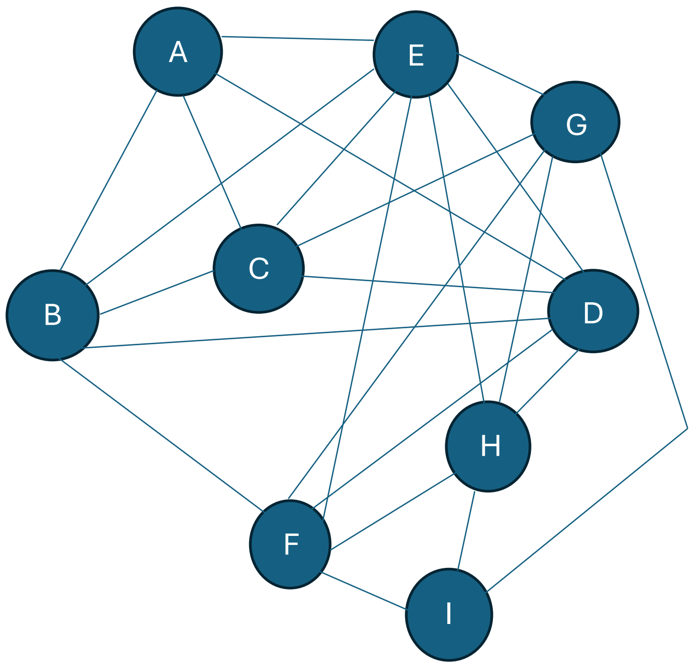
WEEK -4
PRIMS'S AND KRUSKEL'S ALGORITHM

PRIMS'S ALGORITHM:

Prim's Algorithm is used to find a Minimum Spanning Tree (MST) of a graph.

- Connect all vertices
- Use no cycles
- Total edge cost is minimum

GRAPH DIAGRAM:



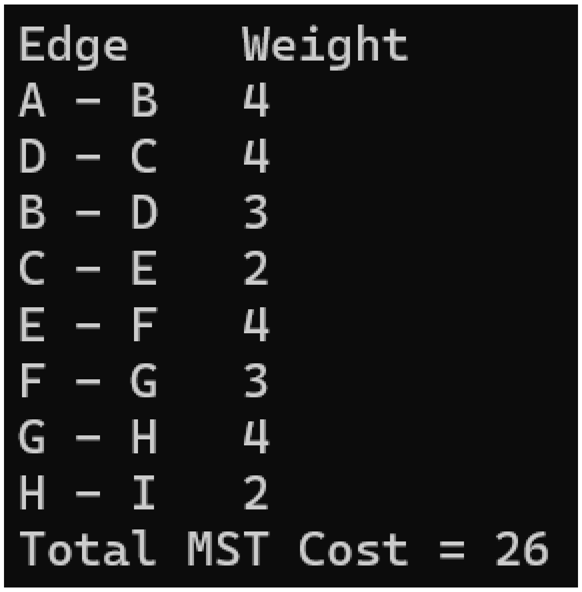
Weight of the graph:

i. A–B = 4 A–C = 8 A–D = 6 A–E = 7
ii. B–C = 5 B–D = 3 B–F = 9 B–E = 6
iii. C–D = 4 C–E = 2 C–G = 10
iv. D–E = 5 D–F = 7 D–H = 6
v. E–F = 4 E–G = 8 E–H = 9
vi. F–G = 3 F–H = 5 F–I = 6
vii. G–H = 4 G–I = 7
viii. H–I = 2

CODE:

```c
#include <stdio.h>
#include <limits.h>
#define V 9
int minKey(int key[], int mstSet[]) {
  int min = INT_MAX, min_index;
  for (int v = 0; v < V; v++) {
    if (!mstSet[v] && key[v] < min) {
      min = key[v];
      min_index = v;
    }
  }
  return min_index;
}
void printMST(int parent[], int graph[V][V]) {
  int cost = 0;
  printf("Edge \tWeight\n");
  for (int i = 1; i < V; i++) {
    printf("%c - %c \t%d\n", parent[i] + 'A', i + 'A',
        graph[i][parent[i]]);
    cost += graph[i][parent[i]];
  }
  printf("Total MST Cost = %d\n", cost);
}
void primMST(int graph[V][V]) {
  int parent[V];
  int key[V];
  int mstSet[V];
  for (int i = 0; i < V; i++) {
    key[i] = INT_MAX;
    mstSet[i] = 0;
  }
  key[0] = 0;
  parent[0] = -1;
  for (int count = 0; count < V - 1; count++) {
    int u = minKey(key, mstSet);
    mstSet[u] = 1;
    for (int v = 0; v < V; v++) {
            if (graph[u][v] && !mstSet[v] && graph[u][v] < key[v]) {
                parent[v] = u;
                key[v] = graph[u][v];
            }
        }
    }
    printMST(parent, graph);
}
int main() {
    int graph[V][V] = {
        {0,4,8,6,7,0,0,0,0},
        {4,0,5,3,6,9,0,0,0},
        {8,5,0,4,2,0,10,0,0},
        {6,3,4,0,5,7,0,6,0},
        {7,6,2,5,0,4,8,9,0},
        {0,9,0,7,4,0,3,5,6},
        {0,0,10,0,8,3,0,4,7},
        {0,0,0,6,9,5,4,0,2},
        {0,0,0,0,0,6,7,2,0}
    };
    primMST(graph);
    return 0;
}
```

<u>OUTPUT:</u>

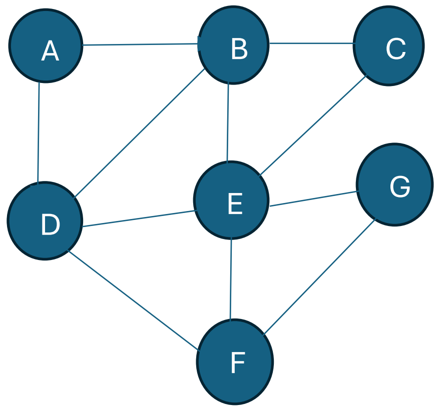


```
Edge    Weight
A - B   4
D - C   4
B - D   3
C - E   2
E - F   4
F - G   3
G - H   4
H - I   2
Total MST Cost = 26
```

KRUSKAL'S ALGORITHM:

Kruskal's algorithm constructs a minimum spanning tree by selecting edges in ascending order of weight without forming cycles.

GRAPH DIAGRAM:



Weight of the graph:

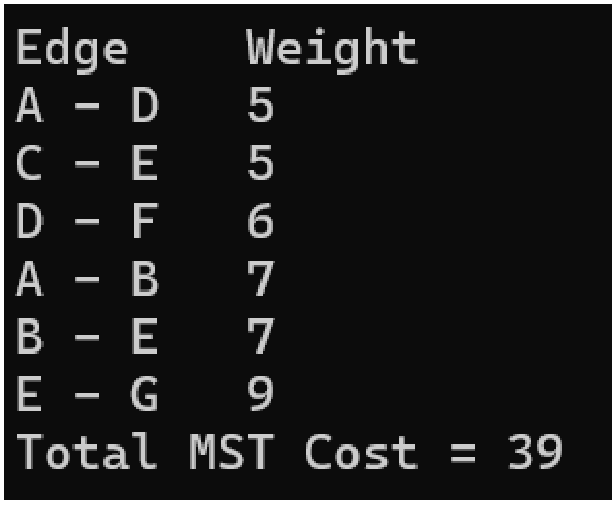
I. A - B = 7 , A - D = 5
II. B - C = 8 , B - D = 9 , B - E = 7
III. C - E = 5
IV. D - E = 15 , D - F = 6
V. E - F = 8 , E - G = 9
VI. F - G = 11

CODE:

```
#include <stdio.h>
#include <stdlib.h>
#define V 7
#define E 11
struct Edge {
  int src, dest, weight;
};
struct Subset {
  int parent;
  int rank;
};
int find(struct Subset subsets[], int i) {
  if (subsets[i].parent != i)
```

```
        subsets[i].parent = find(subsets, subsets[i].parent);
    return subsets[i].parent;
}
void Union(struct Subset subsets[], int x, int y) {
    int xroot = find(subsets, x);
    int yroot = find(subsets, y);
    if (subsets[xroot].rank < subsets[yroot].rank)
        subsets[xroot].parent = yroot;
    else if (subsets[xroot].rank > subsets[yroot].rank)
        subsets[yroot].parent = xroot;
    else {
        subsets[yroot].parent = xroot;
        subsets[xroot].rank++;
    }
}
int compare(const void *a, const void *b) {
    return ((struct Edge *)a)->weight - ((struct Edge *)b)->weight;
}
void KruskalMST(struct Edge edges[]) {
    struct Edge result[V];
    int e = 0, i = 0;
    qsort(edges, E, sizeof(edges[0]), compare);
    struct Subset subsets[V];
    for (int v = 0; v < V; v++) {
        subsets[v].parent = v;
        subsets[v].rank = 0;
    }
    while (e < V - 1 && i < E) {
        struct Edge next = edges[i++];
        int x = find(subsets, next.src);
        int y = find(subsets, next.dest);
        if (x != y) {
            result[e++] = next;
            Union(subsets, x, y);
        }
    }
    int total = 0;
    printf("Edge \tWeight\n");
    for (i = 0; i < e; i++) {
        printf("%c - %c \t%d\n",
               result[i].src + 'A',
               result[i].dest + 'A',
               result[i].weight);
        total += result[i].weight;
    }
    printf("Total MST Cost = %d\n", total);
}
int main() {
    struct Edge edges[E] = {
        {0,1,7},
        {0,3,5},
        {1,2,8},
        {1,3,9},
        {1,4,7},
        {2,4,5},
        {3,4,15},
        {3,5,6},
        {4,5,8},
        {4,6,9},
        {5,6,11}
    };
    KruskalMST(edges);
    return 0;
}
```

OUTPUT:



```
Edge    Weight
A - D   5
C - E   5
D - F   6
A - B   7
B - E   7
E - G   9
Total MST Cost = 39
```