# Dijkstras

0.1.0

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# Chapter 1

# Final Project - Dijkstra's Algorithm

1. This project is using Dijkstra's Algorithm to find the shortest path among any length of nodes in a graph. We decided to choose 9 different vertices starting from 0 to 8. The purpose of this program is to find the shortest distance from vertex 0 being the starting point and to other vertices 1-8.
2. For example, the shortest distance path between 0 and 8 vertices is $0 \rightarrow 1 \rightarrow 2 \rightarrow 8$, and the actual distance would be 14 since the distance from $0 \rightarrow 1 = 4$ (0,1,4), $1 \rightarrow 2 = 8$ (1,2,8), $2 \rightarrow 8 = 2$ (2,8,2) according to addEdge functions, therefore, 4 + 8 + 2 = 14.
3. We wanted to do a project that uses something that we have learned before such as graphs data structure, and Dijkstra's algorithm was something that seemed interesting to learn and implement with our project.
4. The data structure we chose is graphs because it is the best representation of applying Dijkstra's algorithm.
5. We used Dijkstra's algorithm because it is the algorithm to find the shortest distance between certain pair of vertices.

## 1.1 References


1. https://www.geeksforgeeks.org/dijkstras-shortest-path-algorithm-greedy-algo-7/
2. http://www.gitta.info/Accessibiliti/en/html/Dijkstra_learningObject1.html
3. http://www.cplusplus.com/forum/articles/7459/

# Chapter 2

# Class Index

## 2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

# Chapter 3

# File Index

## 3.1 File List

Here is a list of all files with brief descriptions:

# Chapter 4

# Class Documentation

## 4.1 Graph Class Reference

### Public Member Functions

- Graph (int x)
- void addEdge (int i, int j, int dist)
- void removeEdge (int i, int j)
- int distance (int i, int j)
- vector< int > outEdges (int i)
- int length ()
- int ** matrixOut ()

### 4.1.1 Detailed Description

This class creates an integer matrix graph.

Definition at line 19 of file main.cpp.

### 4.1.2 Constructor & Destructor Documentation

#### 4.1.2.1 Graph()

```
Graph::Graph (
            int x )  [inline]
```

Graph constructor

**Parameters**

| | |
|---|---|
| *x* | The dimensions of the graph |

Definition at line 31 of file main.cpp.

```
31                  {
32          n = x;
33          matrix = new int*[n];
34          for (int i=0; i<n; i++)
35              matrix[i] = new int[n];
36
37      }
```

### 4.1.3 Member Function Documentation

#### 4.1.3.1 addEdge()

```
void Graph::addEdge (
              int i,
              int j,
              int dist )  [inline]
```

Adds an edge to the graph by setting [i][j] to the distance from the nodes

**Parameters**

| | |
|---|---|
| *i* | Initial node |
| *j* | Node to connect |

Definition at line 45 of file main.cpp.

```
45                                          {
46          matrix[i][j] = dist;
47          matrix[j][i] = dist;
48      }
```

#### 4.1.3.2 distance()

```
int Graph::distance (
              int i,
              int j )  [inline]
```

Finds distance by checking the number stored in [i][j]

**Parameters**

| | |
|---|---|
| *i* | Initial node |
| *j* | A connected node |

Definition at line 66 of file main.cpp.

```
66                                  {
67          return matrix[i][j];
68      }
```

#### 4.1.3.3 length()

```
int Graph::length ( )  [inline]
```

Returns the length by returning n

**Returns**

lenght of graph

Definition at line 91 of file main.cpp.

```
91                  {
92          return n;
93      }
```

#### 4.1.3.4 matrixOut()

```
int** Graph::matrixOut ( )  [inline]
```

Retruns the matrix

**Returns**

the matrix

Definition at line 100 of file main.cpp.

```
100                         {
101          return matrix;
102      }
```

#### 4.1.3.5 outEdges()

```
vector<int> Graph::outEdges (
              int i )  [inline]
```

Finds all nodes connected to i by checking all of it's rows

**Parameters**

| | |
|---|---|
| *i* | Initial node |

**Returns**

A vector of all connected nodes

Definition at line 76 of file main.cpp.

```
76                                  {
77          vector<int> edges;
```

```
78          for (int j=0; j<n; j++) {
79              if (matrix[i][j]) {
80                  edges.push_back(j);
81              }
82          }
83          return edges;
84      }
```

#### 4.1.3.6 removeEdge()

```
void Graph::removeEdge (
              int i,
              int j )  [inline]
```

Removes an edge from the graph by setting [i][j] to 0

**Parameters**

| | |
|---|---|
| *i* | Initial node |
| *j* | Connected node |

Definition at line 56 of file main.cpp.

```
56                                      {
57          matrix[i][j] = 0;
58          matrix[i][j] = 0;
59      }
```

The documentation for this class was generated from the following file:

- /home/brandon/CPTR227/FinalProject/Dijkstras-Algorithm/src/main.cpp

# Chapter 5

# File Documentation

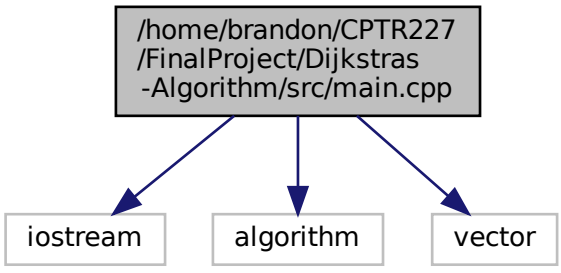
## 5.1 /home/brandon/CPTR227/FinalProject/Dijkstras-Algorithm/README.md File Reference

## 5.2 /home/brandon/CPTR227/FinalProject/Dijkstras-Algorithm/src/main.cpp File Reference

This is Final Project for CPTR 227.

```
#include <iostream>
#include <algorithm>
#include <vector>
```

Include dependency graph for main.cpp:




### Classes

- class Graph

## Functions

- void Dijkstra (Graph g, int source, int ∗dist, int ∗parent)
- void printShortPath (Graph g, int ∗dist, int ∗parent)
- int main (int, char ∗∗)

### 5.2.1 Detailed Description

This is Final Project for CPTR 227.

This is implementation of Dijkstra's Algorithm to find the shortest path.

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**Date**

5/5/2021

### 5.2.2 Function Documentation

#### 5.2.2.1 Dijkstra()

```
void Dijkstra (
            Graph g,
            int source,
            int * dist,
            int * parent )
```

Finds the shortest path in a graph using Dijkstras algorithm

**Parameters**

| | |
|---|---|
| *g* | The graph |
| *source* | Initial node |
| *dist* | An empty array with the same size as g to store distance values |
| *parent* | An empty array with the same size as g to store path values |

Definition at line 114 of file main.cpp.

```
114                                                     {
115     int index = 0;
116     bool used[g.length()]; // An array that stors if the node's shortest path has already be found
117
118     for (int i=0; i<g.length(); i++){
119         dist[i] = -1;
120         used[i] = false;
121     }
122
123     dist[source] = 0; // The distance from source to source is 0
```

```
124     used[source] = true; // Mark source as used
125     parent[source] = 0; // Source has no path to source
126 
127     for (int i=0; i<g.length(); i++){
128 
129         vector<int> edge = g.outEdges(index); // Stores all of index's connected nodes
130 
131         // Updates the distances from source to the edge
132         for (int ii=0; ii<edge.size(); ii++){
133             int u = dist[index] + g.distance(index, edge[ii]);
134             if (u < dist[edge[ii]] || dist[edge[ii]] == -1){
135                 parent[edge[ii]] = index;
136                 dist[edge[ii]] = dist[index] + g.distance(index, edge[ii]);
137             }
138         }
139         // Reset min
140         int min = -1; // Stores the smalles distance value
141 
142         // Finds the shortest path of the discovered distances
143         for (int ii=0; ii<g.length(); ii++){
144             if (!used[ii] && dist[ii] != -1){
145                 if (dist[ii] < min || min == -1){
146                     min = dist[ii];
147                     index = ii;
148                 }
149             }
150         }
151         // Marks shortest node path as used
152         used[index] = true;
153     }
154 }
```

#### 5.2.2.2 main()

```
int main (
              int ,
              char **  )
```

Definition at line 190 of file main.cpp.

```
190                         {
191     Graph g(9);
192 
193     int dist[g.length()];
194     int parent[g.length()];
195 
196     g.addEdge(0,1,4);
197     g.addEdge(1,2,8);
198     g.addEdge(2,3,7);
199     g.addEdge(3,4,9);
200     g.addEdge(4,5,10);
201     g.addEdge(5,6,2);
202     g.addEdge(6,7,1);
203     g.addEdge(7,8,7);
204     g.addEdge(7,0,8);
205     g.addEdge(1,7,11);
206     g.addEdge(2,5,4);
207     g.addEdge(3,5,14);
208     g.addEdge(2,8,2);
209     g.addEdge(6,8,6);
210     g.addEdge(0,7,8);
211 
212     Dijkstra(g, 0, dist, parent);
213     printShortPath(g, dist, parent);
214 }
```

#### 5.2.2.3 printShortPath()

```
void printShortPath (
              Graph g,
              int * dist,
              int * parent )
```

Prints the distances and shortest path of each node from source

**Parameters**

| | |
|---|---|
| *g* | The graph |
| *dist* | The list of smallest distances |
| *parent* | A list that hold path info |

Definition at line 163 of file main.cpp.

```
163                                                 {
164     cout « "Distance  Shortest" « endl;
165     cout « "  from 0      path" « endl;
166     cout « "------------------" « endl;
167     int index = 0;
168     vector<int> items;
169     for (int i=1; i<g.length(); i++){
170         cout « i « ": " « dist[i] « string(5, ' ');
171         items.clear();
172         index = i;
173         do
174         {
175                 items.push_back(parent[index]);
176                 index = parent[index];
177         } while (index > 0);
178         reverse(items.begin(),items.end());
179         for (int ii=0; ii<=items.size()-1; ii++){
180             if (ii==0 && dist[i] < 10){
181                 cout « ' ';
182             }
183             cout « items[ii] « " → ";
184         }
185         cout « i «endl;
186     }
187 }
```

# Index