DESIGN ANALYSIS AND ALGORITHM

PRACTICAL NO 8

027_Abhishek_Ojha

Experiment No - 8 **Date of Experiment :- 23 October 2021**

Program :- Write a program to Implement Dijkstra's algorithm.

Algorithm

Dijkstra's Algorithm

1. Create cost matrix C[ ][ ] from adjacency matrix adj[ ][ ]. C[i][j] is the cost of going

from vertex i to vertex j. If there is no edge between vertices i and j then C[i][j] is

infinity.

2. Array visited[ ] is initialized to zero.

for(i=0;i<n;i++)

visited[i]=0;

3. If the vertex 0 is the source vertex then visited[0] is marked as 1.

4. Create the distance matrix, by storing the cost of vertices from vertex no. 0 to n-1

from the source vertex 0.

for(i=1;i<n;i++)

distance[i]=cost[0][i];

Initially, distance of source vertex is taken as 0. i.e. distance[0]=0;

5. for(i=1;i<n;i++)

– Choose a vertex w, such that distance[w] is minimum and visited[w] is 0. Mark

visited[w] as 1.

– Recalculate the shortest distance of remaining vertices from the source.

– Only, the vertices not marked as 1 in array visited[ ] should be considered for

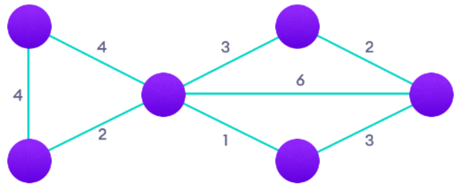
recalculation of distance. i.e. for each vertex v

if(visited[v]==0)

distance[v]=min(distance[v],

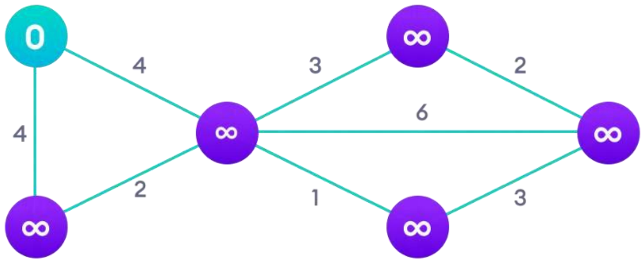
distance[w]+cost[w][v])

Fig:



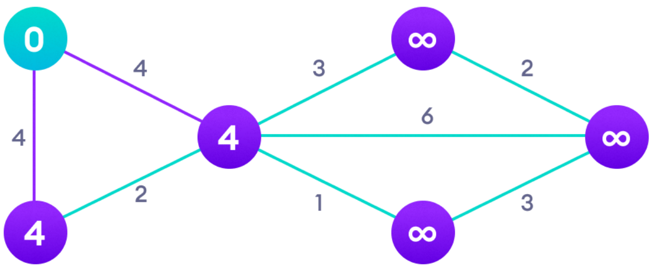
Step: 1

Start with a weighted graph



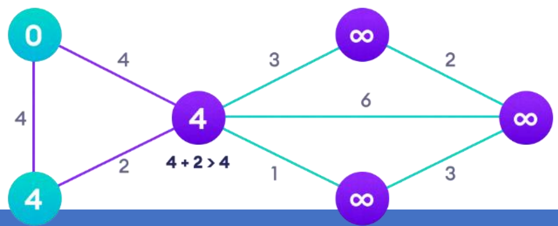
Step: 2

Choose a starting vertex and assign infinity path values to all other devices



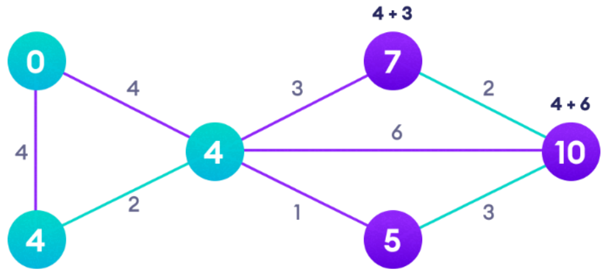
Step: 3

Go to each vertex and update its path length



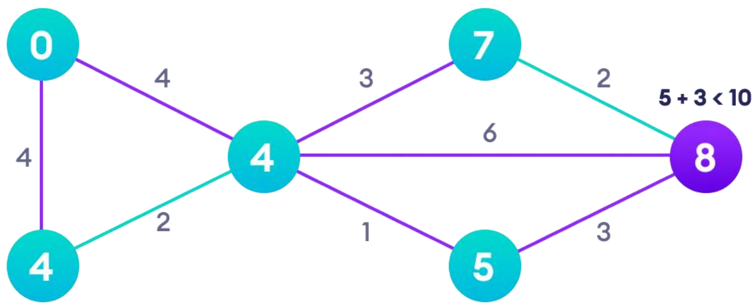
Step: 4

If the path length of the adjacent vertex is lesser than new path length, don't update it



Step: 5

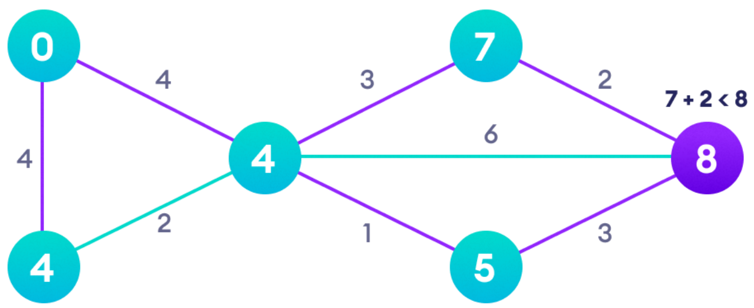
Avoid updating path lengths of already visited vertices



Step: 6

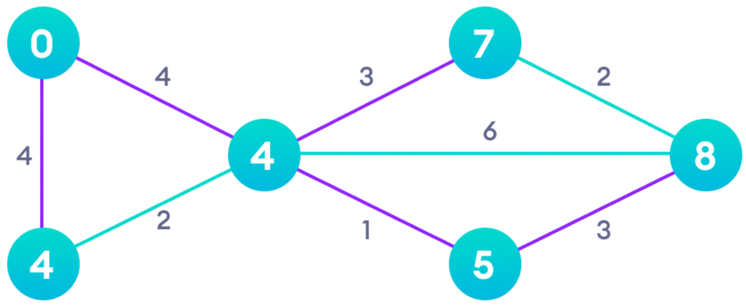
After each iteration, we pick the unvisited vertex with the least path length. So

we choose 5 before 7



Step: 7

Notice how the rightmost vertex has its path length updated twice



Step: 8

Repeat until all the vertices have been visited

Practical Implementation Djikstra's code algorithm

```
import sys

class Graph():

    def __init__(self, vertices):
        self.V = vertices
        self.graph = [[0 for column in range(vertices)]
                      for row in range(vertices)]

    def printSolution(self, dist):
        print "Vertex \tDistance from Source"
        for node in range(self.V):
            print node, "\t", dist[node]


    def minDistance(self, dist, sptSet):

        min = sys.maxint
        for u in range(self.V):
            if dist[u] < min and sptSet[u] == False:
                min = dist[u]
                min_index = u
```

```
        return min_index
    def dijkstra(self, src):

        dist = [sys.maxint] * self.V
        dist[src] = 0
        sptSet = [False] * self.V

        for cout in range(self.V):

            x = self.minDistance(dist, sptSet)
            sptSet[x] = True
            for y in range(self.V):
                if self.graph[x][y] > 0 and sptSet[y] == False and \
                dist[y] > dist[x] + self.graph[x][y]:
                        dist[y] = dist[x] + self.graph[x][y]

        self.printSolution(dist)

g = Graph(9)
g.graph = [[0, 4, 0, 0, 0, 0, 0, 8, 0],
        [4, 0, 8, 0, 0, 0, 0, 11, 0],
        [0, 8, 0, 7, 0, 4, 0, 0, 2],
        [0, 0, 7, 0, 9, 14, 0, 0, 0],
        [0, 0, 0, 9, 0, 10, 0, 0, 0],
        [0, 0, 4, 14, 10, 0, 2, 0, 0],
        [0, 0, 0, 0, 0, 2, 0, 1, 6],
        [8, 11, 0, 0, 0, 0, 1, 0, 7],
        [0, 0, 2, 0, 0, 0, 6, 7, 0]
        ];

g.dijkstra(0);
```

Output:

```
Vertex   Distance from Source
0            0
1            4
2            12
```

```
3           19
4           21
5           11
6           9
7           8
8           14
```

Time Complexity of the implementation is O(V^2). If the input graph is represented using adjacency list, it can be reduced to O(E log V) with the help of a binary heap.

Conclusion: Successfully Implemented the Dijkstra's algorithm.