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AIM:	**To Implement Dijkstra's Algorithm.**

ALGORITHM/ THEORY:	Dijkstra algorithm is also called single source shortest path algorithm. It is based on greedy technique. The algorithm maintains a list visited[ ] of vertices, whose shortest distance from the source is already known.
	
	If visited[1], equals 1, then the shortest distance of vertex i is already known. Initially, visited[i] is marked as, for source vertex.
	
	At each step, we mark visited[v] as 1. Vertex v is a vertex at shortest distance from the source vertex. At each step of the algorithm, shortest distance of each vertex is stored in an array distance[ ].
	
	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.
	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]) **Time Complexity** The program contains two nested loops each of which has a complexity of O(n). n is number of vertices. So the complexity of algorithm is $O(n^2)$.

PROGRAM:	`#include <stdio.h>`
	`#include <conio.h>`
	`#define INFINITY 9999`
	`#define MAX 10`
	
	`void dijkstra(int G[MAX][MAX], int n, int startnode);`
	
	`int main()`
	`{`
	`int G[MAX][MAX], i, j, n, u;`
	`printf("Enter no. of vertices:");`
	`scanf("%d", &n);`

```
    printf("\nEnter the adjacency matrix:\n");
    for (i = 0; i < n; i++)
        for (j = 0; j < n; j++)
            scanf("%d", &G[i][j]);
    printf("\nEnter the starting node:");
    scanf("%d", &u);
    dijkstra(G, n, u);
    return 0;
}

void dijkstra(int G[MAX][MAX], int n, int startnode)
{

    int cost[MAX][MAX], distance[MAX], pred[MAX];
    int visited[MAX], count, mindistance, nextnode, i, j;
    // pred[] stores the predecessor of each node
    // count gives the number of nodes seen so far
    // create the cost matrix
    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];
    // initialize pred[],distance[] and visited[]
    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;
        // nextnode gives the node at minimum distance
        for (i = 0; i < n; i++)
            if (distance[i] < mindistance && !visited[i])
            {
                mindistance = distance[i];
                nextnode = i;
            }
```

```
        // check if a better path exists through nextnode
        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++;
    }

    // print the path and distance of each node
    for (i = 0; i < n; i++)
        if (i != startnode)
        {
            printf("\nDistance of node%d=%d", i, distance[i]);
            printf("\nPath=%d", i);
            j = i;
            do
            {
                j = pred[j];
                printf("<-%d", j);
            } while (j != startnode);
        }
}
```

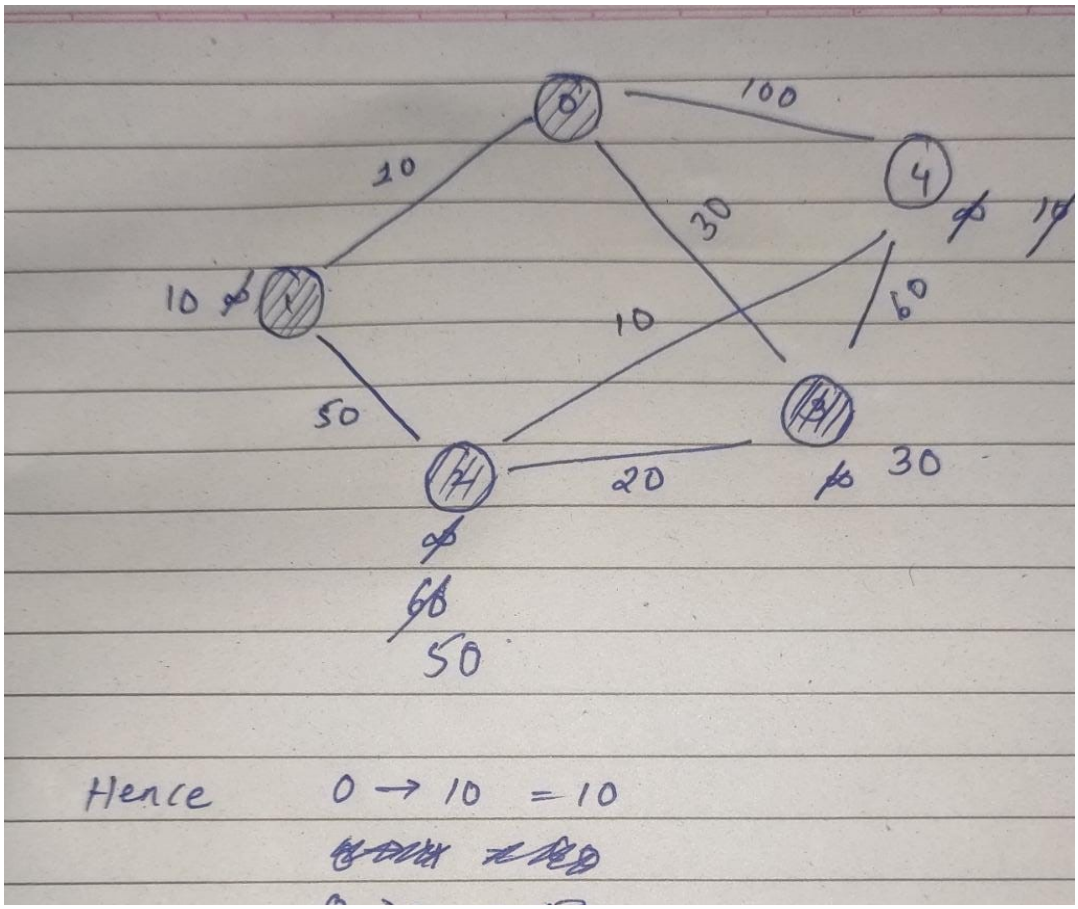
RESULT:

```
PS C:\Users\maazs\OneDrive\Desktop\Studies\DAA\DAA Coding> cd "c:\Users\maazs\OneDrive\Desktop\Studies\DAA\DAA Coding\" ; if ($?) { gcc Djk
stras.c -o Djkstras } ; if ($?) { .\Djkstras }
Enter no. of vertices:5

Enter the adjacency matrix:
0 10 0 30 100
10 0 50 0 0
0 50 0 20 10
30 0 20 0 60
100 0 10 60 0

Enter the starting node:0

Distance of node1=10
Path=1<-0
Distance of node2=50
Path=2<-3<-0
Distance of node3=30
Path=3<-0
Distance of node4=60
Path=4<-2<-3<-0
```



CONCLUSION:	I Understood how Dijkstra's algorithm is used to find the shortest path between two given vertices.