Computer Networks Lab

TITLE: *Prim's and Kruskal's Algorithm.*

Objective: Implementation of Prim's and Kruskal's Algorithm

***PROBLEM STATEMENT*:**

Given a weighted, undirected, and connected graph G, the objective is to find the minimum spanning tree G' for G using Prim's and Kruskal's Algorithm.

***Prim's algorithm*:** It is a greedy algorithm that starts from one vertex and continues to add the edges with the smallest weight until the goal is reached. The edges with the minimal weights causing no cycles in the graph got selected.

Kruskal's Algorithm: It is used to find the minimum spanning tree for a connected weighted graph. The main target of the algorithm is to find the subset of edges by using which we can traverse every vertex of the graph. It follows the greedy approach that finds an optimum solution at every stage instead of focusing on a global optimum.

***ALGORITHM*:**

PRIM'S ALGORITHM:

STEP 1 : Choose a Node and add it to MST

STEP 2 : Check all of its adjacent nodes, if they are already present in MST or not if they are not present, add edge weight to that edge into Min-Heap.

STEP 3 : Add the smallest weighted edge and its node in Min-Heap to MST. Repeat step 2 and step 3 for Node added.

STEP 4 : Repeat step 2 , step 3 for recently added node.

KRUSKAL'S ALGORITHM:

STEP 1: Sort the given edges

STEP 2: Check each edge in sorted order if it forms a cycle with already selected edges. If not Add it to list of MST . If it does move to next edge.

STEP 3: Run steps 1 and 2 till v-1 edges are selected (v=no.of.vertices).

CODE:

PRIM'S ALGORITHM:

```
#include<stdio.h>

#include<stdbool.h>


#define INF 9999999


// number of vertices in graph

// create a 2d array of size 5x5

//for adjacency matrix to represent graph

int main() {

   int V;

   scanf("%d",&V);

   int G[V][V];

for(int i=0;i<V;i++)

{
```

```
 for(int j=0;j<V;j++)
 {
   scanf("%d",&G[i][j]);
 }
}
  int no_edge;  // number of edge

  // create a array to track selected vertex
  // selected will become true otherwise false
  int selected[V];

  // set selected false initially
  memset(selected, false, sizeof(selected));
  no_edge = 0;

  // the number of egde in minimum spanning tree will be
  // always less than (V -1), where V is number of vertices in graph
// choose 0th vertex and make it true
  selected[0] = true;

  int x;  //  row number
  int y;  //  col number

  // print for edge and weight
  printf("Edge : Weight\n");
```

```
while (no_edge < V - 1) {
  //For every vertex in the set S, find the all adjacent vertices
  // , calculate the distance from the vertex selected at step 1.
  // if the vertex is already in the set S, discard it otherwise
  //choose another vertex nearest to selected vertex  at step 1.

  int min = INF;
  x = 0;
  y = 0;

  for (int i = 0; i < V; i++) {
    if (selected[i]) {
      for (int j = 0; j < V; j++) {
        if (!selected[j] && G[i][j]) {  // not in selected and there is an edge
          if (min > G[i][j]) {
            min = G[i][j];
            x = i;
            y = j;
          }
        }
      }
    }
  }
  printf("%d - %d : %d\n", x, y, G[x][y]);
```

```
    selected[y] = true;
    no_edge++;
  }

  return 0;
}
```

KRUSKAL'S ALGORITHM:

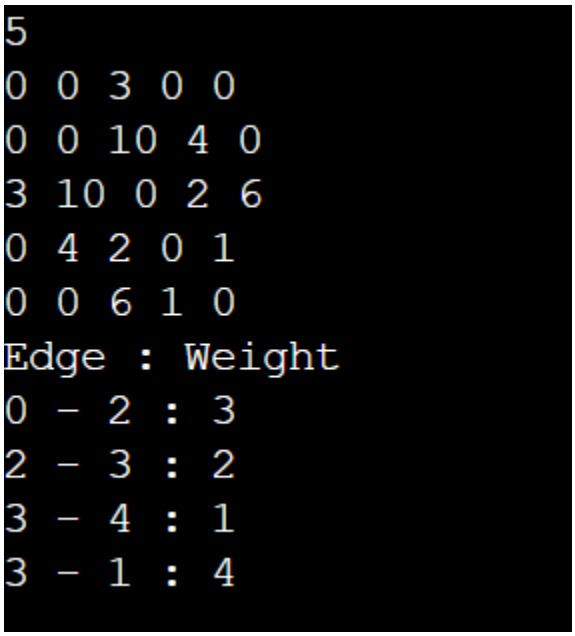
```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
int i,j,k,a,b,u,v,n,ne=1;
int min,mincost=0,cost[9][9],parent[9];
int find(int);
int uni(int,int);
void main()
{
        printf("\n\tImplementation of Kruskal's algorithm\n");
        printf("\nEnter the no. of vertices:");
        scanf("%d",&n);
        printf("\nEnter the cost adjacency matrix:\n");
        for(i=1;i<=n;i++)
        {
                for(j=1;j<=n;j++)
                {
```

```
                scanf("%d",&cost[i][j]);
                if(cost[i][j]==0)
                        cost[i][j]=999;
        }
}
printf("The edges of Minimum Cost Spanning Tree are\n");
while(ne < n)
{
        for(i=1,min=999;i<=n;i++)
        {
                for(j=1;j <= n;j++)
                {
                        if(cost[i][j] < min)
                        {
                                min=cost[i][j];
                                a=u=i;
                                b=v=j;
                        }
                }
        }
        u=find(u);
        v=find(v);
        if(uni(u,v))
        {
                printf("%d edge (%d,%d) =%d\n",ne++,a,b,min);
```

```
                        mincost +=min;
                }
                cost[a][b]=cost[b][a]=999;
        }
        printf("\n\tMinimum cost = %d\n",mincost);
        getch();
}
int find(int i)
{
        while(parent[i])
        i=parent[i];
        return i;
}
int uni(int i,int j)
{
        if(i!=j)
        {
                parent[j]=i;
                return 1;
        }
        return 0;
}
```

OUTPUT:

PRIM'S ALGORITHM:



EXPLANATION:

The number of vertices is taken as input which is 5 and the adjacency matrix in the form of the array is entered by the user which indicates the weights from edge to edge. From the start vertex, all the minimum cost edges are traversed and the edges selected along with their corresponding weights are printed which gives minimum cost.

KRUSKAL'S ALGORITHM:

```
Enter the no. of vertices:5

Enter the cost adjacency matrix:
0 0 3 0 0
0 0 10 4 0
3 10 0 2 6
0 4 2 0 1
0 0 6 1 0
The edges of Minimum Cost Spanning Tree are
1 edge (4,5) =1
2 edge (3,4) =2
3 edge (1,3) =3
4 edge (2,4) =4

        Minimum cost = 10
```

***EXPLANATION*:**

The number of vertices is taken as input which is 5 and the adjacency matrix in the form of the 2D array is entered by the user which indicates the weights from edge to edge. The edges are sorted based on the cost of the edges. The starting vertex is the vertex of the edge with minimum weight. The edges are traversed in this way and give the minimum cost. Here the edges and corresponding weights are printed and the minimum cost obtained is 10.

***PROBLEMS FACED*:**

Initially, the problems I faced while implementing the algorithms are finding which is the best approach either Prim's or Kruskal's.

***CONCLUSION*:**

Prim's and Kruskal's are the best possible algorithms to find MST and complete the sorting process. Kruskal has better running time if the number of edges is kept low. While Prim's has better running time if both the number of edges and nodes are kept low So, of course, the best algorithm depends on the graph and the cost of data structure.