Experiment No. 6
Prim's Algorithm
Date of Performance:
Date of Submission:

Experiment No. 6

Title: Prim's Algorithm.

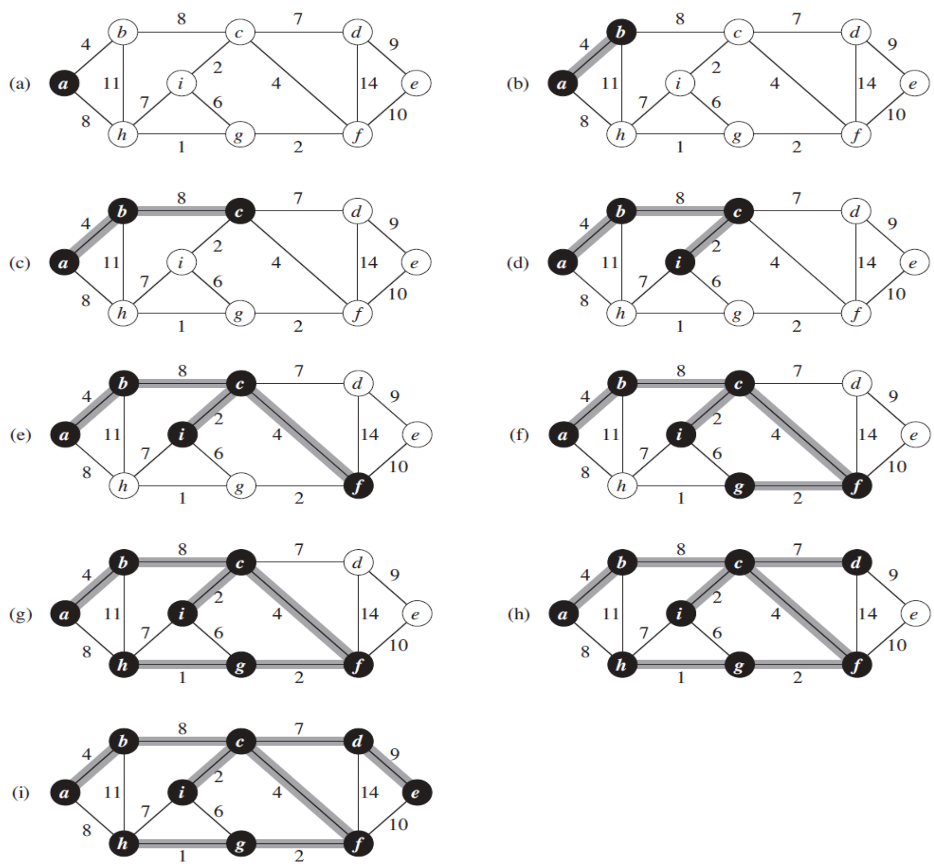
Aim: To study and implement Prim's Minimum Cost Spanning Tree Algorithm.

Objective: To introduce Greedy based algorithms

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.

Example:



Algorithm and Complexity:

```
Algorithm Prim(E, cost, n, t)
// E is the set of edges in G. cost[1 : n, 1 : n] is the cost
// adjacency matrix of an n vertex graph such that cost[i, j] is
// either a positive real number or ∞ if no edge (i, j) exists.
// A minimum spanning tree is computed and stored as a set of
// edges in the array t[1 : n − 1, 1 : 2]. (t[i, 1], t[i, 2]) is an edge in
// the minimum-cost spanning tree. The final cost is returned.
{
    Let (k, l) be an edge of minimum cost in E;
    mincost := cost[k, l];
    t[1, 1] := k; t[1, 2] := l;
    for i := 1 to n do  // Initialize near.
        if (cost[i, l] < cost[i, k]) then near[i] := l;
        else near[i] := k;
    near[k] := near[l] := 0;
    for i := 2 to n − 1 do
    { // Find n − 2 additional edges for t.
        Let j be an index such that near[j] ≠ 0 and
        cost[j, near[j]] is minimum;
        t[i, 1] := j; t[i, 2] := near[j];
        mincost := mincost + cost[j, near[j]];
        near[j] := 0;
        for k := 1 to n do // Update near[ ].
            if ((near[k] ≠ 0) and (cost[k, near[k]] > cost[k, j]))
                then near[k] := j;
    }
    return mincost;
}
```

Time Complexity is O(n2), Where, n = number of vertices **Theory:**

Implementation:

```
#include <limits.h> #include <stdbool.h> #include <stdio.h> #define V 5
int minKey(int key[], bool mstSet[])
{
int min = INT_MAX, min_index; for (int v = 0; v < V; v++)
if (mstSet[v] == false && key[v] < min) min = key[v], min_index = v;
return min_index;
}
int printMST(int parent[], int graph[V][V])
{
printf("Edge \tWeight\n"); for (int i = 1; i < V; i++)
printf("%d - %d \t%d \n", parent[i], i, graph[i][parent[i]]);
}
void primMST(int graph[V][V])
{
int parent[V]; int key[V];
bool mstSet[V];
for (int i = 0; i < V; i++)
Key[i] = INT_MAX, mstSet[i] = false; key[0] = 0;
parent[0] = -1;
for (int count = 0; count < V - 1; count++) { int u = minKey(key, mstSet);
mstSet[u] = true;
for (int v = 0; v < V; v++)
if (graph[u][v] && mstSet[v] == false && graph[u][v] < key[v])
parent[v] = u, key[v] = graph[u][v];
}
printMST(parent, graph);
}
int main()
```

```
{
int graph[V][V] = { { 0, 2, 0, 6, 0 },
{ 2, 0, 3, 8, 5 },
{ 0, 3, 0, 0, 7 },
{ 6, 8, 0, 0, 9 },
{ 0, 5, 7, 9, 0 } };
primMST(graph); return 0;
}
```

Output:

```
Output
/tmp/1zaAFOzepq.o
Edge    Weight
0 - 1   2
1 - 2   3
0 - 3   6
1 - 4   5


=== Code Execution Successful ===
```

Conclusion: Implementing Prim's Algorithm requires managing data structures efficiently to ensure the algorithm's greedy property is maintained throughout the process. Its simplicity and guaranteed optimality make it a popular choice for finding minimum spanning trees in various graph-related problems.