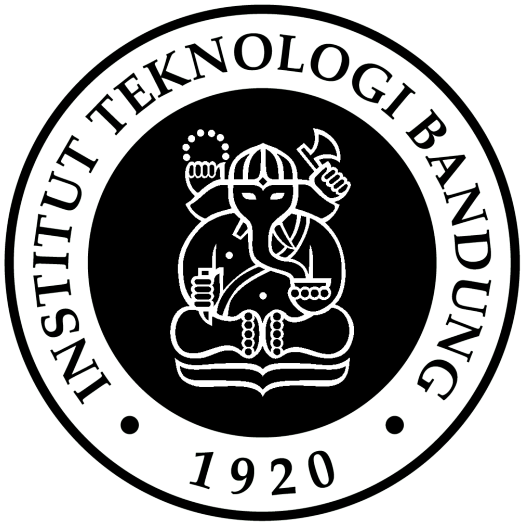
Tugas Kecil 3
Penentuan Rute Terpendek menggunakan Algoritma UCS dan A*
IF2211 Strategi Algoritma



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Daftar Isi

BAB 1

Latar Belakang

1.1 Deskripsi Persoalan

Pada peta, kadang kala diperlukan rute yang terpendek agar dapat menghemat perjalanan, baik dari segi biaya maupun tenaga. Pencarian rute terpendek ini dapat menggunakan beberapa algoritma pada graf. Contoh dari algoritma tersebut adalah algoritma A* dan Uniformed Cost Search.

1.2 Algoritma Uniformed Cost Search (UCS)

Algoritma Uniformed Cost Search (UCS) merupakan modifikasi dari breadth-first search dan iterative depth search, tetapi menghasilkan langkah terpendek yang paling memungkinkan. Algoritma ini memperhitungkan biaya atau *cost* dari setiap simpul ke simpul lainnya pada saat memeriksa simpul-simpul yang bertetangga. Setelahnya, dari simpul-simpul tersebut, diambil simpul dengan nilai terkecil.

Dengan memeriksa simpul dengan nilai yang paling kecil terlebih dahulu, dapat dipastikan bahwa langkah yang diambil akan menghasilkan alur pergerakan yang paling hemat dan juga cost yang hemat. Fungsi untuk menghitung cost diberi nama $g(n)$ yang digunakan untuk mengukur cost dari suatu simpul ke simpul lainnya.

1.3 Algoritma A*

Algoritma A* merupakan bentuk informed search dari algoritma UCS yang menggunakan nilai heuristic estimasi jarak lurus dari suatu simpul ke simpul tujuan. Pemeriksaan tidak hanya menggunakan nilai $g(n)$ tetapi juga nilai dari $h(n)$ yang merupakan nilai heuristic seperti yang sudah dijelaskan.

Dengan menggunakan perhitungan ini, akan dihasilkan alur pergerakan yang lebih optimal lagi dikarenakan adanya tambahan informasi dari $h(n)$ untuk penentuan nilai terkecil pada setiap pemeriksaan simpul.

BAB 2

Hasil

2.1 Penerapan UCS

Secara umum, penerapan UCS dalam penentuan rute terpendek adalah sebagai berikut,

1. Dari simpul awal, catatlah semua simpul yang bertetangga, beserta nilai jarak dari simpul awal ke simpul yang bertetangga
2. Urutkan simpul-simpul berdasarkan nilai jarak terkecil
3. Dari simpul yang memiliki nilai terkecil, catat kembali semua simpul yang bertetangga dan jumlahkan nilai jarak dari simpul tersebut ke simpul yang bertetangga dengan nilai sebelumnya
4. Proses dilangsungkan kembali hingga tercapai simpul tujuan

2.2 Penerapan A*

Secara umum, penerapan A* dalam penentuan rute terpendek adalah sebagai berikut,

1. Dari simpul awal, catatlah semua simpul yang bertetangga, beserta nilai jarak dari simpul awal ke simpul yang bertetangga ($g(n)$) yang dijumlahkan dengan jarak lurus dari simpul awal ke simpul tujuan ($h(n)$)
2. Urutkan simpul-simpul berdasarkan nilai $g(n) + h(n)$
3. Dari simpul yang memiliki nilai terkecil, catat kembali semua simpul yang bertetangga dan jumlahkan nilai $g(n)$ jarak dari simpul tersebut ke simpul yang bertetangga dengan nilai sebelumnya serta catat jarak dari simpul tersebut ke simpul tujuan
4. Proses dilangsungkan kembali hingga tercapai simpul tujuan

2.3 Source Code

Program dibagi menjadi beberapa file yaitu, Solver.java, Graph.java, Location.java, Node.java, dan App.java. App.java adalah file yang digunakan untuk menjalankan program

2.3.1 App.java

```
1  package stima;
2
3  import java.util.ArrayList;
4  import java.util.HashSet;
5  import java.util.List;
6  import java.util.Set;
7  import java.awt.*;
8
9  import javax.swing.JFrame;
10
11 import org.jxmapviewer.JXMapViewer;
12 import org.jxmapviewer.OSMTileFactoryInfo;
13 import org.jxmapviewer.painter.CompoundPainter;
14 import org.jxmapviewer.painter.Painter;
15 import org.jxmapviewer.viewer.DefaultTileFactory;
16 import org.jxmapviewer.viewer.DefaultWaypoint;
17 import org.jxmapviewer.viewer.GeoPosition;
18 import org.jxmapviewer.viewer.TileFactoryInfo;
19 import org.jxmapviewer.viewer.Waypoint;
20 import org.jxmapviewer.viewer.WaypointPainter;
21
22 import algorithms.*;
23 import visuals.*;
24
25 /**
26  * Aplikasi yang menerima file input graf map
27  * dan menampilkan hasil path terpendek dari point start ke
       point finish
28  * @author Matthew Mahendra
29  * @author Christophorus Dharma Winata
30  */
31 public class App
32 {
33     /**
34      * @param args the program args (ignored)
35      */
36     public static void main(String[] args)
37     {
38         // Opening java terminal
39         System.out.println("Welcome to the shortest path finder!
               ");
40         System.out.println("Please enter the file name of the
               map you want to use:");
41         // Input file name
42         String fileName = System.console().readLine();
43
```

```
44          // Read file and create graph
45          Graph graph = new Graph(fileName);
46          // Print location
47          System.out.println("\nMAP LOCATIONS: ");
48          for (int i = 0; i < graph.getLocCount(); i++) {
49              System.out.println((i+1) + ". " + graph.getLocName(i
                ));
50          }
51
52          //input start and finish location
53          System.out.println("\nEnter the starting location name:"
                );
54          String startingPosition = System.console().readLine();
55          System.out.println("\nEnter the target finish location
                name:");
56          String finishPosition = System.console().readLine();
57
58          // Calling solver from algorithms
59          Solver _solver = new Solver(startingPosition,
                finishPosition, fileName);
60
61          // Choosing algorithm
62          System.out.println("\nPlease choose the algorithm for
                pathfinding:");
63          System.out.println("1. UCS");
64          System.out.println("2. A*");
65          int choice = Integer.parseInt(System.console().readLine
                ());
66          ArrayList<String> path;
67          if (choice == 1) {
68              // Path and distance from UCS algorithm
69              path = _solver.UCS();
70          } else if (choice == 2) {
71              // Path and distance from A* algorithm
72              path = _solver.AStar();
73          } else {
74              System.out.println("Invalid choice");
75              return;
76          }
77
78          System.out.println("\nShortest Path:");
79          for(int i = 0; i < path.size(); i++){
80              if(i != path.size() - 1){
81                  System.out.print(path.get(i) + " - ");
82              }else{
83                  System.out.println(path.get(i));
84              }
85          }
```

```
86
87          if(graph.isBonus()){
88              System.out.println("Distance: " + _solver.getJarak()
                    + " km");
89          }else{
90              System.out.println("Distance: " + _solver.getJarak()
                    );
91          }
92
93          if(graph.isBonus()){
94              // Instantiate JXMapViewer
95              JXMapViewer mapViewer = new JXMapViewer();
96
97              // Display the viewer in a JFrame
98              JFrame frame = new JFrame("Map Viewer");
99              frame.getContentPane().add(mapViewer);
100             frame.setSize(800, 600);
101             frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE)
                    ;
102             frame.setVisible(true);
103
104             // Create a TileFactoryInfo for OpenStreetMap
105             TileFactoryInfo info = new OSMTileFactoryInfo();
106             DefaultTileFactory tileFactory = new
                    DefaultTileFactory(info);
107             mapViewer.setTileFactory(tileFactory);
108
109             // Instantiating locations from input file
110             GeoPosition[] locationsOnMap = new GeoPosition[graph
                    .getLocCount()];
111             for (int i = 0; i < graph.getLocCount(); i++) {
112                 locationsOnMap[i]= new GeoPosition(graph.getPos(
                        i));
113             }
114
115             // Create a track from the geo-positions
116             List<GeoPosition> solvedPath = new ArrayList<
                    GeoPosition>();
117
118             for (int i = 0; i < path.size(); i++) {
119                 solvedPath.add(new GeoPosition(graph.getPos(path
                        .get(i))));
120             }
121             // Calling RoutePainter from visuals
122             RoutePainter routePainter = new RoutePainter(
                    solvedPath);
123
124             // Set the focus
```

```
125             double frac = 0.1;
126             if(frac * path.size() <= 1){
127                 mapViewer.zoomToBestFit(new HashSet<GeoPosition
                        >(solvedPath), frac*path.size());
128             }else{
129                 mapViewer.zoomToBestFit(new HashSet<GeoPosition
                        >(solvedPath), 0.2);
130             }
131
132             // Create waypoints from the geo-positions
133             List<Waypoint> waypointsList = new ArrayList<
                    Waypoint>();
134             for (int i = 0; i < graph.getLocCount(); i++) {
135                 waypointsList.add(new DefaultWaypoint(
                        locationsOnMap[i]));
136             }
137             Set<Waypoint> waypointsSet = new HashSet<Waypoint>(
                    waypointsList);
138
139             // Create a waypoint painter that takes all the
                    waypoints
140             WaypointPainter<Waypoint> waypointPainter = new
                    WaypointPainter<Waypoint>();
141             waypointPainter.setWaypoints(waypointsSet);
142
143             // Create a compound painter that uses both the
                    route-painter and the waypoint-painter
144             List<Painter<JXMapViewer>> painters = new ArrayList<
                    Painter<JXMapViewer>>();
145             painters.add(routePainter);
146             painters.add(waypointPainter);
147
148             CompoundPainter<JXMapViewer> painter = new
                    CompoundPainter<JXMapViewer>(painters);
149             mapViewer.setOverlayPainter(painter);
150         }else{
151             JFrame frame = new JFrame("Graph Viewer");
152             GraphPainter graphPainter = new GraphPainter(path,
                    graph);
153             graphPainter.setPreferredSize(new Dimension(600,
                    600));
154             frame.add(graphPainter);
155             frame.pack();
156             // frame.setLocationRelativeTo(null);
157             frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE)
                    ;
158             frame.setVisible(true);
159         }
```

```
160     }
161 }
```

2.3.2 Solver.java

```
1  package algorithms;
2  import java.util.*;
3
4  public class Solver extends Graph{
5      private PriorityQueue<Node> queue;
6      private String startPoint, endPoint;
7      private double jarak;
8
9      public Solver(String sp, String ep, String fileName){
10         super(fileName);
11         startPoint = sp;
12         endPoint = ep;
13         queue = new PriorityQueue<>();
14         jarak = 0;
15     }
16
17     public ArrayList<String> AStar(){
18         queue = new PriorityQueue<>();
19
20         ArrayList<String> visit = new ArrayList<>();
21         visit.add(startPoint);
22         Node start = new Node(startPoint, endPoint, 0,
               euclideanDistance(getPos(startPoint), getPos(endPoint
               )),visit);
23         queue = new PriorityQueue<Node>();
24         queue.add(start);
25
26
27         while(queue.size() != 0){
28             Node check = queue.remove();
29
30             if(check.getCurrent().equals(check.getGoal())){
31                 this.jarak = check.calculateFN();
32                 return (check.getPath());
33             }
34
35             for(int i = 0; i < getNodes() ; i++){
36                 if(getGraph(getIndex(check.getCurrent()), i) > 0
                       && !check.getPath().contains(getLocName(i)))
                       {
37                     /* Masukkan ke prioqueue
38                      * Buat nodes baru
```

```
39                      */
40                      ArrayList<String> visitNew = new ArrayList
                            <>(check.getPath());
41
42                      Node newNode;
43                      visitNew.add(getLocName(i));
44                      if(isBonus()){
45                          newNode = new Node(getLocName(i),
46                                             check.getGoal(),
47                                             haversine(getPos(
                                                   check.getCurrent
                                                   ()), getPos(
                                                   getLocName(i))) +
                                                    check.getGn(),
48                                             haversine(getPos(
                                                   getLocName(i)),
                                                   getPos(check.
                                                   getGoal())),
49                                             visitNew);
50                      }else{
51                          newNode = new Node(getLocName(i),
52                                             check.getGoal(),
53                                             getGraph(getIndex(
                                                   check.getCurrent
                                                   ()), i) + check.
                                                   getGn(),
54                                             euclideanDistance(
                                                   getPos(getLocName
                                                   (i)), getPos(
                                                   check.getGoal()))
                                                   ,
55                                             visitNew);
56                      }
57                      queue.add(newNode);
58                  }
59              }
60          }
61          return new ArrayList<>();
62      }
63
64      public ArrayList<String> UCS(){
65          queue = new PriorityQueue<>();
66
67          ArrayList<String> visitedLocs = new ArrayList<>();
68          visitedLocs.add(startPoint);
69          Node startNode = new Node(startPoint, endPoint, 0,
                visitedLocs);
70          queue.add(startNode);
```

```
71
72          while(queue.size() != 0){
73              Node check = queue.remove();
74
75              if(check.getCurrent().equals(check.getGoal())){
76                  this.jarak = check.getGn();
77                  return (check.getPath());
78              }
79
80              for(int i = 0; i < getNodes() ; i++){
81                  if(getGraph(getIndex(check.getCurrent()), i) > 0
                        && !check.getPath().contains(getLocName(i)))
                       {
82                      ArrayList<String> visitNew = new ArrayList
                           <>(check.getPath());
83
84                      visitNew.add(getLocName(i));
85
86                      Node newNode;
87
88                      if(isBonus()){
89                          newNode = new Node(getLocName(i),
90                                             check.getGoal(),
91                                             haversine(getPos(
                                                  check.getCurrent
                                                  ()), getPos(
                                                  getLocName(i))) +
                                                   check.getGn(),
92                                             visitNew);
93                      }else{
94                          newNode = new Node(getLocName(i),
95                                             check.getGoal(),
96                                             getGraph(getIndex(
                                                  check.getCurrent
                                                  ()), i) + check.
                                                  getGn(),
97                                             visitNew);
98                      }
99
100                     queue.add(newNode);
101                 }
102             }
103         }
104         return new ArrayList<>();
105     }
106
107     public double getJarak(){
108         return jarak;
```

```
109     }
110 }
```

2.3.3 Node.java

```
1  package algorithms;
2  import java.util.*;
3
4  public class Node implements Comparable<Node>{
5      private String current;
6      private String goal;
7      private double gn;
8      private double hn;
9      private ArrayList<String> visited = new ArrayList<>();
10
11     /* Node untuk A* */
12     public Node(String c, String g, double gn, double hn,
           ArrayList<String> visited){
13         current=c;
14         goal = g;
15         this.gn = gn;
16         this.hn = hn;
17         this.visited = visited;
18     }
19
20     /* Node untuk UCS, tidak ada nilai h(n) */
21     public Node(String c, String g, double gn, ArrayList<String>
           visited){
22         current=c;
23         goal = g;
24         this.gn = gn;
25         this.hn = 0;
26         this.visited = visited;
27     }
28
29     public String getCurrent(){
30         return current;
31     }
32
33     public String getGoal(){
34         return goal;
35     }
36
37     public double getGn(){
38         return gn;
39     }
40
```

```
41      public double getHn(){
42          return hn;
43      }
44
45      public double calculateFN(){
46          return hn+gn;
47      }
48
49      public ArrayList<String> getPath(){
50          return visited;
51      }
52
53      @Override
54      public int compareTo(Node o) {
55          if(calculateFN() < o.calculateFN()){
56              return -1;
57          }else if (calculateFN() == o.calculateFN()){
58              return 0;
59          }else{
60              return 1;
61          }
62      }
63  }
```

2.3.4 Graph.java

```
1   package algorithms;
2   import java.io.File;
3   import java.io.FileNotFoundException;
4   import java.util.Scanner;
5
6   public class Graph {
7       protected int[][] graph;
8       protected int nodes;
9       protected Location[] loc;
10      protected boolean isBonus;
11
12      public Graph(String filename){
13          try{
14              File file = new File("./test/", filename);
15              Scanner reader = new Scanner(file);
16
17              /* Ambil jumlah nodes dan set ukuran matrix */
18              String nString = reader.nextLine();
19              int n = Integer.parseInt(nString);
20              nodes = n;
21              graph = new int[n][n];
```

```
22
23              /* Insert lokasi */
24              loc = new Location[n];
25              for(int i = 0; i < n ; i++){
26                  String line = reader.nextLine();
27                  String[] parse = line.split("\\s+");
28                  loc[i] = new Location(parse[0], Double.
                        parseDouble(parse[1]), Double.parseDouble(
                        parse[2]));
29              }
30
31              /* Fill the matrix */
32              for(int i = 0; i < n ; i++){
33                  String line = reader.nextLine();
34                  String[] splited = line.split("\\s+");
35                  for(int j = 0; j < n; j++){
36                      graph[i][j] = Integer.parseInt(splited[j]);
37                  }
38              }
39
40              /* Penentuan Bonus atau bukan */
41              for(int i = 0; i < n ; i++){
42                  for(int j = 0; j < n ; j++){
43                      if(graph[i][j] > 1){
44                          isBonus = false;
45                          break;
46                      }
47                      isBonus = true;
48                  }
49              }
50
51
52              reader.close();
53
54          }catch (FileNotFoundException e){
55              System.out.println("File not found!");
56              e.printStackTrace();
57          }
58      }
59      public double euclideanDistance(double[] l1, double[] l2){
60          return (Math.sqrt( Math.pow(l1[0]-l2[0], 2) + Math.pow(
                l1[1]-l2[1], 2) ));
61      }
62
63      static double haversine(double[] l1, double[] l2){
64          // distance between latitudes and longitudes
65          double dLat = Math.toRadians(l2[0] - l1[0]);
66          double dLon = Math.toRadians(l2[1] - l1[1]);
```

```
67
68          // convert to radians
69          double lat1 = Math.toRadians(l1[0]);
70          double lat2 = Math.toRadians(l2[0]);
71
72          // apply formulae
73          double a = Math.pow(Math.sin(dLat / 2), 2) +
74                     Math.pow(Math.sin(dLon / 2), 2) *
75                     Math.cos(lat1) *
76                     Math.cos(lat2);
77          double rad = 6371;
78          double c = 2 * Math.asin(Math.sqrt(a));
79          return rad * c;
80      }
81
82      public double[] getPos(String locName){
83          int idx = 0;
84          for(int i = 0; i < nodes; i++){
85              if(loc[i].getLocName().equals(locName))
86              {
87                  idx = i;
88                  break;
89              }
90          }
91          return loc[idx].getCoord();
92      }
93
94      /**
95       * Mengembalikan koordinat lokasi berdasarkan indeks
96       * @param i indeks lokasi
97       * @return double[] koordinat lokasi
98       */
99      public double[] getPos(int i){
100         return loc[i].getCoord();
101     }
102
103     public String getLocName(int i){
104         return loc[i].getLocName();
105     }
106
107     public int getIndex(String locName){
108         int idx = 0;
109         for(int i = 0; i < nodes; i++){
110             if(loc[i].getLocName().equals(locName))
111             {
112                 idx = i;
113                 break;
114             }
```

```
115         }
116         return idx;
117     }
118
119     public int getGraph(int b, int c){
120         return graph[b][c];
121     }
122
123     public int getNodes(){
124         return nodes;
125     }
126     public int getLocCount(){
127         return loc.length;
128     }
129
130     public Location[] getLocation(){
131         return loc;
132     }
133
134     public boolean isBonus(){
135         return isBonus;
136     }
137 }
```

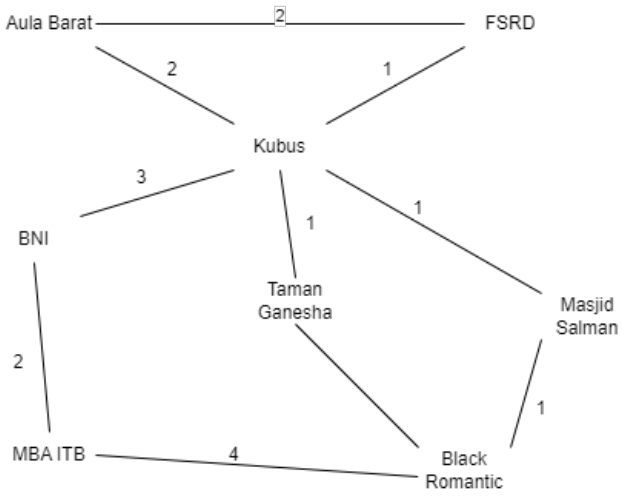
2.3.5 Location.java

```
1  package algorithms;
2  public class Location {
3      private String locName;
4      private double x;
5      private double y;
6
7      public Location(String locName, double x, double y){
8          this.x = x;
9          this.y = y;
10         this.locName = locName;
11     }
12
13     public String getLocName(){
14         return locName;
15     }
16
17     public double[] getCoord(){
18         double[] coord = {this.x, this.y};
19         return coord;
20     }
21 }
```

2.4 Hasil Pengujian

2.4.1 Peta di Kawasan ITB Ganesha

Pada folder test, peta ini diberi nama file map2.txt, dengan visualisasi dalam bentuk graf sebagai berikut,



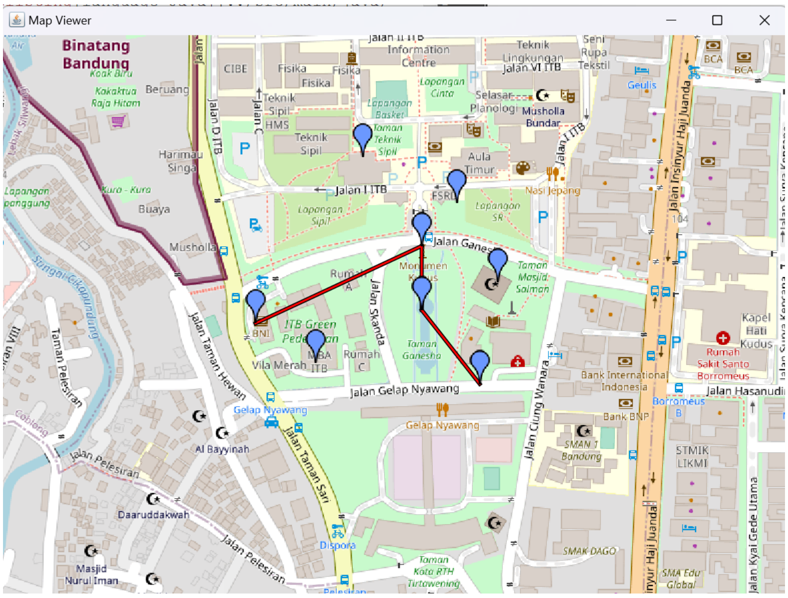
Gambar 2.1: Visualisasi Graf Map2.txt

Rute dari BNI - Black Romantic

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map2.txt

MAP LOCATIONS:
1. Monumen_Kubus
2. Masjid_Salman
3. Black_Romantic
4. Taman_Ganesha
5. MBA_ITB
6. BNI
7. FSRD
8. Aula_Barat

Enter the starting location name:
BNI

Enter the target finish location name:
Black_Romantic

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1
Shortest Path:
BNI - Monumen_Kubus - Taman_Ganesha - Black_Romantic
Distance: 5.0
```

Gambar 2.2: Pencarian dengan UCS

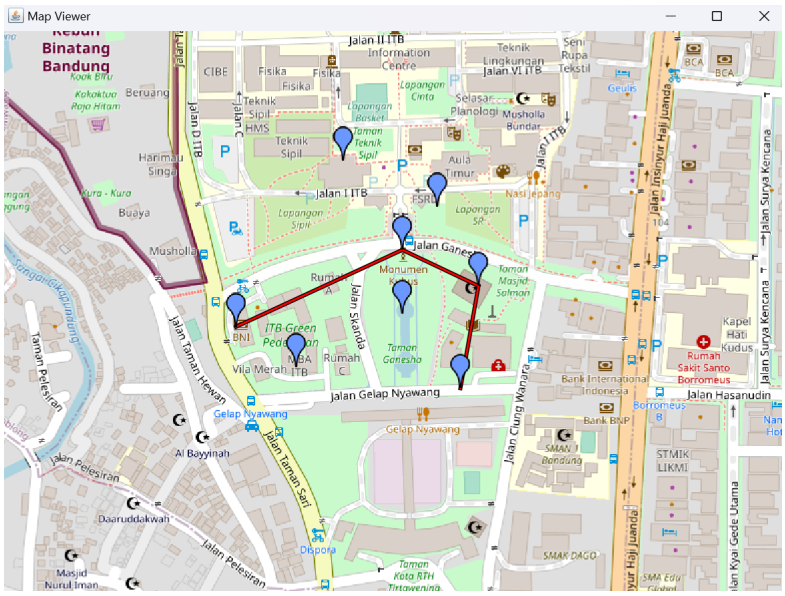
Rute dari Masjid Salman - Aula Barat



Gambar 2.3: Visualisasi Pencarian dengan UCS

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use
map2.txt

MAP LOCATIONS:
1. Monumen_Kubus
2. Masjid_Salman
3. Black_Romantic
4. Taman_Ganesha
5. MBA_ITB
6. BNI
7. FSRD
8. Aula_Barat

Enter the starting location name:
BNI

Enter the target finish location name:
Black_Romantic

Please choose the algorithm for pathfinding:
1. UCS
2. A*
2
Shortest Path:
BNI - Monumen_Kubus - Masjid_Salman - Black_Romantic
Distance: 5.0
```

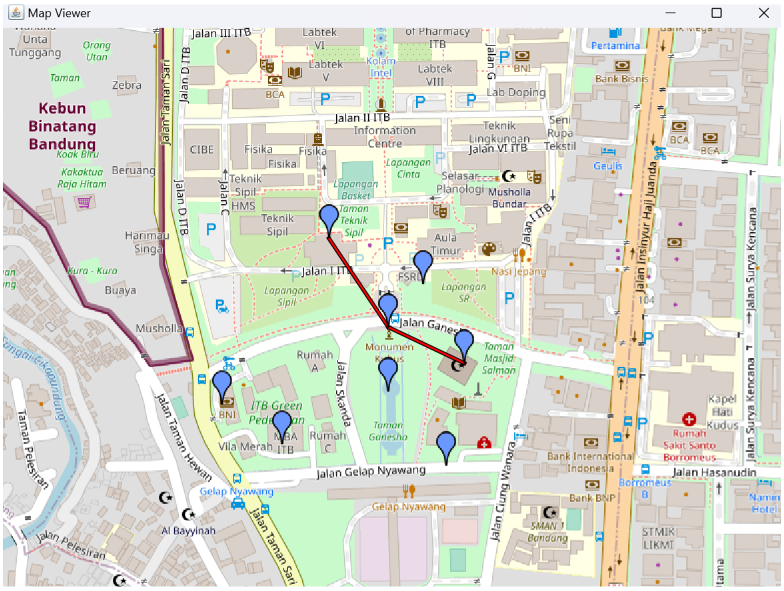
Gambar 2.4: Pencarian dengan A*



Gambar 2.5: Visualisasi Pencarian dengan A*

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map2.txt

MAP LOCATIONS:
1. Monumen_Kubus
2. Masjid_Salman
3. Black_Romantic
4. Taman_Ganesha
5. MBA_ITB
6. BNI
7. FSRD
8. Aula_Barat

Enter the starting location name:
Masjid_Salman

Enter the target finish location name:
Aula_Barat

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1
Shortest Path:
Masjid_Salman - Monumen_Kubus - Aula_Barat
Distance: 3.0
```

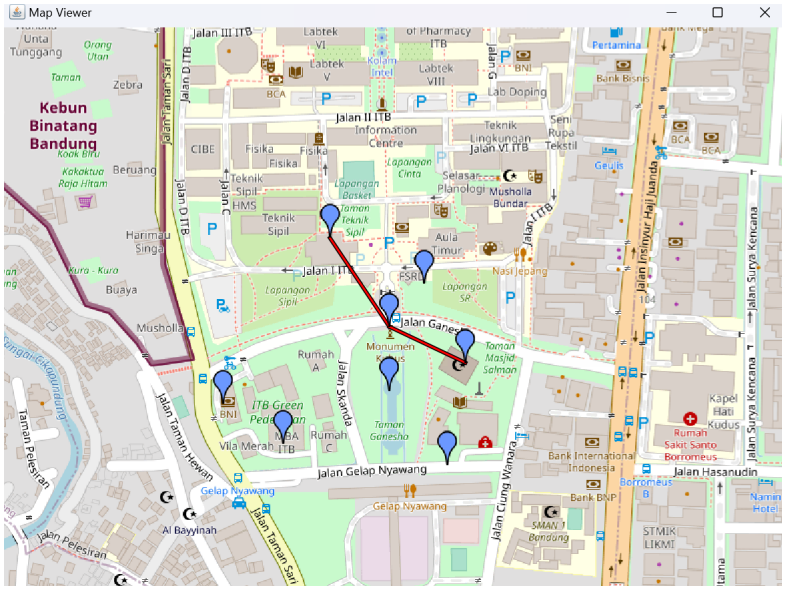
Gambar 2.6: Pencarian dengan UCS



Gambar 2.7: Visualisasi Pencarian dengan UCS

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map2.txt

MAP LOCATIONS:
1. Monumen_Kubus
2. Masjid_Salman
3. Black_Romantic
4. Taman_Ganesha
5. MBA_ITB
6. BNI
7. FSRD
8. Aula_Barat

Enter the starting location name:
Masjid_Salman

Enter the target finish location name:
Aula_Barat

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1
Shortest Path:
Masjid_Salman - Monumen_Kubus - Aula_Barat
Distance: 3.0
```

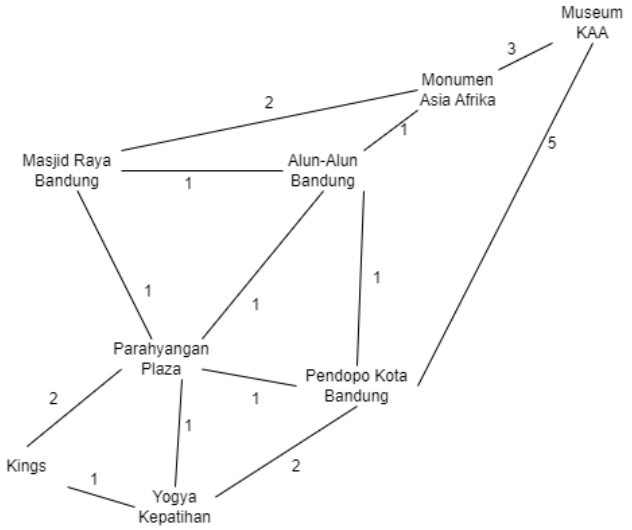
Gambar 2.8: Pencarian dengan A*



Gambar 2.9: Visualisasi Pencarian dengan A*

2.4.2 Peta di Kawasan Alun-Alun Bandung

Pada folder test, peta ini diberi nama file map4.txt, dengan visualisasi dalam bentuk graf sebagai berikut,

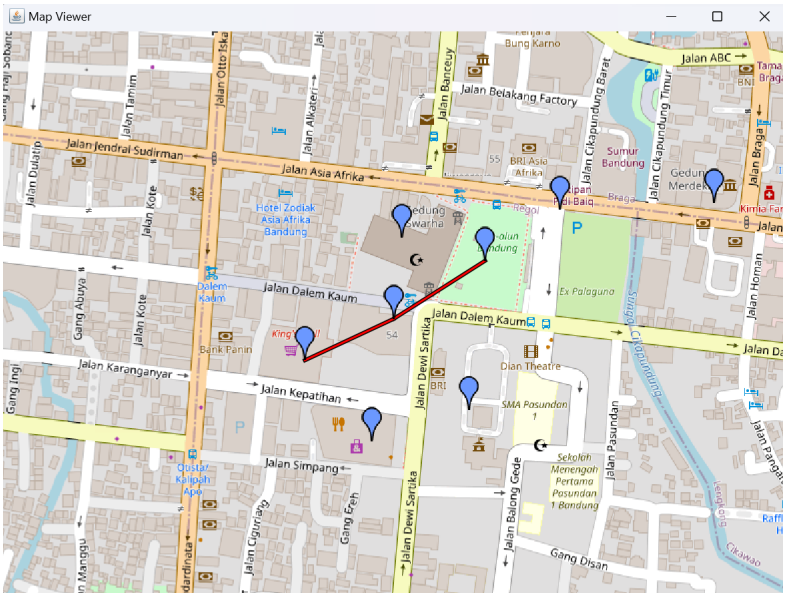


Gambar 2.10: Visualisasi Graf Map3.txt

Rute Alun-Alun Bandung - Kings

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map3.txt

MAP LOCATIONS:
1. Alun-Alun_Bandung
2. Masjid_Raya_Bandung
3. Monumen_Asia_Afrika
4. Parahyangan_Plaza
5. Pendopo_Kota_Bandung
6. Museum_KAA
7. Yogya_Kepatihan
8. Kings

Enter the starting location name:
Alun-Alun_Bandung

Enter the target finish location name:
Kings

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1

Shortest Path:
Alun-Alun_Bandung - Parahyangan_Plaza - Kings
Distance: 3.0
```

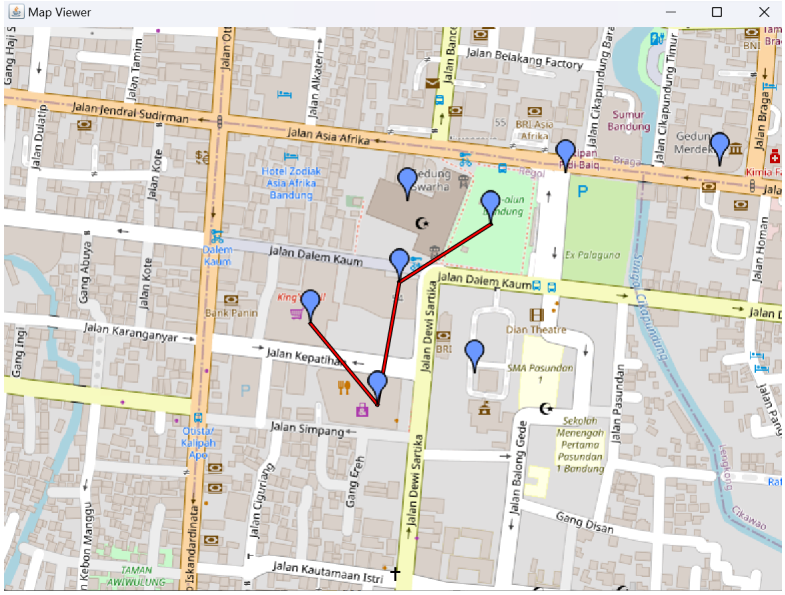
Gambar 2.11: Pencarian dengan UCS



Gambar 2.12: Visualisasi Pencarian dengan UCS

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map3.txt

MAP LOCATIONS:
1. Alun-Alun_Bandung
2. Masjid_Raya_Bandung
3. Monumen_Asia_Afrika
4. Parahyangan_Plaza
5. Pendopo_Kota_Bandung
6. Museum_KAA
7. Yogya_Kepatihan
8. Kings

Enter the starting location name:
Alun-Alun_Bandung

Enter the target finish location name:
Kings

Please choose the algorithm for pathfinding:
1. UCS
2. A*
2

Shortest Path:
Alun-Alun_Bandung - Parahyangan_Plaza - Yogya_Kepatihan - Kings
Distance: 3.0
```

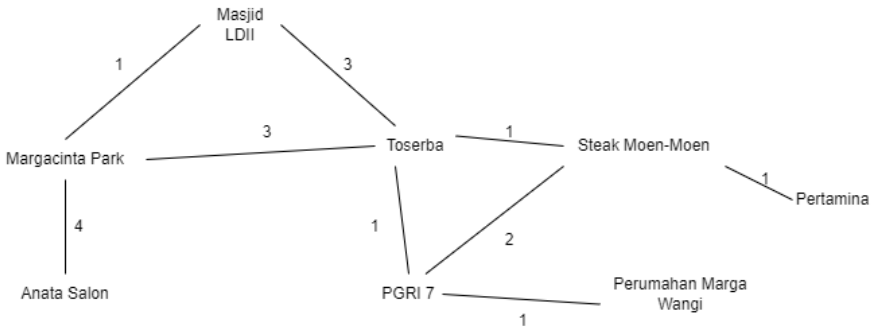
Gambar 2.13: Pencarian dengan A*



Gambar 2.14: Visualisasi Pencarian dengan A*

2.4.3 Peta di Kawasan Buah Batu

Pada folder test, peta ini diberi nama file map3.txt, dengan visualisasi dalam bentuk graf sebagai berikut,

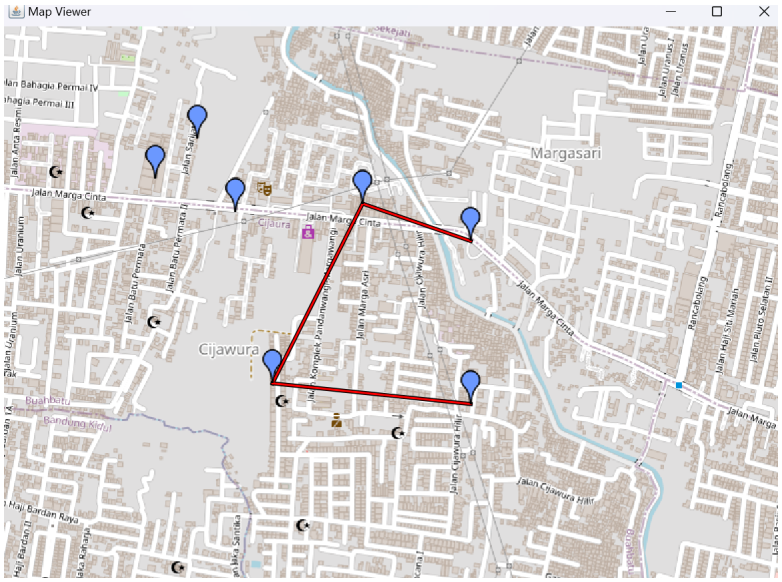


Gambar 2.15: Visualisasi Graf Map4.txt

Perumahan Marga Wangi - Pertamina

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map4.txt

MAP LOCATIONS:
1. Marga_Cinta_Park
2. Anata_Salon
3. Masjid_LDII
4. Toserba
5. PGRI_7
6. Perumahan_Marga_Wangi
7. Pertamina
8. Steak_Moen_Moen

Enter the starting location name:
Perumahan_Marga_Wangi

Enter the target finish location name:
Pertamina

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1

Shortest Path:
Perumahan_Marga_Wangi - PGRI_7 - Steak_Moen_Moen - Pertamina
Distance: 4.0
```

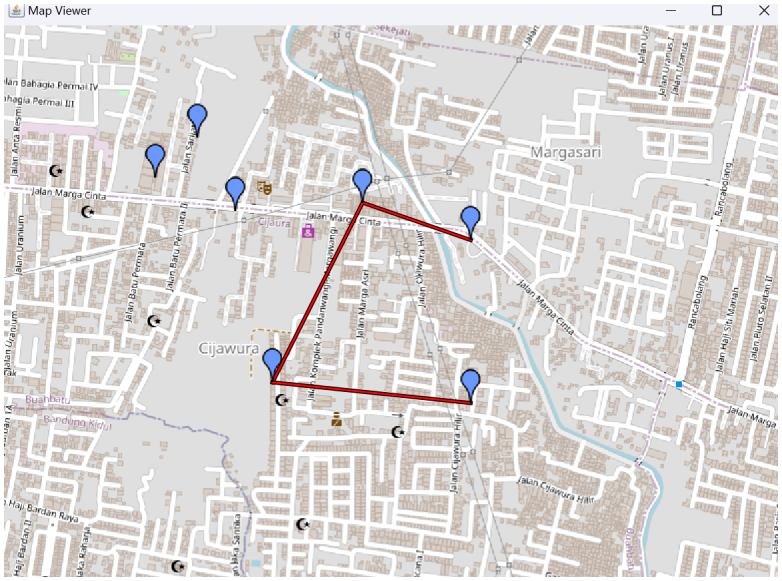
Gambar 2.16: Pencarian dengan UCS



Gambar 2.17: Visualisasi Pencarian dengan UCS

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map4.txt

MAP LOCATIONS:
1. Marga_Cinta_Park
2. Anata_Salon
3. Masjid_LDII
4. Toserba
5. PGRI_7
6. Perumahan_Marga_Wangi
7. Pertamina
8. Steak_Moen_Moen

Enter the starting location name:
Perumahan_Marga_Wangi

Enter the target finish location name:
Pertamina

Please choose the algorithm for pathfinding:
1. UCS
2. A*
2

Shortest Path:
Perumahan_Marga_Wangi - PGRI_7 - Steak_Moen_Moen - Pertamina
Distance: 4.0
```

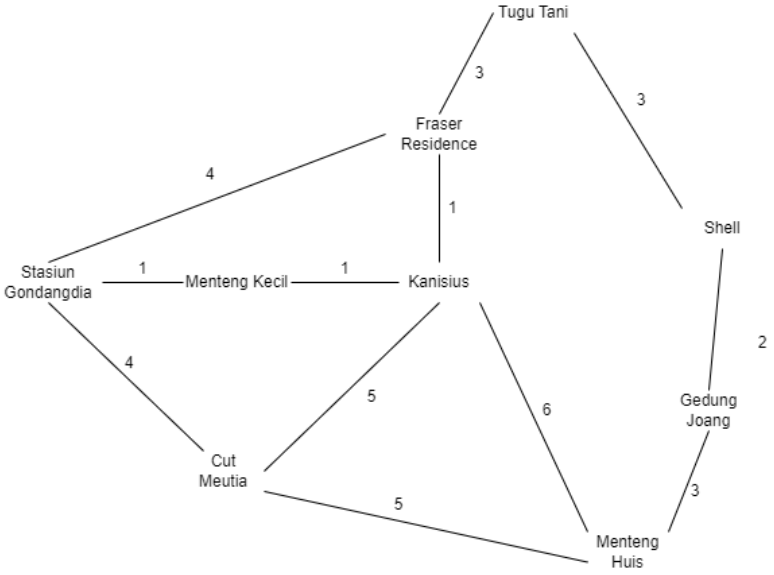
Gambar 2.18: Pencarian dengan A*



Gambar 2.19: Visualisasi Pencarian dengan A*

2.4.4 Peta di Jakarta

Pada folder test, peta ini diberi nama file map1.txt, dengan visualisasi dalam bentuk graf sebagai berikut,

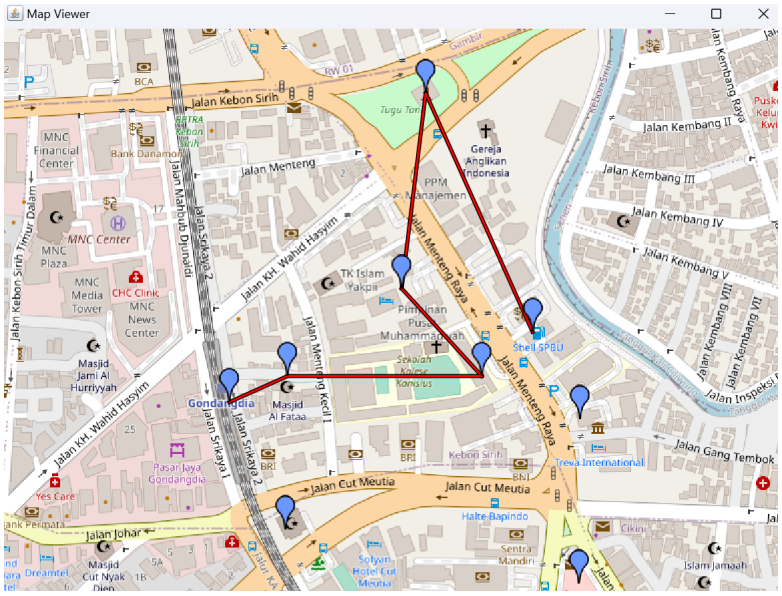


Gambar 2.20: Visualisasi Graf Map1.txt

Rute Shell Menteng - Stasiun Gondangdia

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
Map1.txt

MAP LOCATIONS:
1. Tugu_Tani
2. Kanisius
3. Masjid_Cut_Meutia
4. Menteng_Huis
5. Gedung_Joang
6. Shell_Menteng
7. Fraser_Residence
8. Stasiun_Gondangdia
9. Menteng_Kecil

Enter the starting location name:
Shell_Menteng

Enter the target finish location name:
Stasiun_Gondangdia

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1

Shortest Path:
Shell_Menteng - Tugu_Tani - Fraser_Residence - Kanisius - Menteng_Kecil - Stasiun_Gondangdia
Distance: 8.0
```

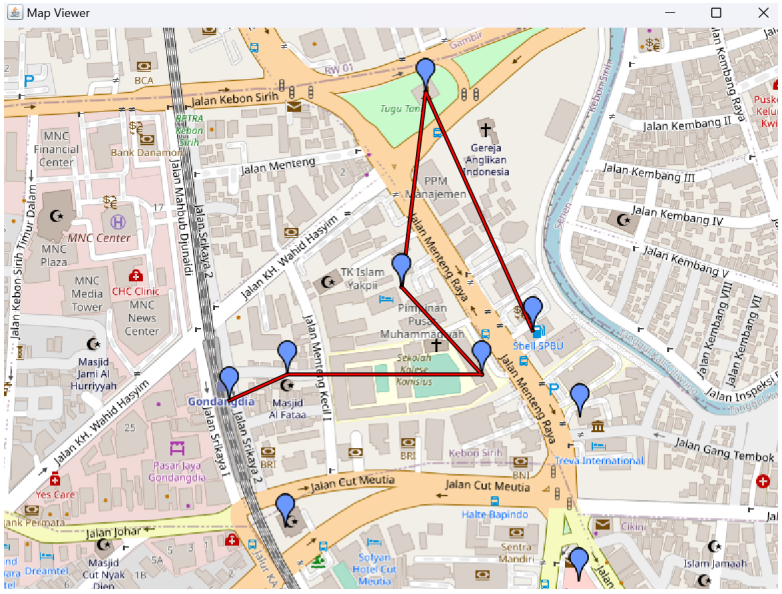
Gambar 2.21: Pencarian dengan UCS



Gambar 2.22: Visualisasi Pencarian dengan UCS

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map1.txt

MAP LOCATIONS:
1. Tugu_Tani
2. Kanisius
3. Masjid_Cut_Meutia
4. Menteng_Huis
5. Gedung_Joang
6. Shell_Menteng
7. Fraser_Residence
8. Stasiun_Gondangdia
9. Menteng_Kecil

Enter the starting location name:
Shell_Menteng

Enter the target finish location name:
Stasiun_Gondangdia

Please choose the algorithm for pathfinding:
1. UCS
2. A*
2

Shortest Path:
Shell_Menteng - Tugu_Tani - Fraser_Residence - Kanisius - Menteng_Kecil - Stasiun_Gondangdia
Distance: 8.0
```

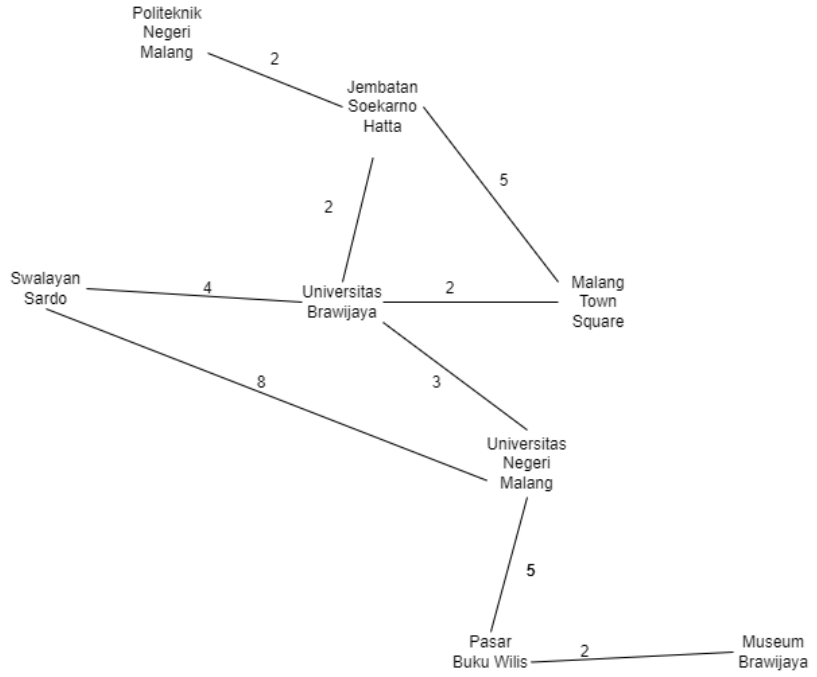
Gambar 2.23: Pencarian dengan A*



Gambar 2.24: Visualisasi Pencarian dengan A*

2.4.5 Peta di Malang

Pada folder test, peta ini diberi nama file map5.txt, dengan visualisasi dalam bentuk graf sebagai berikut,

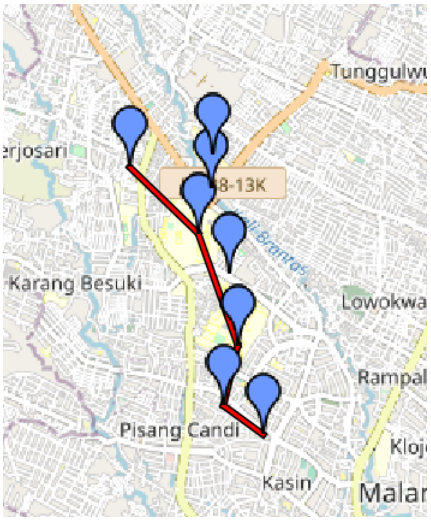


Gambar 2.25: Visualisasi Graf Map5.txt

Rute Museum Brawijaya - Swalayan Sardo

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map5.txt

MAP LOCATIONS:
1. Universitas_Brawijaya
2. Universitas_Negeri_Malang
3. Swalayan_Sardo
4. Pasar_Buku_Wilis
5. Museum_Brawijaya
6. Jembatan_Soeta
7. Malang_Town_Square
8. Politeknik_Negeri_Malang

Enter the starting location name:
Museum_Brawijaya

Enter the target finish location name:
Swalayan_Sardo

Please choose the algorithm for pathfinding:
1. UCS
2. A*
1

Shortest Path:
Museum_Brawijaya - Pasar_Buku_Wilis - Universitas_Negeri_Malang - Universitas_Brawijaya - Swalayan_Sardo
Distance: 14.0
```

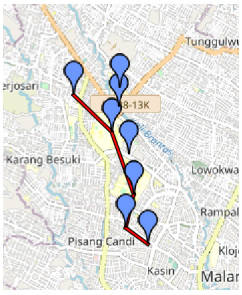
Gambar 2.26: Pencarian dengan UCS



Gambar 2.27: Visualisasi Pencarian dengan UCS

```
Welcome to the shortest path finder!
Please enter the file name of the map you want to use:
map5.txt

MAP LOCATIONS:
1. Universitas_Brawijaya
2. Universitas_Negeri_Malang
3. Swalayan_Sardo
4. Pasar_Buku_Wilis
5. Museum_Brawijaya
6. Jembatan_Soeta
7. Malang_Town_Square
8. Politeknik_Negeri_Malang

Enter the starting location name:
Museum_Brawijaya

Enter the target finish location name:
Swalayan_Sardo

Please choose the algorithm for pathfinding:
1. UCS
2. A*
2

Shortest Path:
Museum_Brawijaya - Pasar_Buku_Wilis - Universitas_Negeri_Malang - Universitas_Brawijaya - Swalayan_Sardo
Distance: 14.0
```

Gambar 2.28: Pencarian dengan A*



Gambar 2.29: Visualisasi Pencarian dengan A*

BAB 3

Simpulan

3.1 Simpulan

Dari tugas kecil ini, dapat disimpulkan hal-hal sebagai berikut,

1. Algoritma pencarian rute terpendek adalah A* dan UCS. Keduanya merupakan modifikasi dari breadth-first search dengan menggunakan perhitungan
2. UCS merupakan uninformed search karena tidak ada perhitungan nilai heuristic dari suatu titik ke titik tujuan. UCS hanya mengandalkan nilai jarak dari suatu titik ke titik akhir, hingga ditemukan titik tujuan
3. A* merupakan informed search karena perhitungan nilai heuristic dari suatu titik ke titik tujuan membantu menentukan apakah suatu titik sudah lebih dekat ke titik yang ingin dituju tanpa perlu melakukan pergerakan yang tidak diperlukan

3.2 Komentar

- Matthew Mahendra: Jadi lebih paham UCS sama A* dibandingkan kalau cuman dengerin di kelas
- Christophorus Dharma Winata:

Lampiran A

Pranala Github

Tugas ini sudah dipublikasi pada Github dengan pranala `https://github.com/MHEN2606/Tucil3_13521007_13521009`

Lampiran B

Checklist

Poin	Ya	Tidak
1. Program dapat menerima input graf	✓	
2. Program dapat menghitung lintasan terpendek dengan UCS	✓	
3. Program dapat menghitung lintasan terpendek dengan A*	✓	
4. Program dapat menampilkan lintasan terpendek serta jaraknya	✓	
5. Bonus: Program dapat menerima input peta dengan Google Map API dan menampilkan peta serta lintasan terpendek pada peta	✓	

Table B.1: Tabel Check List