CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

DEVANG PATEL INSTITUTE OF ADVANCE TECHNOLOGY & RESEARCH

Computer Science & Engineering

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SUBJECT: DESIGN AND ANALYSIS OF ALGORITHM

CODE: CS 351

GRAPH

PRACTICAL-6.1

AIM:

Write a program to detect cycles in an directed graph.

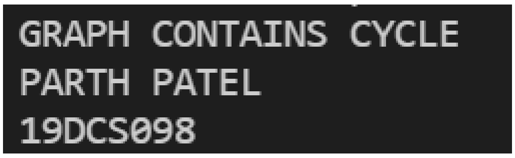
PROGRAM CODE:

```
#include <iostream>
#include <list>
#include <limits.h>
using namespace std;
class Graph
{
    int V;
    list<int> *adj;
    bool isCyclicUtil(int v, bool visited[], bool *rs);

public:
    Graph(int V);
    void addEdge(int v, int w);
    bool isCyclic();
};
Graph::Graph(int V)
{
    this->V = V;
    adj = new list<int>[V];
}
```

```
void Graph::addEdge(int v, int w)
{
    adj[v].push_back(w);
}
bool Graph::isCyclicUtil(int v, bool visited[], bool *recStack)
{
    if (visited[v] == false)
    {
        visited[v] = true;
        recStack[v] = true;
        list<int>::iterator i;
        for (i = adj[v].begin(); i != adj[v].end(); ++i)
        {
            if (!visited[*i] && isCyclicUtil(*i, visited, recStack))
                return true;
            else if (recStack[*i])
                return true;
        }
    }
    recStack[v] = false;
    return false;
}
bool Graph::isCyclic()
{
    bool *visited = new bool[V];
    bool *recStack = new bool[V];
    for (int i = 0; i < V; i++)
    {
        visited[i] = false;
        recStack[i] = false;
    }
    for (int i = 0; i < V; i++)
        if (isCyclicUtil(i, visited, recStack))
```

```
            return true;
    return false;
}
int main()
{
    Graph g(4);
    g.addEdge(0, 1);
    g.addEdge(1, 2);
    g.addEdge(1, 2);
    g.addEdge(2, 0);
    g.addEdge(2, 3);
    g.addEdge(3, 3);
    if (g.isCyclic())
        cout << "GRAPH CONTAINS CYCLE";
    else
        cout << "GRAPH DOES NOT CONTAIN CYCLE";

    cout << "\nPARTH PATEL\n19DCS098" << endl;
    return 0;
}
```

OUTPUT:



```
GRAPH CONTAINS CYCLE
PARTH PATEL
19DCS098
```

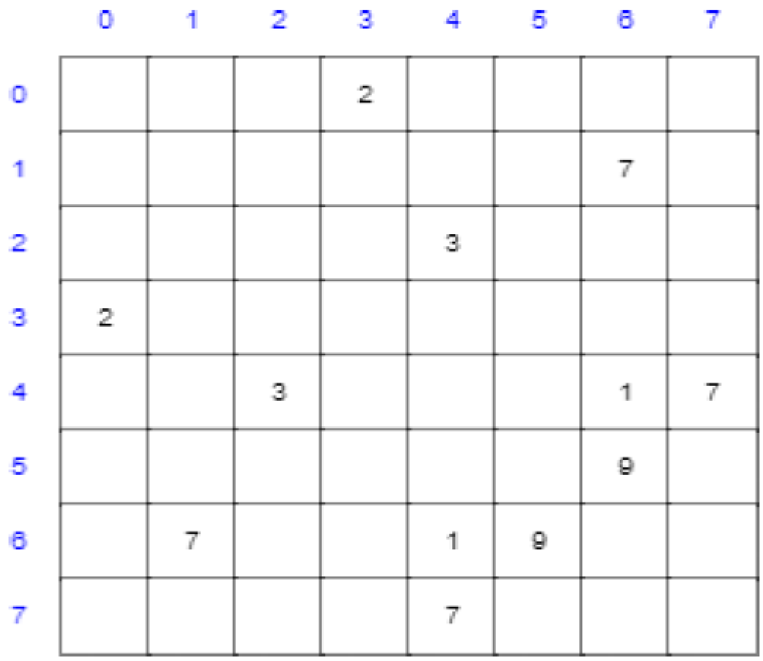
CONCLUSION:

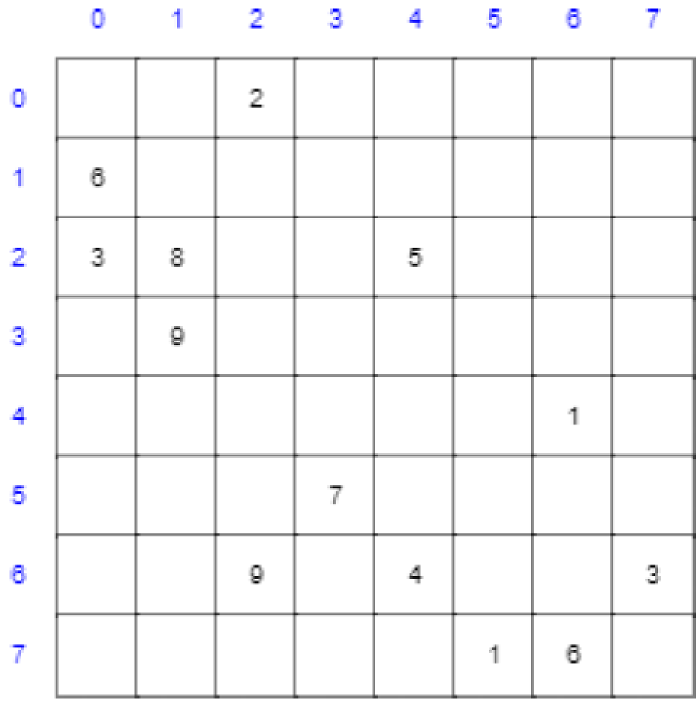
- DFS for a connected graph produces a tree.
- Time Complexity: **O(V + E)**
- Depth First Traversal can be used to detect a cycle in a Graph.

PRACTICAL-6.2

AIM:

From a given vertex in a weighted graph, implement a program to find shortest paths to other vertices using Dijkstra's algorithm.

Test Case	Adjacency Matrix of graph	Start Vertex
1	 $\begin{array}{c\|cccccccc} & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ \hline 0 & & & & 2 & & & & \\ 1 & & & & & & & 7 & \\ 2 & & & & & 3 & & & \\ 3 & 2 & & & & & & & \\ 4 & & & 3 & & & & 1 & 7 \\ 5 & & & & & & & 9 & \\ 6 & & 7 & & & 1 & 9 & & \\ 7 & & & & & 7 & & & \end{array}$	1

<table>
<tr>
<td>2</td>
<td>

<table>
<tr><th></th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td>0</td><td></td><td></td><td>2</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>3</td><td>8</td><td></td><td></td><td>5</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td><td></td></tr>
<tr><td>5</td><td></td><td></td><td></td><td>7</td><td></td><td></td><td></td><td></td></tr>
<tr><td>6</td><td></td><td></td><td>9</td><td></td><td>4</td><td></td><td></td><td>3</td></tr>
<tr><td>7</td><td></td><td></td><td></td><td></td><td></td><td>1</td><td>6</td><td></td></tr>
</table>
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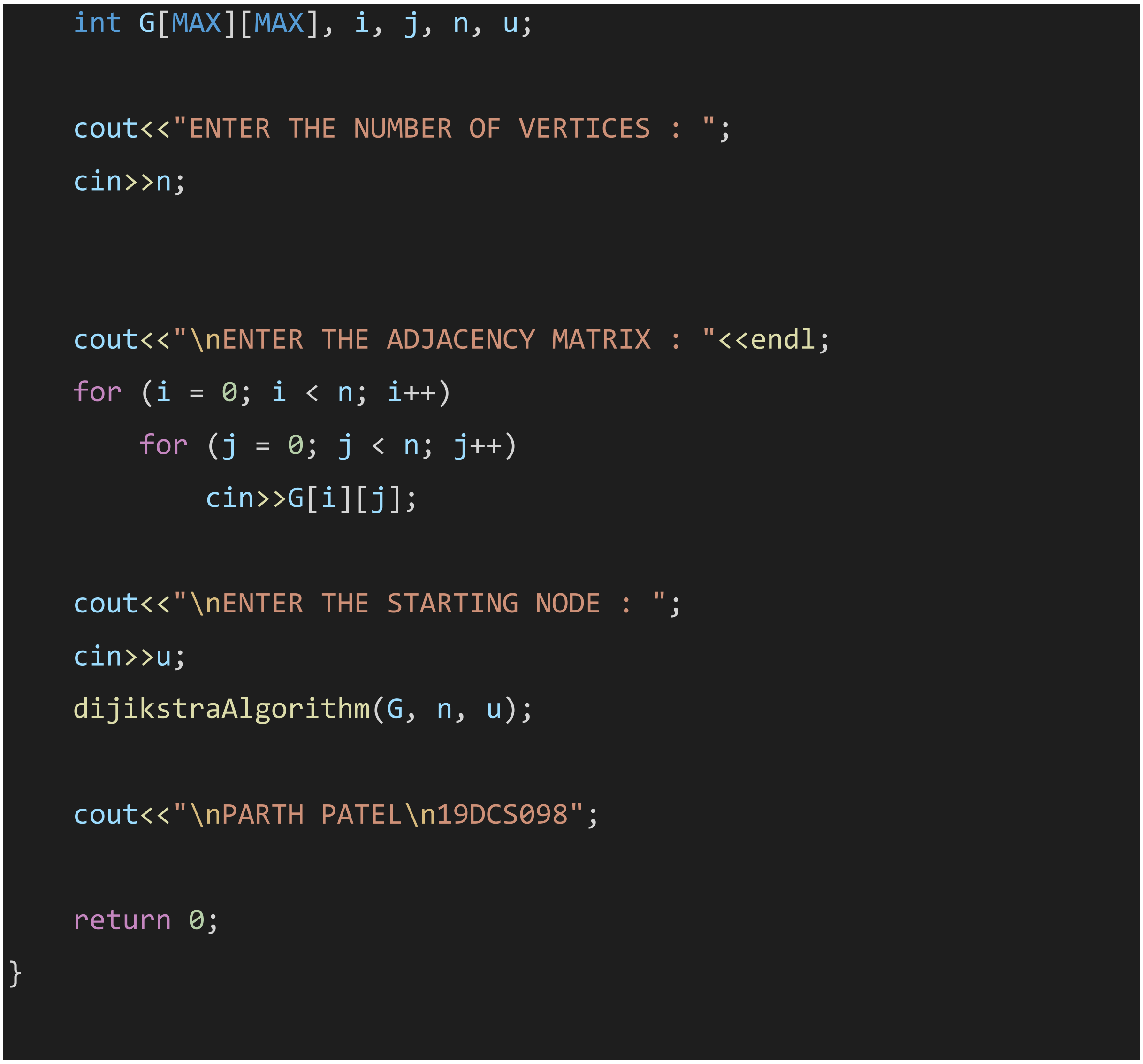
</tr>
</table>

PROGRAM CODE:

```
#include <iostream>
#define INFINITY 10000
#define MAX 10

using namespace std;

void dijikstraAlgorithm(int G[MAX][MAX], int n, int startnode)
{
    int cost[MAX][MAX], distance[MAX], pred[MAX];
    int visited[MAX], count, mindistance, nextnode, i, j;
    for (i = 0; i < n; i++)
        for (j = 0; j < n; j++)
            if (G[i][j] == 0)
                cost[i][j] = INFINITY;
            else
                cost[i][j] = G[i][j];
    for (i = 0; i < n; i++)
    {
        distance[i] = cost[startnode][i];
        pred[i] = startnode;
        visited[i] = 0;
    }
    distance[startnode] = 0;
    visited[startnode] = 1;
    count = 1;
    while (count < n - 1)
    {
        mindistance = INFINITY;
        for (i = 0; i < n; i++)
```

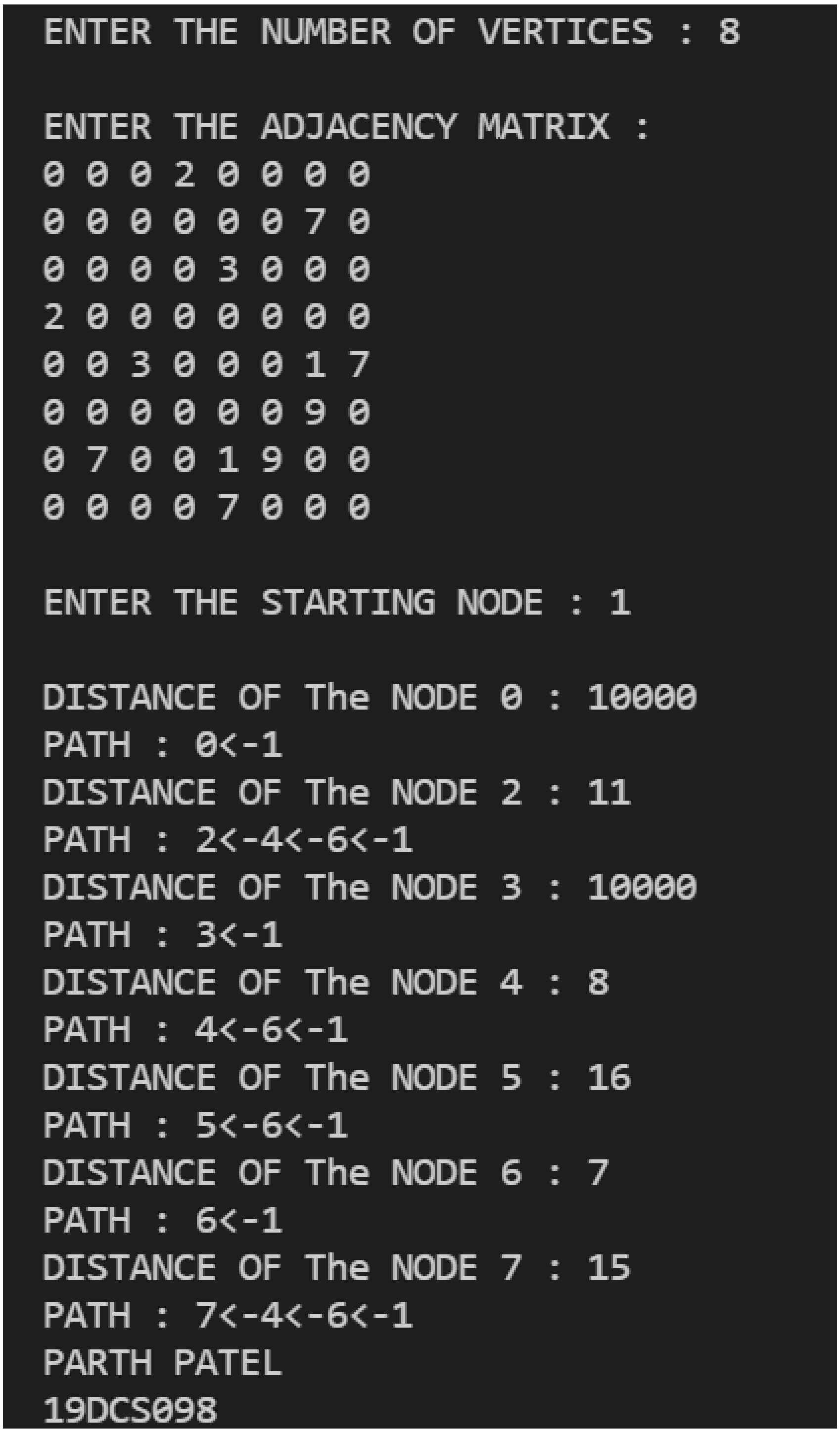
```
            if (distance[i] < mindistance && !visited[i])
            {
                mindistance = distance[i];
                nextnode = i;
            }
        visited[nextnode] = 1;
        for (i = 0; i < n; i++)
            if (!visited[i])
                if (mindistance + cost[nextnode][i] < distance[i])
                {
                    distance[i] = mindistance + cost[nextnode][i];
                    pred[i] = nextnode;
                }
        count++;
    }
    for (i = 0; i < n; i++)
        if (i != startnode)
        {

            cout<<"\nDISTANCE OF The NODE "<<i<<" : "<<distance[i];

            cout<<"\nPATH : "<<i;
            j = i;
            do
            {
                j = pred[j];
                printf("<-%d", j);
            } while (j != startnode);
        }
}

int main()
{
```



```
    int G[MAX][MAX], i, j, n, u;

    cout<<"ENTER THE NUMBER OF VERTICES : ";
    cin>>n;



    cout<<"\nENTER THE ADJACENCY MATRIX : "<<endl;
    for (i = 0; i < n; i++)
        for (j = 0; j < n; j++)
            cin>>G[i][j];

    cout<<"\nENTER THE STARTING NODE : ";
    cin>>u;
    dijikstraAlgorithm(G, n, u);

    cout<<"\nPARTH PATEL\n19DCS098";

    return 0;
}
```

OUTPUT:

Test Case-1:



```
ENTER THE NUMBER OF VERTICES : 8

ENTER THE ADJACENCY MATRIX :
0 0 0 2 0 0 0 0
0 0 0 0 0 0 7 0
0 0 0 0 3 0 0 0
2 0 0 0 0 0 0 0
0 0 3 0 0 0 1 7
0 0 0 0 0 0 9 0
0 7 0 0 1 9 0 0
0 0 0 0 7 0 0 0

ENTER THE STARTING NODE : 1

DISTANCE OF The NODE 0 : 10000
PATH : 0<-1
DISTANCE OF The NODE 2 : 11
PATH : 2<-4<-6<-1
DISTANCE OF The NODE 3 : 10000
PATH : 3<-1
DISTANCE OF The NODE 4 : 8
PATH : 4<-6<-1
DISTANCE OF The NODE 5 : 16
PATH : 5<-6<-1
DISTANCE OF The NODE 6 : 7
PATH : 6<-1
DISTANCE OF The NODE 7 : 15
PATH : 7<-4<-6<-1
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```
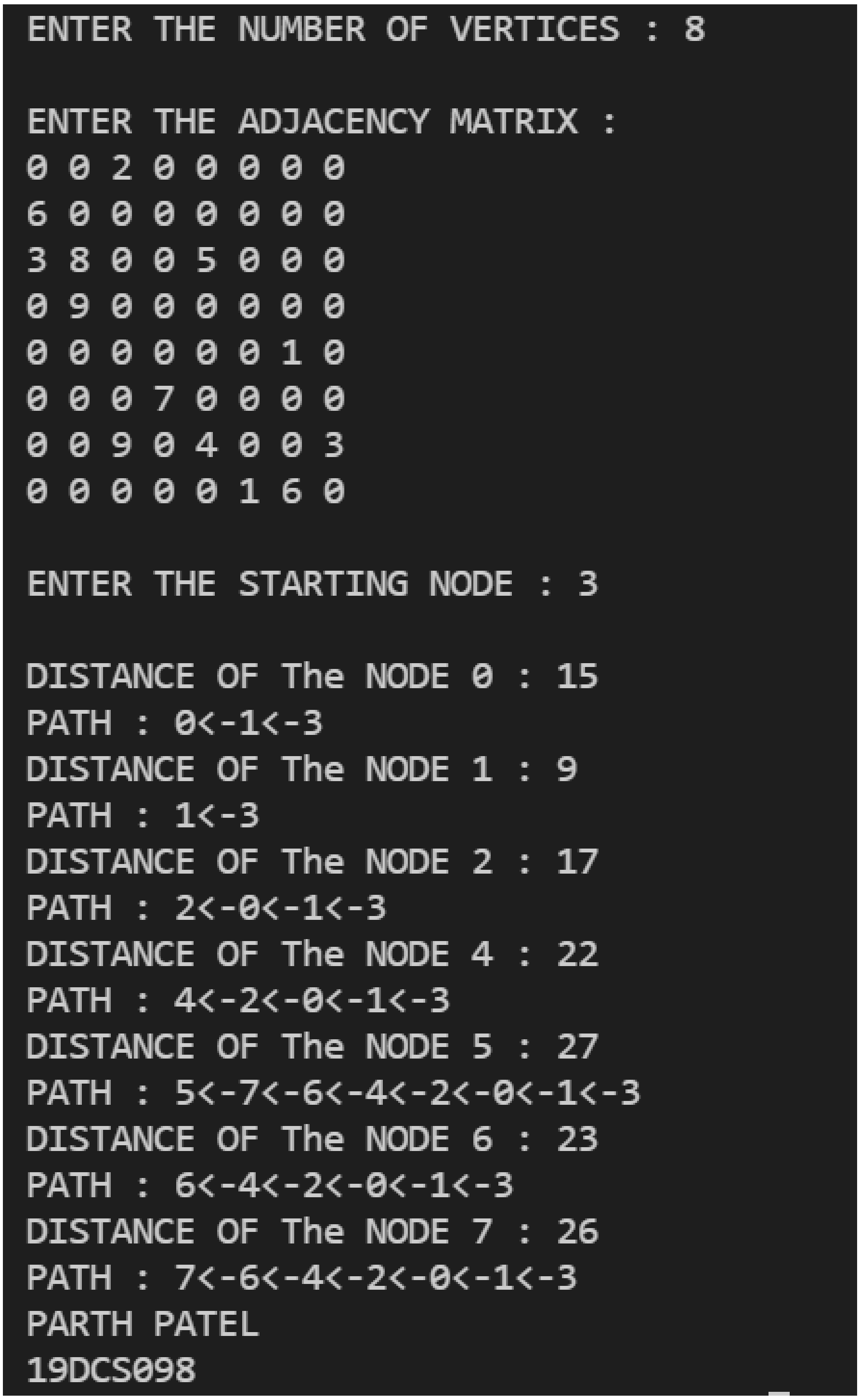

Test Case-2:



```
ENTER THE NUMBER OF VERTICES : 8

ENTER THE ADJACENCY MATRIX :
0 0 2 0 0 0 0 0
6 0 0 0 0 0 0 0
3 8 0 0 5 0 0 0
0 9 0 0 0 0 0 0
0 0 0 0 0 0 1 0
0 0 0 7 0 0 0 0
0 0 9 0 4 0 0 3
0 0 0 0 0 1 6 0

ENTER THE STARTING NODE : 3

DISTANCE OF The NODE 0 : 15
PATH : 0<-1<-3
DISTANCE OF The NODE 1 : 9
PATH : 1<-3
DISTANCE OF The NODE 2 : 17
PATH : 2<-0<-1<-3
DISTANCE OF The NODE 4 : 22
PATH : 4<-2<-0<-1<-3
DISTANCE OF The NODE 5 : 27
PATH : 5<-7<-6<-4<-2<-0<-1<-3
DISTANCE OF The NODE 6 : 23
PATH : 6<-4<-2<-0<-1<-3
DISTANCE OF The NODE 7 : 26
PATH : 7<-6<-4<-2<-0<-1<-3
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19DCS098
```

CONCLUSION:

- Dijkstra’s algorithm is very similar to Prim’s algorithm for minimum spanning tree.
- Dijkstra's algorithm is an algorithm for finding the shortest paths between nodes in a graph
- Complexity: **O(ElogV)**
- It is also known as **SINGLE SOURCE SHORTEST PATH ALGORITHM**