

Skill Development Lab-II (2018-2019)

BRACT's

VISHWAKARMA INSTITUTE OF INFORMATION TECHNOLOGY, PUNE – 48

An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune

SD(LP-II) ASSIGNMENT (S.Y.B. Tech. – DIV: C)

Name.: Prathamesh Gaikwad;

Roll no.: 223019;

GR. No.: 17u416; Batch: C1

ASSIGNMENT 4

Aim:

For a weighted graph G, find the minimum spanning tree using Prim's Algorithm.

Objective:

To find the minimum cost by weight using Prim's algorithm.

Theory:

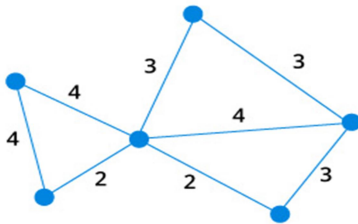
Prim's algorithm is a greedy algorithm that finds a minimum spanning tree for a weighted undirected graph. This means it finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all the edges in the tree is minimized. The algorithm operates by building this tree one vertex at a time, from an arbitrary starting vertex, at each step adding the cheapest possible connection from the tree to another vertex. Prim's algorithm is a minimum spanning tree algorithm that takes a graph as input and finds the subset of the edges of that graph which form a tree that includes every vertex and has the minimum sum of weights among all the trees that can be formed from the graph.

Example of Prim's algorithm

Skill Development Lab-II (2018-2019)

1

Start with a weighted graph



2

Choose a vertex



3

Choose the shortest edge from this vertex and add it



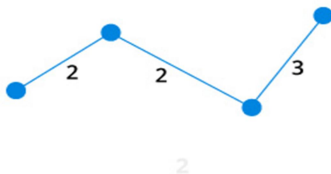
4

Choose the nearest vertex not yet in the solution



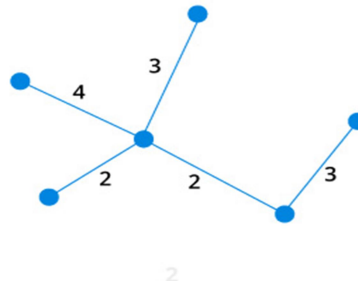
5

Choose the nearest edge not yet in the solution, if there are multiple choices, choose one at random



6

Repeat until you have a spanning tree



Algorithm:

1. Maintain two disjoint sets of vertices. One containing vertices that are in the growing spanning tree and other that are not in the growing spanning tree.
2. Select the cheapest vertex that is connected to the growing spanning tree and is not in the growing spanning tree and add it into the growing spanning tree. This can be done using Priority Queues. Insert the vertices, that are connected to growing spanning tree, into the Priority Queue.

3. Check for cycles. To do that, mark the nodes which have been already selected and insert only those nodes in the Priority Queue that are not marked.

Program code:

```
#include<iostream>
using namespace std;
class prim
{
    int ve,e;
    int w[100][100];
    int v[100];
    int p[100];
    int d[100];
public:
    void create()
    {
        cout<<"\n Enter the number of vertices";
        cin>>ve;
        cout<<"\n Enter the number of edges";
        cin>>e;
        for(int i=1;i<=ve;i++)
            for(int j=1;j<=ve;j++)
                w[i][j]=0;
        //v[ve]={0};

        for(int i=1;i<=ve;i++)
        {   v[i]=0;
            p[i]=0;
        }
        for(int i=1;i<=ve;i++)
        {
            d[i]=32767;
        }
        for(int i=1;i<=e;i++)
```

```
{
int a,b,weight;
cout<<"\n ENter vertex no. a and b and weight";
cin>>a>>b>>weight;
w[a][b]=w[b][a]=weight;
}

}

void prims()
{
int current=1;
d[current]=0;
v[current]=1;
p[current]=0;
int tot=0;
while(tot<ve-1)

{

for(int i=1;i<=ve;i++)
{
if(w[current][i]!=0 && v[i]==0)
{
if(w[current][i]<d[i])
{
d[i]=w[current][i];
p[i]=current;

}

}

}

int mini=32767;
for(int k=1;k<=ve;k++)
```

Skill Development Lab-II (2018-2019)

```
{
if((d[k]<mini) && (v[k]==0))
{

mini=d[k];
current=k;

}

}

v[current]=1;
tot++;

}

int minw=0;
for(int i=1;i<=ve;i++)
{
minw=minw+d[i];

}
cout<<"\n Minimum Weight is "<<minw;
cout<<"\n Edges are: "<<endl;
for(int i=1;i<=ve;i++)
{
cout<<i<<"-"<<p[i]<<" ";

}

}

};
int main()
```

```
{  
prim s;  
s.create();  
s.prims();  
}
```

Output:

```
"C:\Users\Lenovo\Downloads\SD 4.exe"  
  
Enter the number of vertices4  
Enter the number of edges4  
Enter vertex no. a and b and weight1  
2  
5  
Enter vertex no. a and b and weight2  
3  
9  
Enter vertex no. a and b and weight3  
4  
7  
Enter vertex no. a and b and weight4  
1  
2  
  
Minimum Weight is 14  
Edges are:  
1-0 2-1 3-4 4-1  
Process returned 0 (0x0) execution time : 48.850 s  
Press any key to continue.
```

Conclusion:

The time complexity of the Prim's Algorithm is $O((V+E)\log V)$ because each vertex is inserted in the priority queue only once and insertion in priority queue take logarithmic time.