Bangalore Institute of Technology

Department of Computer Science and Engineering

DESIGN AND ANALYSIS OF ALGORITHMS LAB (BCSL404)

1. **Design and implement C Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.**

Aim : To apply Kruskal's Algorithm for computing the minimum spanning tree is directly based on the generic MST algorithm. It builds the MST in forest.

Definition: Kruskal's algorithm is an algorithm in graph theory that finds a minimum spanning tree for a connected weighted graph. This mean it finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all the edges in the tree is minimized. If the graph is not connected, then it finds a minimum spanning forest .It is an example of a greedy algorithm**.**

Efficiency:With an efficient sorting algorithm, the time efficiency of Kruskal's algorithm will be in O(E log E)

Algorithm

Start with an empty set A, and select at every stage the shortest edge that has not been chosen or rejected, regardless of where this edge is situated in graph.

- Initially, each vertex is in its own tree in forest.
- Then, algorithm consider each edge in turn, order by increasing weight.
- If an edge (*u*, *v*) connects two different trees, then (*u*, *v*) is added to the set of edges of the MST, and two trees connected by an edge (*u*, *v*) are merged into a single tree.
- On the other hand, if an edge (*u*, *v*) connects two vertices in the same tree, then edge (*u*, *v*) is discarded.

Kruskals algorithm can be implemented using **disjoint set** data structure or **priority queue** data structure.

I Kruskal's algorithm implemented with disjoint-sets data structure.

MST_KRUSKAL (G, w)

1. A ← {} // A will ultimately contains the edges of the MST
2. for each vertex v in V[G]
3. do Make_Set (*v*)
4. Sort edge of E by nondecreasing weights w
5. for each edge (*u*, *v*) in E
6. do if FIND_SET (*u*) ≠ FIND_SET (*v*)
7. then A = AU{(*u*, *v*)}
8. UNION (*u*, *v*)
9. Return A

```
#include<stdio.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\t Implementation 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);
}
  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;}
```

```
        Implementation of Kruskal's algorithm

Enter the no. of vertices:4

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

        Minimum cost = 4
```

Input/Output:

Enter the n value:5
Enter the cost adjacency matrix:
0 10 15 9 999
10 0 999 17 15
15 999 0 20 999
9 17 20 0 18
999 15 999 18 0

The edges of minimum cost spanning tree are:
1 edge (1 ,4)
2 edge (1 ,2)
3 edge (1 ,3)
4 edge (2,5)
Minimum cost =49

Program 2 Design and implement C Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.

Aim: To find minimum spanning tree of a given graph using prim's algorithm

Definition: Prim's is an algorithm that finds a minimum spanning tree for a connected weighted undirected graph. This means it finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all edges in the tree is minimized. Prim's algorithm is an example of a greedy algorithm.

Algorithm

MST_PRIM (G, *w*, *v*)

// Prim's algorithm for constructing a minimum spanning tree
// Input : A weighted connected graph G=(V,E)
// Output : The set of edges composing a minimum spanning tree of G

1. Q ← V[G]
2. for each *u* in Q do
3. key [*u*] ← ∞
4. key [*r*] ← 0
5. π[*r*] ← NIl
6. while queue is not empty do
7. *u* ← EXTRACT_MIN (Q)
8. for each *v* in Adj[*u*] do
9. if v is in Q and *w*(*u*, *v*) < key [*v*]
10. then π[*v*] ← *w*(*u*, *v*)
11. key [*v*] ← *w*(*u*, *v*)

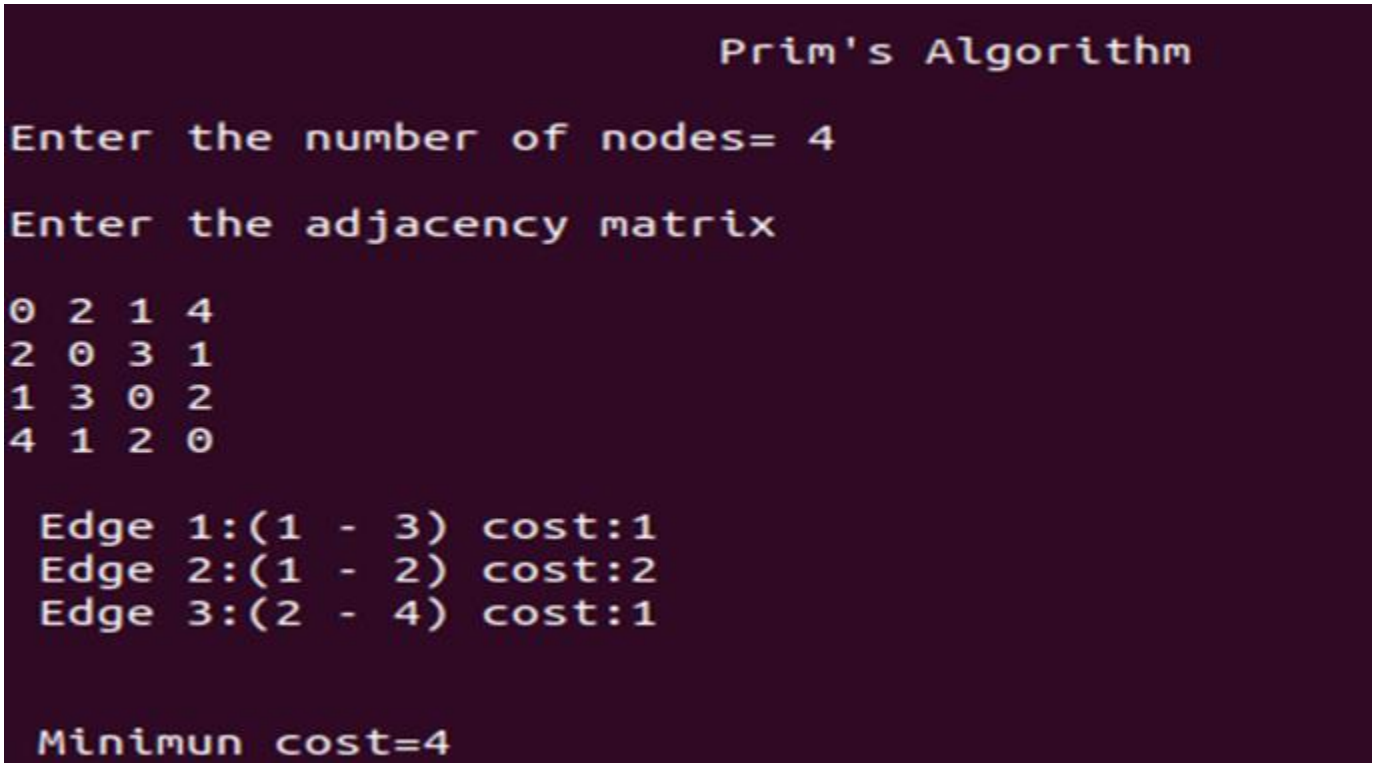
Program:

```
#include<stdio.h>

int visited[10]={0}, cost[10][10], min, mincost=0;
int i,j,ne=1, a, b, u, v;
```

```
int main()
{
	int num;
	printf("\n\t\t\tPrim's Algorithm");
	printf("\n\nEnter the number of nodes= ");
	scanf("%d", &num);
	printf("\nEnter the adjacency matrix\n\n");

	for(i=1; i<=num; i++)
	{
		for(j=1; j<=num; j++)
		{
			scanf("%d", &cost[i][j]);
			if(cost[i][j]==0)
				cost[i][j]=999;
		}
	}
	visited[1]=1;
	while(ne < num)
	{
		for(i=1,min=999;i<=num;i++)
		for(j=1;j<=num;j++)
			if(cost[i][j]< min)
			if(visited[i]!=0)
			{
				min=cost[i][j];
				a=u=i;
				b=v=j;
			}
			printf("\n Edge %d:(%d - %d) cost:%d",ne++,a,b,min);
			mincost=mincost+min;
			visited[b]=1;
			cost[a][b]=cost[b][a]=999;
	}
	printf("\n\n\n Minimun cost=%d",mincost);
	return 0; }
```

OUTPUT:

1)



2)Input/output:

Enter n value:3
Enter the graph data:
0 10 1
10 0 6
1 6 0
Enter the souce node:1
1 -> 3 cost=1
3 -> 2 cost=7
minimum Cost=7