Bangalore Institute of Technology

Department of Computer Science and Engineering

DESIGN AND ANALYSIS OF ALGORITHMS LAB (BCSL404)

Program 4

Design and implement C Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.

Dijikstra’s algorithm : For a given source vertex(node) in the graph, the algorithm finds the path with lowest cost between that vertex and every other vertex. It can also be used for finding cost of shortest paths from a single vertex to a single destination vertex by stopping the algorithm once the shortest path to the destination vertex has been determined.

Efficiency:

1)$\Theta(|V^2|)$ graph represented by weighted matrix and priority queue as unordered array

2)$O(E \log_2 V)$ graph represented by adjacency lists and priority queue as min-heap

Dijkstra(G,s)

```
// Dijkstra's algorithm for single-source shortest paths

// Input : A weighted connected graph G=(V,E) with nonnegative weights and
          its vertex s
// Output : The length $d_v$ of a shortest path from s to v and its penultimate vertex
          $p_v$ for every v in V.
Initialise(Q)                    // Initialise vertex priority queue to empty
for every vertex v in V do
  {
        $d_v \leftarrow \infty$;
        pv$\leftarrow$null
        Insert(Q,v,dv
  //Initialise vertex priority in the priority queue
  $d_s \leftarrow 0$;
  Decrease(Q,s ds)                    //Update priority of s with $d_s$
  Vt$\leftarrow \emptyset$
   for i$\leftarrow$0 to |v|-1 do
   u* $\leftarrow$ DeleteMin(Q)              //delete the minimum priority element
  Vt $\leftarrow$Vt U {u*}
  for every vertex u in V-$V_T$ that is adjacent to u* do
  if  $d_u$* + w(u*,u)<$d_u$
  $d_u \leftarrow d_u$*+w(u*,u);
  $p_u \leftarrow$u*
  Decrease(Q,u,$d_u$)
```

Program:

```
#include<stdio.h>
#define INF 999
void dijkstra(int c[10][10],int n,int s,int d[10])
{
	int v[10],min,u,i,j;
	for(i=1;i<=n;i++)
	{
		d[i]=c[s][i];
		v[i]=0;
	}
	v[s]=1;
	for(i=1;i<=n;i++)
	{
		min=INF;
		for(j=1;j<=n;j++)
		if(v[j]==0 && d[j]<min)
		{
			min=d[j];
			u=j;
		}
```

```
                v[u]=1;
                for(j=1;j<=n;j++)
                if(v[j]==0 && (d[u]+c[u][j])<d[j])
                d[j]=d[u]+c[u][j];
        }
}

int main()
{
        int c[10][10],d[10],i,j,s,sum,n;
        printf("\nEnter n value:");
        scanf("%d",&n);
        printf("\nEnter the graph data:\n");
        for(i=1;i<=n;i++)
        for(j=1;j<=n;j++)
        scanf("%d",&c[i][j]);
        printf("\nEnter the souce node:");
        scanf("%d",&s);
        dijkstra(c,n,s,d);
        for(i=1;i<=n;i++)
        printf("\nShortest distance from %d to %d is %d",s,i,d[i]);
   return 0;
}
```

Input/Output

```
1) Enter n value:6
Enter the graph data:
0 15 10 999 45 999
999 0 15 999 20 999
20 999 0 20 999 999
999 10 999 0 35 999
999 999 999 30 0 999
999 999 999 4 999 0
Enter the souce node:2
Shortest distance from 2 to 1 is 35
Shortest distance from 2 to 2 is 0
Shortest distance from 2 to 3 is 15
Shortest distance from 2 to 4 is 35
Shortest distance from 2 to 5 is 20
Shortest distance from 2 to 6 is 999
```

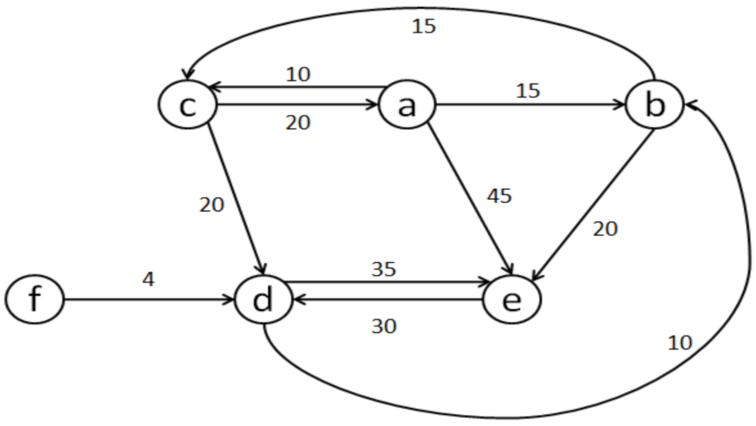
Output:

2)enter the no. of nodes:

```
6
enter the cost adjacency matrix,'9999' for no direct path

0     15    10    9999   45    9999
9999  0     15    9999   20    9999
20    9999  0     20     9999  9999
9999 10     9999  0      35    9999
9999 9999   9999  30     0     9999
9999 9999   9999  4      9999  0

enter the starting vertex:
6
Shortest path from starting vertex to other vertices are
```



```
6->1=49
6->2=14
6->3=29
6->4=4
6->5=34
6->6=0
```