



Experiment - 8

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Semester: 5th

Date of Performance: 13/10/25

Subject Name: Design and Analysis of Algorithms

Subject Code: 23CSH-301

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

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

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

4. 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.
- 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 (from source) and weight of edge $u-v$, is less than the distance value of v , then update the distance value of v .

5. 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

6. 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] +
```



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```
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 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;
```



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```
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
```