Third Year B. Tech., Sem V 2022-23

Design and Analysis of Algorithm Lab

Lab ESE Assignment / Journal submission

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Title of assignment: kruskal's Algorithm

1. Implement Kruskal's algorithm & Prim's algorithm to find Minimum Spanning Tree (MST) of the given an undirected, connected and weighted graph.

   Ans: **Kruskal's Algorithm**

   a) Algorithm: (Pseudocode) //Initialize result mst_weight = 0 // Create V single item sets for each vertex v parent[v] = v; rank[v] = 0; Sort all edges into non decreasing order by weight w for each (u, v) taken from the sorted list E do if FIND-SET(u) != FIND-SET(v) print edge(u, v) mst_weight += weight of edge(u, v) UNION(u, v)

a) Code snapshots of implementation

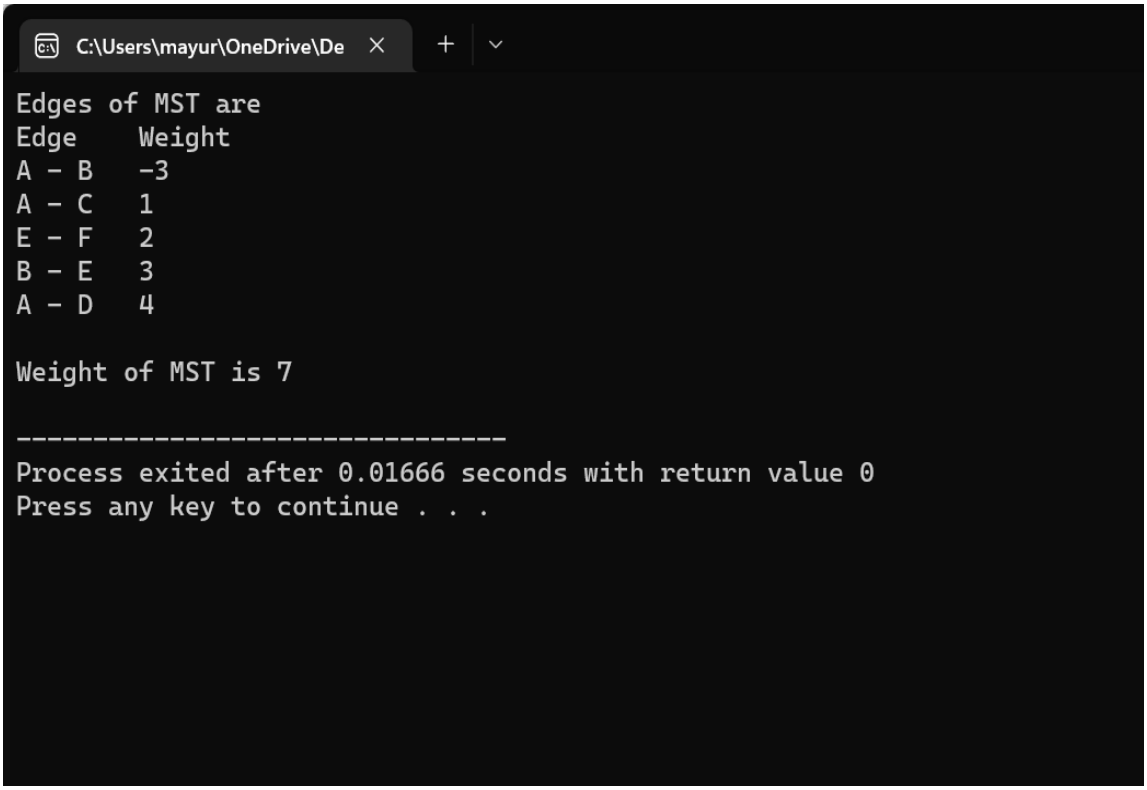
```
#include<bits/stdc++.h>
using namespace std;
typedef pair<int, int> iPair;
struct Graph
{
int V, E;
vector< pair<int, iPair> > edges;
Graph(int V, int E)
{
this->V = V;
this->E = E;
}
```

```
void addEdge(int u, int v, int w)
{
edges.push_back({w, {u, v}});
}
int kruskalMST();
};
struct DisjointSets
{
int *parent, *rnk;
int n;
DisjointSets(int n)
{
this->n = n;
parent = new int[n+1];
rnk = new int[n+1];
for (int i = 0; i <= n; i++)
{
rnk[i] = 0;
parent[i] = i;
}
}
int find(int u)
{
if (u != parent[u])
parent[u] = find(parent[u]);
return parent[u];
}
void merge(int x, int y)
{
x = find(x), y = find(y);
if (rnk[x] > rnk[y])
parent[y] = x;
else
parent[x] = y;
if (rnk[x] == rnk[y])
```

```
rnk[y]++;
}
};
int Graph::kruskalMST()
{
int mst_wt = 0;
sort(edges.begin(), edges.end());
DisjointSets ds(V);
vector< pair<int, iPair> >::iterator it;
cout<<"Edge\tWeight\n";
for (it=edges.begin(); it!=edges.end(); it++)
{
int u = it->second.first;
int v = it->second.second;
int set_u = ds.find(u);
int set_v = ds.find(v);
if (set_u != set_v)
{
cout << char(u+64) << " - " << char(v+64) <<"\t"<< it->first << endl;
mst_wt += it->first;
ds.merge(set_u, set_v);
}
}
return mst_wt;
}
int main()
{
int V = 10, E = 19;
Graph g(V, E);
g.addEdge(1,2,-3);
g.addEdge(1,3,1);
g.addEdge(1,4,4);
g.addEdge(2,1,-3);
g.addEdge(2,5,3);
g.addEdge(2,4,5);
```

```
g.addEdge(3,4,5);
g.addEdge(3,1,1);
g.addEdge(3,6,3);
g.addEdge(4,1,4);
g.addEdge(4,2,5);
g.addEdge(4,3,5);
g.addEdge(4,6,6);
g.addEdge(5,2,3);
g.addEdge(5,6,2);
g.addEdge(6,3,3);
g.addEdge(6,4,6);
g.addEdge(6,5,2);
cout << "Edges of MST are \n";
int mst_wt = g.kruskalMST();
cout << "\nWeight of MST is " << mst_wt << "\n";
return 0;
}
```

Output:



b) **Complexity of proposed algorithm (Time & Space)**

- ➢ Time Complexity: O(E*logV)
- ➢ Space Complexity: O(V+E) d)

Your comment (How your solution is optimal?)

Code can be optimized to stop the main loop of Kruskal when number of selected edges becomes V-1