

Semester Project

(Data Structures and Algorithms)

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421G

Introduction

For my semester project at Data Structures and Algorithms I chose to develop a program that can help you find the fastest route between some of the important cities of Romania.

The requirement of the problem:

Write a program that can find the fastest route between two cities. The user will be prompted to select his starting point and the destination. The program will show him the fastest path and the distance that he needs to travel.

Description of the program in natural language

The program will ask for two names and display the required information. The cities represent nodes in a weighted graph, the weight being the distance between two nodes in kilometers. For an easier visualization I realized the following schematic:



```

1
2 #include <stdio.h>
3 #include <stdlib.h>
4 #include <stdbool.h>
5 #include <math.h>
6 #include <string.h>
7 #define numar 100
8 #define Raza 6371
9
10
11
12 typedef struct {
13     double x;
14     double y;
15     char *name;
16     int number;
17 } Point;
18
19 typedef struct {
20     int source;
21     int destination;
22     double weight;
23 } Edge;
24
25 typedef struct {
26     Point nodes[numar];
27     int numNodes;
28     double adjacencyMatrix[numar][numar];
29 } Graph;
30
31 double distance(Point* p, Point* q);
32
33 Point* addNode(Graph* graph, const char* name, double x, double y, int number) {
34     Point* newNode = (Point*)malloc(sizeof(Point));
35     newNode->x = x;
36     newNode->y = y;
37     newNode->number = number;
38     newNode->name = strdup(name);
39     graph->nodes[number] = *newNode;
40     graph->numNodes++;
41
42     return newNode;
43 }
44
45 void addEdge(Graph* graph, Point *p, Point *q) {
46
47     Edge newEdge;
48     newEdge.source=p->number;
49     newEdge.destination=q->number;
50     newEdge.weight=distance(p,q);
51     graph->adjacencyMatrix[p->number][q->number] = distance(p,q);
52     graph->adjacencyMatrix[q->number][p->number] = distance(p,q);
53
54 }
55
56
57 double distance(Point* p, Point* q) {
58     double latitude1, longitude1, height1, latitude2, longitude2, height2;
59
60     double x1 = p->y * 0.017;
61     double y1 = p->x * 0.017;
62     double x2 = q->y * 0.017;
63     double y2 = q->x * 0.017;
64
65     height1 = Raza * cos(x1);
66     latitude1 = Raza * sin(x1) * cos(y1);
67     longitude1 = Raza * sin(x1) * sin(y1);
68
69     height2 = Raza * cos(x2);
70     latitude2 = Raza * sin(x2) * cos(y2);
71     longitude2 = Raza * sin(x2) * sin(y2);
72
73     double distance = (latitude1 - latitude2) * (latitude1 - latitude2) +
74                     (longitude1 - longitude2) * (longitude1 - longitude2) +
75                     (height1 - height2) * (height1 - height2);
76
77     return sqrt(distance);
78 }
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154     addEdge(graph, p: c10, q: c6);
155     addEdge(graph, p: c9, q: c10);
156     addEdge(graph, p: c15, q: c9);
157     addEdge(graph, p: c2, q: c11);
158     addEdge(graph, p: c11, q: c12);
159     addEdge(graph, p: c14, q: c8);
160     addEdge(graph, p: c5, q: c9);
161     addEdge(graph, p: c5, q: c15);
162     addEdge(graph, p: c14, q: c6);
163     addEdge(graph, p: c5, q: c13);
164     addEdge(graph, p: c13, q: c15);
165     addEdge(graph, p: c13, q: c7);
166     addEdge(graph, p: c7, q: c3);
167     addEdge(graph, p: c11, q: c8);
168     addEdge(graph, p: c16, q: c5);
169     addEdge(graph, p: c16, q: c12);
170     addEdge(graph, p: c17, q: c3);
171     addEdge(graph, p: c17, q: c4);
172     addEdge(graph, p: c17, q: c2);
173     addEdge(graph, p: c17, q: c7);
174     Point *start=NULL,*end=NULL;
175     char ans[10], city1[50], city2[50];
176
177     do {
178         printf( format: "Where do you want your journey to start?\n");
179         scanf( format: "%s", city1);
180         printf( format: "Where do you want your journey to end?\n");
181         scanf( format: "%s", city2);
182         for (int i = 0; i < graph->numNodes; i++) {
183             if (strcmp(graph->nodes[i].name, city1) == 0) start = &graph->nodes[i];
184             else if (strcmp(graph->nodes[i].name, city2) == 0) end = &graph->nodes[i];
185             if (start != NULL && end != NULL) {
186                 break;
187             }
188         }
189         bfs(graph, start, end);
190         printf( format: "Would you like to do something else ['no' to stop]? ");
191         scanf( format: "%s", ans);
192     } while (strcmp(ans, "no") != 0);
193
194
195     free( Memory: graph);
196
197     return 0;

```

Where do you want your journey to start?

Constanta

Where do you want your journey to end?

Iasi

Path: Iasi Focsani Constanta

Total Distance: 367.22 km

Where do you want your journey to start?

Timisoara

Where do you want your journey to end?

Bucuresti

Path: Bucuresti Ploiesti Pitesti Craiova Timisoara

Total Distance: 506.53 km