From a given vertex in a weighted connected graph, find shortest paths to other vertices using **Dijkstra's algorithm**.

Handwrite the Algorithm
- Handwrite the Program
- Pasting of the printout of the Output or handwrite the Output

ALGORITHM: dijkstras(c[1….n,1….n],src)
//To compute shortest distance from given source node to all nodes of a weighted undirected graph
//Input: An nXn cost matrix c[1…n,1….n] with source node *src*
//Output: The length *dist[j]* of a shortest path from *src* to *j*

```
for j□1 to n do
    dist[j]□c[src,[j]
end for
for j□1 to n do
     vis[j]□0
end for
dist[src]□0
vis[src]□1
count□1
while count!=n do
       min□9999
       for j□1 to n do
           if dist[j]<min and vis[j]!=1
              min□dist[j]
              u□j
           end if
        end for
        vis[u]□1
        count□count+1
        for j□1 to n do
            if min+c[u,j]<dist[j] and vis[j]!=1
               dist[j]□min+c[u,j]
            end if
        end for
end while
write 'shortest distance is'
for j□1 to n do
    write src,j,dist[j]
end for
```

Code:

```
#include <stdio.h>

#include <stdlib.h>

#define MAX_NODES 100

#define INF 9999
```

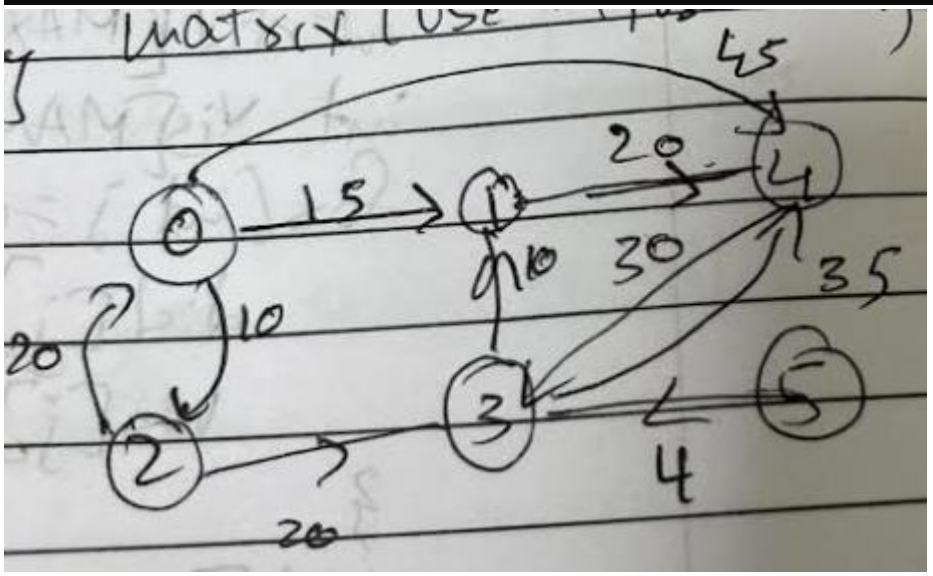
```
void dijkstra(int n, int src, int cost[MAX_NODES][MAX_NODES]);
int main() {
    int n;
    int cost[MAX_NODES][MAX_NODES];
    int src;
    printf("Enter the number of nodes: ");
    scanf("%d", &n);
    printf("Enter the cost adjacency matrix (use -1 for infinity):\n");
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            scanf("%d", &cost[i][j]);
            if (cost[i][j] == -1 && i != j) {
                cost[i][j] = INF;
            }
        }
    }
    printf("Enter the source node: ");
    scanf("%d", &src);
    dijkstra(n, src, cost);
    return 0;
}
void dijkstra(int n, int src, int cost[MAX_NODES][MAX_NODES]) {
    int dist[MAX_NODES];
    int vis[MAX_NODES];
    for (int j = 0; j < n; j++) {
        dist[j] = cost[src][j];
        vis[j] = 0;
    }
    dist[src] = 0;
    vis[src] = 1;
```

```
    int count = 1;
    while (count != n) {
        int min = INF;
        int u = -1;
        for (int j = 0; j < n; j++) {
            if (!vis[j] && dist[j] < min) {
                min = dist[j];
                u = j;
            }
        }
        if (u == -1) break;
        vis[u] = 1;
        count++;
        for (int j = 0; j < n; j++) {
            if (!vis[j] && cost[u][j] != INF && dist[u] + cost[u][j] < dist[j]) {
                dist[j] = dist[u] + cost[u][j];
            }
        }
    }
    printf("Shortest distances from source node %d:\n", src);
    for (int j = 0; j < n; j++) {
        if (dist[j] == INF) {
            printf("To %d: Infinity\n", j);
        } else {
            printf("To %d: %d\n", j, dist[j]);
        }
    }
}
```

Output:

```
Enter the number of nodes: 6
Enter the cost adjacency matrix (use -1 for infinity):
0 15 10 -1 45 -1
-1 0 15 -1 20 -1
20 -1 0 20 -1 -1
-1 10 -1 0 35 -1
-1 -1 -1 30 0 -1
-1 -1 -1 4 -1 0
Enter the source node: 5
Shortest distances from source node 5:
To 0: 49
To 1: 14
To 2: 29
To 3: 4
To 4: 34
To 5: 0

Process returned 0 (0x0)   execution time : 8.517 s
Press any key to continue.
```



Find Minimum Cost Spanning Tree of a given undirected graph using **Kruskals algorithm**.
- Handwrite the Algorithm
- Handwrite the Program
- Pasting of the printout of the Output or handwrite the Output

ALGORITHM: kruskals(c[1…n,1…n])
//To compute the minimum spanning tree of a given weighted undirected graph using Kruskal's
// algorithm
//Input: An nXn cost matrix c[1…n,1….n]
//Output: minimum cost of spanning tree of given undirected graph
ne□0

```
mincost□0
for i□1 to n do
    parent[i]□0
end for
while ne!=n-1 do
    min□9999
    for i□1 to n do
        for j□1 to n do
            if c[i,j]<min
               min□c[i,j]
               u□i
               a□i
             v□j
             b□j
          end if
       end for
   end for
   while parent[u]!=0 do
          u□parent[u]
   end while
   while parent[v]!=0 do
          v□parent[v]
   end while
   if u!= v
     write a,b,min
     parent[v]□u
     ne□ne+1
     mincost□mincost+min
   end if
   c[a,b]□9999
   c[b,a]□9999
end while
write mincost
return
```

Code:

```
#include <stdio.h>

#include <stdlib.h>

#define MAX 100

#define INF 9999

struct Edge {

   int u, v, weight;

};

int compare(const void *a, const void *b) {
```

```
    struct Edge *a1 = (struct Edge *)a;
    struct Edge *b1 = (struct Edge *)b;
    return a1->weight - b1->weight;
}
int find(int parent[], int i) {
    if (parent[i] == 0)
        return i;
    return find(parent, parent[i]);
}
void unionSets(int parent[], int u, int v) {
    parent[v] = u;
}
void kruskals(int cost_matrix[][MAX], int n) {
    struct Edge edges[MAX * MAX];
    int edge_count = 0;
    int parent[MAX] = {0};
    for (int i = 1; i <= n; i++) {
        for (int j = 1; j <= n; j++) {
            if (cost_matrix[i][j] != INF) {
                edges[edge_count++] = (struct Edge){i, j, cost_matrix[i][j]};
            }
        }
    }
    qsort(edges, edge_count, sizeof(edges[0]), compare);
    int mincost = 0;
    int ne = 0;
    printf("Edges in the Minimum Cost Spanning Tree:\n");
    for (int i = 0; i < edge_count; i++) {
        int u = find(parent, edges[i].u);
        int v = find(parent, edges[i].v);
```

```
        if (u != v) {
            printf("%d - %d : %d\n", edges[i].u, edges[i].v, edges[i].weight);
            unionSets(parent, u, v);
            mincost += edges[i].weight;
            ne++;
        }
        if (ne == n - 1)
            break;
    }
    printf("Minimum Cost of Spanning Tree: %d\n", mincost);
}
int main() {
    int n;
    printf("Enter the number of vertices: ");
    scanf("%d", &n);
    int cost_matrix[MAX][MAX];
    printf("Enter the cost matrix (n x n):\n");
    for (int i = 1; i <= n; i++) {
        for (int j = 1; j <= n; j++) {
            scanf("%d", &cost_matrix[i][j]);
            if (cost_matrix[i][j] == 0 || cost_matrix[i][j] == -1)
                cost_matrix[i][j] = INF;
        }
    }
    kruskals(cost_matrix, n);
    return 0;
```

Output:

```
Enter the number of vertices: 6
Enter the cost matrix (n x n):
0 15 10 -1 45 -1
-1 0 15 -1 20 -1
20 -1 0 20 -1 -1
-1 10 -1 0 35 -1
-1 -1 -1 30 0 -1
-1 -1 -1 4 -1 0
Edges in the Minimum Cost Spanning Tree:
6 - 4 : 4
4 - 2 : 10
1 - 3 : 10
2 - 3 : 15
2 - 5 : 20
Minimum Cost of Spanning Tree: 59

Process returned 0 (0x0)   execution time : 15.980 s
Press any key to continue.
```

}