for (int j = 0 ; j < group; j ++) {
57
58                 //arraylist library
59                 List<double[]> list = new ArrayList<>();
60                 //another loop with
61                 for (double[] key : clusters.keySet()) {
62
```

```

61         for (double[] key : clusters.keySet()) {
62
63             if (clusters.get(key)==j) {
64
65                 list.add(key);
66
67             }
68         }
69     } //end for loop cluster
70
71     //calculator average in center update
72     db = centerCalculator(list);
73     center.put(j, db);
74 }
75 //clear culster to clean output
76 clusters.clear();
77 //
78 clusters = kmeans(r1.features, center, group);
79
80 } //end loop iteration
81
82 //final cluster print line (optional for purpose check)
83 System.out.println("\nFinal Clustering of Data file");
84 System.out.println("Feature1\tFeature2\tFeature3\tFeature4\tCluster");
85
86 //using nested for loop cluster key set
87 for (double[] key : clusters.keySet()) {
88     for (int i = 0; i < key.length; i++) {
89         System.out.print(key[i] + "\t\t");
90     }
91     System.out.print(clusters.get(key) + "\n");
92 }
93
94
95 //calculate Accuracy
96 int accrate = 0 , total = 0;
97 for (double[] key : clusters.keySet()) {
98     if (clusters.get(key) + 1 == r1.getLabel().get(key)) {
99
100         //increment accuraccy
101         accrate ++;
102     }
103     //increment
104     total++;
105 }
106 //accuracy operator calculator
107 double accuracy = (double)accrate / (double)total * 100;
108
109 //end accuracy
110
111
112 //Calculate manhattan distance
113 double distance = 0;
114
115 for(int i = 0 ; i < group ; i++){
116
117     double sse = 0;
118     for (double[] key : clusters.keySet()) {
119         if (clusters.get(key)==i) {

```

```

17         double sse = 0;
18         for (double[] key : clusters.keySet()) {
19             if (clusters.get(key)==i) {
20                 Distance.manhattanDistance(key, center.get(i));
21                 //increment sse
22                 sse++;
23             }
24             //distance assign sse
25             distance = sse;
26         }
27     }
28 }
29 //end manhattan distance
30
31 //print final results iteration, groups, distance and accuracy
32 System.out.println("Iterations: " + max_iterations);
33 System.out.println("Count of Clusters (groups): " + group);
34 System.out.println("Distance: " + distance);
35
36 System.out.println("Accuracy: " + accuracy + "%");
37 //print of sentinel zero
38 System.out.println("Press 1 if you want to continue or press 0 to exit.....");
39
40 //input the counter sentinel
41 ex=sc.nextInt();
42 } while(ex==1); //while loop ends the do while
43 }
44
45 //method to calculate average to update the cluster
46 public static double[] centerCalculator(List<double[]> a) {
47     //variables of two int and double
48     int count = 0;
49     double sum=0.0;
50
51     double[] average = new double[ReadDataset.numberOfFeatures];
52     for (int i = 0; i < ReadDataset.numberOfFeatures; i++) {
53         sum=0.0;
54         count = 0;
55         //single for loop assign a method variables
56         for(double[] x:a){
57             count++;
58             //math operator average
59             sum = sum + x[i];
60         }
61
62         average[i] = sum / count;
63         //System.out.println("average: " + average);
64     }
65     return average;
66 }
67
68 }
69
70 //method for putting features to clusters and reassignment of clusters with hashmap, list to assign distance minimum
71
72 public static Map<double[], Integer> kmeans(List<double[]> features, Map<Integer, double[]> centroids, int k) {
73     //create hashmap for cluster
74     Map<double[], Integer> clusters = new HashMap<>();
75
76

```



```

171 //method for putting features to clusters and reassignment of clusters with hashmap,list to assign distance minimum
172
173 public static Map<double[], Integer> kmeans(List<double[]> features, Map<Integer, double[]> centroids, int k) {
174
175     //create hashmap for cluster
176     Map<double[], Integer> clusters = new HashMap<>();
177     int k1 = 0;
178     double dist=0.0;
179
180     //nested for loop
181     for( double[] x : features) {
182         double minimum = 999999.0;
183         for (int j = 0 ; j < k ; j ++) {
184
185             //declaring distance minimum
186             dist = Distance.manhattanDistance(centroids.get(j), x);
187
188             //distance if statements minimum distance
189             if (dist < minimum) {
190                 //assign equal minimum to distance
191                 minimum = dist;
192                 //assign k1 to j colms
193                 k1 = j;
194             }
195         }
196         clusters.put(x, k1);
197     }
198
199     //System.out.println("Distance: " + dist);
200     return clusters;
201 } //end method
202 } //end program
203
204

```

Read Data set class

```
1 package projectFinal;
2
3 import java.io.*;
4
5
6 public class ReadDataset {
7
8     //create protected for inheritance
9     protected List<double[]> features = new ArrayList<>();
10    protected Map<double[] , Integer> label = new HashMap<>();
11    //variable using protect with static for center number
12    protected static int numberOfFeatures;
13    private BufferedReader readFile;
14
15    //createmethod list library feature
16    public List<double[]> getFeatures()
17    {
18        return features;
19    }
20
21    //create map of labels
22    public Map<double[] , Integer> getLabel()
23    {
24        return label;
25    }
26
27    //void method read file
28    void read(String s) throws NumberFormatException, IOException {
29
30        File file=new File(s);
31
32        //try catch file read
33        try {
34            readFile = new BufferedReader(new FileReader(file));
35            String line;
36
37            //read file using while loop
38            while((line = readFile.readLine()) != null)
39            {
40
41                String[] split = line.split(",");
42                double[] feature = new double[split.length - 1];
43
44                //number feature of loops will include -1
45                numberOfFeatures = split.length-1;
46
47                //for loop for split elements
48                for (int i = 0; i < split.length - 1; i++)
49
50                    feature[i] = Double.parseDouble(split[i]);
51                features.add(feature);
52                String labels = split[feature.length];
53                label.put(feature , Integer.parseInt(labels));
54            }
55        }
56        //catch error exception for files
57        catch (FileNotFoundException e) {
58            // TODO Auto-generated catch block
59            e.printStackTrace();
60        }
61
62    } //end void method
```

```

62 }//end void method
63
64 //disokay for iterator
65 void display(){
66     Iterator<double[]> itr = features.iterator();
67
68
69     while(itr.hasNext()) {
70         //iterate variable with single array
71         double db[] = itr.next();
72         //whiule loop next the 4 x element axis.
73         for(int i = 0 ; i < 4 ; i++){
74             //output the iterator
75             System.out.print(db[i] + " ");
76         }
77
78     }
79
80 }//end void method display
81 }//end program
82

```

Distance class

```

1  package projectFinal;
2
3
4  //distance classs
5  public class Distance {
6
7      //create static of constant method with return
8  public static double manhattanDistance(double point1[], double point2[]){
9      double sum = 0.0;
10     for(int i = 0; i < point1.length; i++) {
11         //math operator manhattan
12         sum += (Math.abs(point1[i] - point2[i]));
13     }
14     return sum;
15 }//end method
16 }//end class and program
17

```

GraphFinalProject class

```
1 package projectFinal;
2
3 import java.awt.*;
4
5
6
7
8
9
10
11
12
13 //library grapg final project
14 public class GraphFinalProject extends JPanel{
15
16     //instance fields
17
18     //instance fiedls of JFrame
19     private static final long serialVersionUID = 5L;
20
21     //thew line axis x and y extend GUI aplication
22     private int labelPadding = 20;
23
24     //color line
25     private Color lineColor = new Color(250,255,254);
26
27     private Color pointColor = new Color(193,0,193 );
28
29     private Color gridColor = new Color(200, 200, 200, 200);
30
31     private static final Stroke GRAPH_STROKE = new BasicStroke(10f);
32
33     private static int pointWidth = 10;
34
35     private int numberDivisions = 6;
36     //variable coordinateds for points
37     private List<Double> coordinates;
38     //extend padd
39     private int padding = 20;
40
41     public GraphFinalProject(List<Double> scores) {
42         this.coordinates = scores;
43     }
44
45     //paint component with overvriding method
46     protected void paintComponent(Graphics g) {
47         super.paintComponent(g);
48         Graphics2D g2 = (Graphics2D) g;
49         g2.setRenderingHint(RenderingHints.KEY_ANTIALIASING, RenderingHints.VALUE_ANTIALIAS_ON);
50
51         //create points using math operator with type casting
52         double xScale = ((double) getWidth() - (3 * padding) - labelPadding) / (coordinates.size() - 1);
53         double yScale = ((double) getHeight() - 2 * padding - labelPadding) / (getMaxScore() - getMincoordinates());
54
55         //include pad points between x axis and y axis
56         List<Point> graphPoints = new ArrayList<>();
57         for (int i = 0; i < coordinates.size(); i++) {
58             int x1 = (int) (i * xScale + padding + labelPadding);
59             int y1 = (int) ((getMaxScore() - coordinates.get(i)) * yScale + padding);
60             graphPoints.add(new Point(x1, y1));
61         }
62         //color background
63         g2.setColor(Color.WHITE);
64         //fill the rect
65         g2.fillRect(padding + labelPadding, padding, getWidth() - (2 * padding) - labelPadding, getHeight() - 2 * padding - labelPadding);
66
67         //loop x axis . y axis
```

```

//loop x axis , y axis
for (int i = 0; i < numberDivisions + 1; i++) {
    int x0 = padding + labelPadding;
    int x1 = pointWidth + padding + labelPadding;
    int y0 = getHeight() - ((i * (getHeight() - padding * 2 -
labelPadding)) / numberDivisions + padding + labelPadding);
    //assign y1 to y0
    int y1 = y0;
    //size coordinates
    if (coordinates.size() > 0) {
        g2.setColor(gridColor);
        g2.drawLine(padding + labelPadding + 1 + pointWidth, y0, getWidth() - padding, y1);
        g2.setColor(Color.BLACK);
        String yLabel = ((int) (getMincoordinates() + (getMaxScore() - getMincoordinates()) * ((i * 8.0) / numberDivisions)) * 100) / 100.0 + "";
        //metric for lines
        FontMetrics metrics = g2.getFontMetrics();
        int labelWidth = metrics.stringWidth(yLabel);
        g2.drawString(yLabel, x0 - labelWidth - 6, y0 + (metrics.getHeight() / 2) - 3);
    }
    //line with 4 lines
    g2.drawLine(x0, y0, x1, y1);
}
ordinates size distance
for (int i = 0; i < coordinates.size(); i++) {
    if (coordinates.size() > 1) {
        int x0 = i * (getWidth() - padding * 2 - labelPadding) / (coordinates.size() - 1) + padding + labelPadding;
        int x1 = x0;
        int y0 = getHeight() - padding - labelPadding;
        int y1 = y0 - pointWidth;
        if ((i % ((int) ((coordinates.size() / 10.0)) + 3)) == 0) {
            g2.setColor(gridColor);
            g2.drawLine(x0, getHeight() - padding - labelPadding - 1 - pointWidth, x1, padding);
            g2.setColor(Color.BLACK);
            String xLabel = i + "";
            FontMetrics metrics = g2.getFontMetrics();
            int labelWidth = metrics.stringWidth(xLabel);
            g2.drawString(xLabel, x0 - labelWidth / 2, y0 + metrics.getHeight() + 3);
        }
        g2.drawLine(x0, y0, x1, y1);
    }
}
} //end loop coordinates

//creating lines
g2.drawLine(padding + labelPadding, getHeight() - padding - labelPadding, padding + labelPadding, padding);
g2.drawLine(padding + labelPadding, getHeight() - padding - labelPadding, getWidth() - padding, getHeight() - padding - labelPadding);

//the line color with graph stroke (2D)
Stroke oldStroke = g2.getStroke();
g2.setColor(lineColor);
g2.setStroke(GRAPH_STROKE);

for (int i = 0; i < graphPoints.size() - 1; i++) {
    int x1 = graphPoints.get(i).x;
    int y1 = graphPoints.get(i).y;
    int x2 = graphPoints.get(i + 1).x;
    int y2 = graphPoints.get(i + 1).y;
    g2.drawLine(x1, y1, x2, y2);
}

```

```

        g2.setColor(pointColor);
        for (int i = 0; i < graphPoints.size(); i++) {
            int x = graphPoints.get(i).x - pointWidth / 2;
            int y = graphPoints.get(i).y - pointWidth / 2;
            int X1 = pointWidth;
            int Y2 = pointWidth;
            g2.fillOval(x, y, X1, Y2);
        }
    }

    //min coordinates.
    private double getMincoordinates() {
        double minScore = Double.MAX_VALUE;
        for (Double score : coordinates) {
            minScore = Math.min(minScore, score);
        }
        return minScore;
    }

    //apply max socre for prevent out of graph
    private double getMaxScore() {
        double maxScore = Double.MIN_VALUE;
        for (Double score : coordinates) {
            maxScore = Math.max(maxScore, score);
        }
        return maxScore;
    }

    //set score of coordinates
    public void setScores(List<Double> scores) {
        this.coordinates = scores;
        invalidate();
        this.repaint();
    }

    //return using method like get and set
    public List<Double> getScores() {
        return coordinates;
    }

    //creating the method createAndShowGui in the main method, where we create the frame too and pack it in the panel
    private static void createAndShowGui() {
        List<Double> scores = new ArrayList<>();
        Random random = new Random();
        int maxDataPoints = 150;
        int maxScore = 8;
        for (int i = 0; i < maxDataPoints; i++) {
            scores.add((double) random.nextDouble() * maxScore);
        }

        //panel main
        GraphFinalProject mainPanel = new GraphFinalProject(scores);
        mainPanel.setPreferredSize(new Dimension(750, 600));
        //frame display with exit and close
        JFrame frame = new JFrame("Distance Data");
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
        frame.getContentPane().add(mainPanel);
        frame.pack();
        frame.setLocationRelativeTo(null);
        frame.setVisible(true);
    }

    //the main method runs createAndShowGui and
    public static void main(String[] args) throws IOException {

```

```

    }
    //the main method runs createAndShowGui and
    public static void main(String[] args) throws IOException {

        //file exception try catch for files
        try (BufferedReader in = new BufferedReader(new FileReader("Data3.txt"))) {

            //variable string
            String str;

            List<String> list = new ArrayList<String>();
            while ((str = in.readLine()) != null) {
                list.add(str);
            }
        } catch (FileNotFoundException e) {
            // TODO Auto-generated catch block
            e.printStackTrace();
        }

        //final output graph
        SwingUtilities.invokeLater(new Runnable() {
            public void run() {
                createAndShowGui();
            }
        }); //end graph
    }
} //end program

```