ASSIGNMENT 5

Aim: You have a business with several offices; you want to lease phone lines to connect them up with each other and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.

Objective: To understand the concept of minimum spanning tree and finding the minimum cost of tree using Kruskals algorithm.

Theory:

A spanning tree of the graph is a connected (if there is at least one path between every pair of vertices in a graph) subgraph in which there are no cycle. Suppose you have a connected undirected graph with a weight (or cost) associated with each edge. The cost of a spanning tree would be the sum of the costs of its edges. A minimum-cost spanning tree is a spanning tree that has the lowest cost. There are two basic algorithms for finding minimum-cost spanning trees: 1. Prim's Algorithm 2. Kruskal's Algorithm .

Kruskals's algorithm: It tarts with no nodes or edges in the spanning tree, and repeatedly add the cheapest edge that does not create a cycle.

Steps of Kruskal's Algorithm to find minimum spanning tree:

1. Select the shortest edge in a network
2. Select the next shortest edge which does not create a cycle
3. Repeat step 2 untill spanning tree has n-1 edges.

Algorithm:

- Algorithm kruskal(G,V,E,T)

{

1.Sort E in increasing order of weight

2.let G=(V,E) and T=(A,B),A=V ,B is null

set and let n =count(V)

3.Initialize n set ,each containing a different element of v.

4.while(|B|<n-1) do

begin

e=<u,v>the shortest edge not yet considered

```
      U=Member(u)
       V=Member(v)
     if( Union(U,V))
         update in B and add the cost
      } }
   end
```

5.T is the minimum spanning tree

}

Program:

```
#include<iostream>
#define MAX 999;
using namespace std;


class kruskal
{
private:
    struct node
    {
        int v1,v2,cost;
    }G[20];
public:
    int edges,vertices;
    void create();
    void mincost();
    void input();
    int minimum(int);
};
```

```
int find (int v2,int parent[])
{
   while(parent[v2]!=v2)
   {
      v2=parent[v2];
   }
}
void uni(int i,int j,int parent[])
{
   if(i<j)
      parent[j]=i;
   else
      parent[i]=j;
}
void kruskal::input()
{
   cout<<"enter number of companies"<<endl;
   cin>>vertices;
   cout<<"enter number of connection"<<endl;
   cin>>edges;
}
void kruskal::create()
{
   cout<<"\n enter edges in v1-v2 form and corresponding cost"<<endl;
   for(int k=0;k<edges;k++)
   {
     cin>>G[k].v1>>G[k].v2>>G[k].cost;
   }
```

```
}
int kruskal::minimum(int n)
{
    int i,small,pos;
    small=MAX;
    pos=-1;
    for(i=0;i<n;i++)
    {
        if(G[i].cost<small)
        {
            small=G[i].cost;
            pos=i;
        }
    }
    return pos;
}
void kruskal::mincost()
{
    int count,k,v1,v2,i,j,tree[10][10],pos,parent[10];
    int sum=0;
    count=0;
    k=0;
    for(i=0;i<vertices;i++)
        parent[i]=i;
    while(count!=vertices-1)
    {
    pos=minimum(edges);
    if(pos==-1)
```

```
        break;
    v1=G[pos].v1;
    v2=G[pos].v2;
    i=find(v1,parent);
    j=find(v2,parent);
    if(i!=j)
        {
        tree[k][0]=v1;
        tree[k][1]=v2;
        k++;
        count++;
        sum=sum+G[pos].cost;
        uni(i,j,parent);
        }
    G[pos].cost=MAX;
    }
    if(count==vertices-1)
    {
        cout<<"spanning tree is"<<endl;
        for(i=0;i<vertices-1;i++)
        {
            cout<<tree[i][0]<<"-"<<tree[i][1]<<endl;
        }
        cout<<"cost required to set cables"<<sum<<endl;
    }
    else
    {
        cout<<"connection can't be set up"<<endl;
```

```
    }
}
int main()
{
    kruskal k;
    k.input();
    k.create();
    k.mincost();
}
```

Output:

```
C:\Users\admin\Desktop\sd2\assignment5\assignment5.exe
enter number of companies
3
enter number of connection
3

 enter edges in v1-v2 form and corresponding cost
0 1 3
1 2 5
0 2 4
spanning tree is
0-1
0-2
cost required to set cables7

Process returned 0 (0x0)   execution time : 25.090 s
Press any key to continue.
```

Conclusion:

Kruskal's algorithm can be shown to run in O(**E log E**) time, where E is the number of edges in the graph. Thus we have connected all the offices with a total minimum cost using kruskal’s algorithm.