



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Experiment - 8

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Semester: 5th

Date of Performance: 16/10/25

Subject Name: Design and Analysis of Algorithms

Subject Code: 23CSH-301

Aim: Develop a program and analyze complexity to find shortest paths in a graph with positive edgeweights using Dijkstra's algorithm.

Objective: Code and analyze to find shortest paths in a graph with positive edge weights using Dijkstra's

Input/Apparatus Used: Graph ($G = (V, E)$) is taken as input for this problem.

Procedure:

Follow the steps below to solve the problem:

- Create a set sptSet (shortest path tree set) that keeps track of vertices included in the shortest- path tree, i.e., whose minimum distance from the source is calculated and finalized. Initially, this set is empty.
- Assign a distance value to all vertices in the input graph. Initialize all distance values as INFINITE. Assign the distance value as 0 for the source vertex so that it is picked first.
- While sptSet doesn't include all vertices
- Pick a vertex u which is not there in sptSet and has a minimum distance value.



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- Include u to sptSet.
- Then update distance value of all adjacent vertices of u.
- To update the distance values, iterate through all adjacent vertices.
- For every adjacent vertex v, if the sum of the distance value of u (fromsource) and weight of edge u-v, is less than the distance value of v, then update the distance value of v.

Algorithm

- **Step 1:** SET STATUS = 1 (ready state) for each node in G
- **Step 2:** Push the starting node A on the stack and set its STATUS = 2 (waiting state)
- **Step 3:** Repeat Steps 4 and 5 until STACK is empty
- **Step 4:** Pop the top node N. Process it and set its STATUS = 3 (processed state)
- **Step 5:** Push on the stack all the neighbours of N that are in the ready state (whose STATUS = 1) and set their STATUS = 2 (waiting state)
[END OF LOOP]
- **Step 6:** EXIT

Code and Output:

```
#include <bits/stdc++.h>
using namespace std;
#define INF INT_MAX
int minDistance(vector<int>& dist, vector<bool>& sptSet, int V)
{ int minVal = INF, minIndex = -1; for (int v = 0; v < V; v++) { if
(!sptSet[v] && dist[v] <= minVal) { minVal = dist[v]; minIndex
= v;
```



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```
        }

    } return

minIndex; }

void printSolution(vector<int>& dist, int V)

{ cout << "\nVertex\tDistance from

Source\n"; for (int i = 0; i < V; i++) cout << i

<< "\t\t"

<< dist[i] << "\n";

}

void dijkstra(vector<vector<int>>& graph, int src, int V) {

vector<int> dist(V, INF); vector<bool> sptSet(V, false);

dist[src] = 0;

for (int count = 0; count < V - 1; count++)

{ int u = minDistance(dist, sptSet, V);

sptSet[u] = true;

for (int v = 0; v < V; v++) { if (!sptSet[v] && graph[u]

[v] && dist[u] != INF && dist[u] + graph[u][v] <

dist[v]) { dist[v] = dist[u] + graph[u][v];

}

}

}

printSolution(dist, V);

}

int main() {

cout << "DIJKSTRA'S ALGORITHM - SHORTEST PATH FINDER\n\n";

int V; cout << "Enter number of

vertices: "; cin >> V;

vector<vector<int>> graph(V, vector<int>(V, 0)); cout <<

"\nEnter the adjacency matrix (0 for no edge):\n"; for (int
```



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```
i = 0; i < V; i++) { for (int j = 0; j < V; j++) cin >>
graph[i][j];
}
int src;
cout << "\nEnter source vertex (0 to " << V - 1 << "): ";
cin >> src;
dijkstra(graph, src, V);
return 0;
}
```

Output

```
DIJKSTRA'S ALGORITHM - SHORTEST PATH FINDER

Enter number of vertices: 5

Enter the adjacency matrix (0 for no edge):
0 10 0 5 0
0 0 1 2 0
0 0 0 0 4
0 3 9 0 2
7 0 6 0 0

Enter source vertex (0 to 4): 0

Vertex  Distance from Source
0          0
1          8
2          9
3          5
4          7
```