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Subject	Design and Analysis of Algorithms (DAA)
Experiment No.	6
Aim	To implement Greedy Approach (Prim's Algorithm and Dijkstra's Algorithm)
Code:	

```c
#include <stdio.h>
#include <stdlib.h>
#include <limits.h>

void primsAlgorithm(int **graph, int vertices) {
    int parent[vertices];
    int key[vertices];
    int mstSet[vertices];

    for (int i = 0; i < vertices; i++) {
        key[i] = INT_MAX;
        mstSet[i] = 0;
    }

    key[0] = 0;
    parent[0] = -1;

    for (int count = 0; count < vertices - 1; count++) {
        int minKey = INT_MAX, minIndex;

        for (int v = 0; v < vertices; v++) {
            if (mstSet[v] == 0 && key[v] < minKey) {
                minKey = key[v];
                minIndex = v;
            }
        }

        mstSet[minIndex] = 1;
```

```
        for (int v = 0; v < vertices; v++) {
            if (graph[minIndex][v] && mstSet[v] == 0 &&
graph[minIndex][v] < key[v]) {
                parent[v] = minIndex;
                key[v] = graph[minIndex][v];
            }
        }
    }

    printf("Edge \tWeight\n");
    for (int i = 1; i < vertices; i++) {
        printf("%d - %d \t%d \n", parent[i], i,
graph[i][parent[i]]);
    }
}

void dijkstraAlgorithm(int **graph, int vertices, int src) {
    int dist[vertices];
    int visited[vertices];

    for (int i = 0; i < vertices; i++) {
        dist[i] = INT_MAX;
        visited[i] = 0;
    }

    dist[src] = 0;

    for (int count = 0; count < vertices - 1; count++) {
        int minDist = INT_MAX, minIndex;

        for (int v = 0; v < vertices; v++) {
            if (!visited[v] && dist[v] <= minDist) {
                minDist = dist[v];
                minIndex = v;
            }
        }
```

```
        visited[minIndex] = 1;

        for (int v = 0; v < vertices; v++) {
            if (!visited[v] && graph[minIndex][v] &&
dist[minIndex] != INT_MAX &&
                dist[minIndex] + graph[minIndex][v] < dist[v])
{
                dist[v] = dist[minIndex] + graph[minIndex][v];
            }
        }
    }

    printf("Vertex \tDistance from Source\n");
    for (int i = 0; i < vertices; i++) {
        printf("%d \t%d\n", i, dist[i]);
    }
}

int main() {
    int choice, vertices, src;

    printf("Enter the number of vertices: ");
    scanf("%d", &vertices);

    int **graph = (int **)malloc(vertices * sizeof(int *));
    for (int i = 0; i < vertices; i++) {
        graph[i] = (int *)malloc(vertices * sizeof(int));
    }

    printf("Enter the adjacency matrix:\n");
    for (int i = 0; i < vertices; i++) {
        for (int j = 0; j < vertices; j++) {
            scanf("%d", &graph[i][j]);
        }
    }
```

```
    do {
        printf("\nChoose an option:\n");
        printf("1. Prim's Algorithm\n");
        printf("2. Dijkstra's Algorithm\n");
        printf("3. Exit\n");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                primsAlgorithm(graph, vertices);
                break;
            case 2:
                printf("Enter the source vertex for Dijkstra's
Algorithm: ");
                scanf("%d", &src);
                if (src >= 0 && src < vertices) {
                    dijkstraAlgorithm(graph, vertices, src);
                } else {
                    printf("Invalid source vertex.\n");
                }
                break;
            case 3:
                printf("Execution Completed\n");
                break;
            default:
                printf("Invalid choice. Please enter
again.\n");
        }
    } while (choice != 3);

    for (int i = 0; i < vertices; i++) {
        free(graph[i]);
    }
    free(graph);

    return 0;
}
```

Output

```
PS D:\Manish\SPIT> cd 'd:\Manish\SPIT\4th SEM\DAA\Exp6\output'
PS D:\Manish\SPIT\4th SEM\DAA\Exp6\output> & .\'greedy.exe'
Enter the number of vertices: 4
Enter the adjacency matrix:
0 1 3 0
1 0 1 4
3 1 0 2
0 4 2 0

Choose an option:
1. Prim's Algorithm
2. Dijkstra's Algorithm
3. Exit
1
Edge    Weight
0 - 1   1
1 - 2   1
2 - 3   2

Choose an option:
1. Prim's Algorithm
2. Dijkstra's Algorithm
3. Exit
2
Enter the source vertex for Dijkstra's Algorithm: 1
Vertex  Distance from Source
0       1
1       0
2       1
3       3

Choose an option:
1. Prim's Algorithm
2. Dijkstra's Algorithm
3. Exit
3
Execution Completed
PS D:\Manish\SPIT\4th SEM\DAA\Exp6\output>
```

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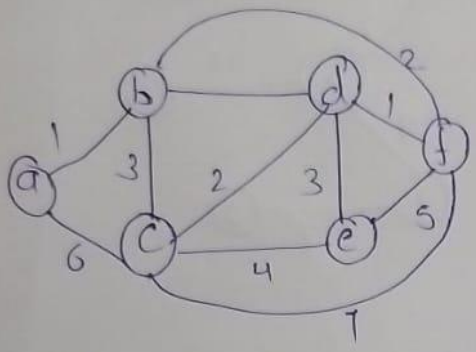
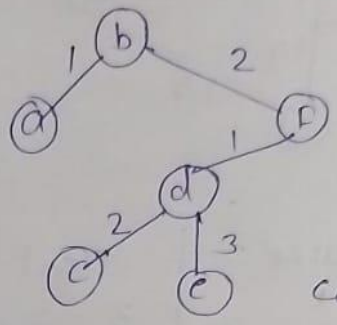
Pseudo Code

* Prims Algorithm

Start 'a'.

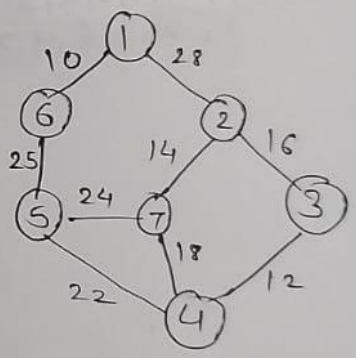




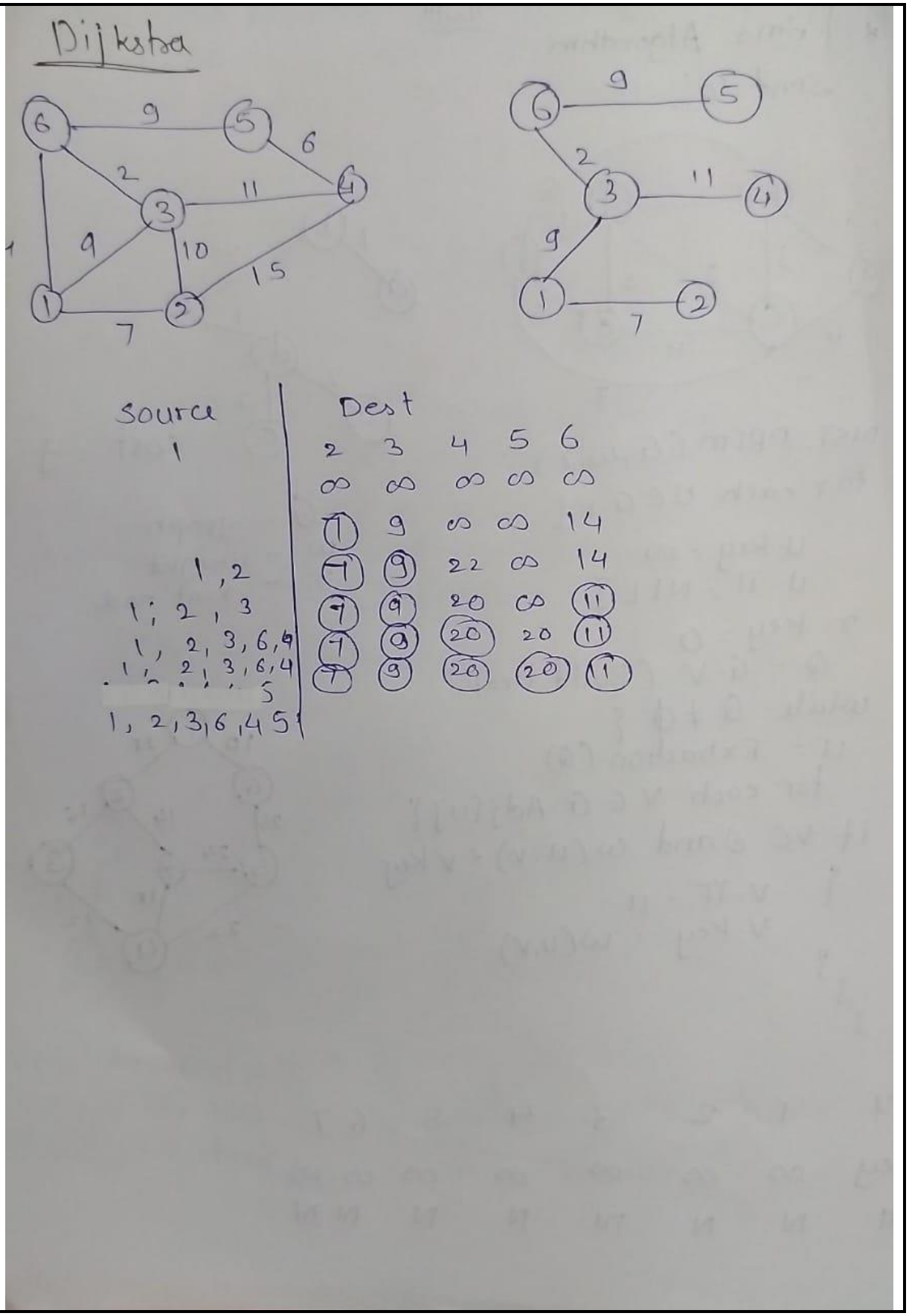
cost = 9

```
MST_PRIM (G, ω, r)
for each u ∈ G.V {
    u.key = ∞
    u.π = NIL }
r.key = 0
Q = G.V (Build Heap)
while Q ≠ ∅ {
  u = Extraction (Q)
  for each v ∈ G.Adj[u] {
if v ∈ Q and ω(u,v) < v.key
  { v.π = u
    v.key = ω(u,v)
  }
}
}
```

G – graph
ω – weight
r – root node



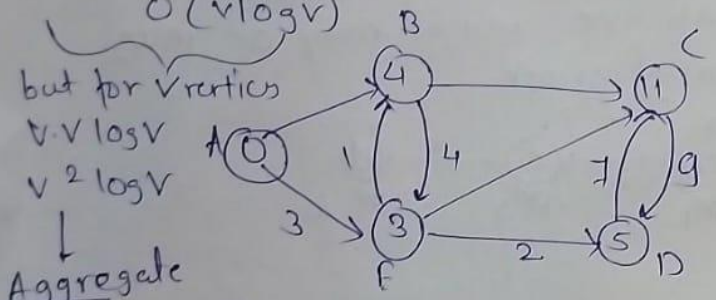
u	1	2	3	4	5	6	7
key	∞	∞	∞	∞	∞	∞	∞
π	N	N	N	N	N	N	N


Dijkstra
6
9
5
6
2
11
4
3
9
10
15
1
2
7
9
5
6
2
11
4
3
9
1
2
7
Source
1
Dest
2 3 4 5 6
∞ ∞ ∞ ∞ ∞
1 9 ∞ ∞ 14
1 9 22 ∞ 14
1 9 20 ∞ 11
1 9 20 20 11
1 9 20 20 11
1, 2
1, 2, 3
1, 2, 3, 6, 4
1, 2, 3, 6, 4
5
1, 2, 3, 6, 4 5

DIJKSTRA (G, w, s)
Initialize single source (G, s) → O(V)
s = ϕ O(1)
Q = G.V O(V)

while Q ≠ ϕ
  u = extract min(Q) O(log V)
  S = S ∪ {u}
1
O(V log V)
  for each vertex v ∈ G . Adj [u]
    Relax (u, v, w)
    ↓
    Decrease key
    O(V log V)

but for V vertices
V . V log V
V² log V
↓
Aggregate
E log V



S = {A, E, B, D, C}

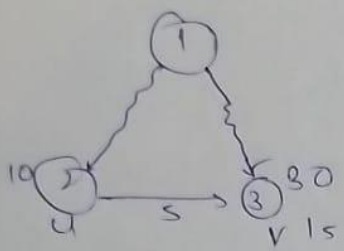
∴ TC = O(V) + O(1) + O(V) + O(log V) + O(V log V) + O(E log V)
= O((V + E) log V)

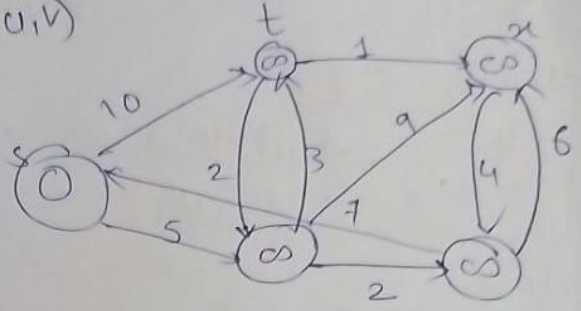
Dijkstra's Algorithm

Relaxation

if $d(v) > d(u) + w(u,v)$

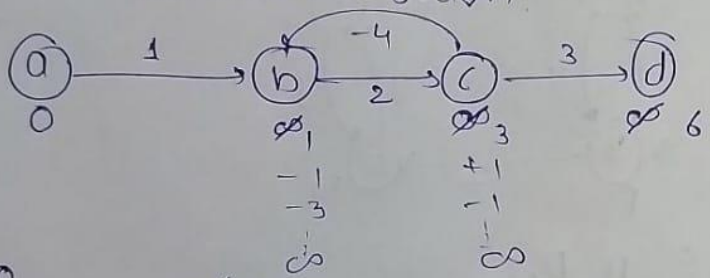
then $d(v) = d(u) + w(u,v)$

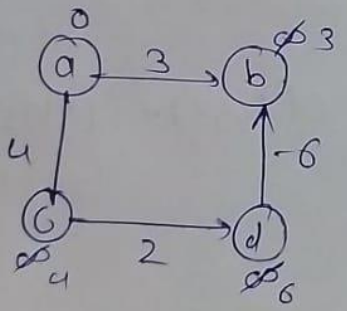




A graph with -ve weight cycle will always result in incorrect weight graph.

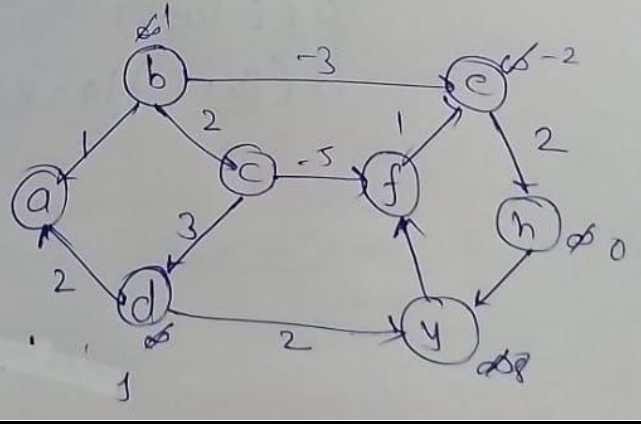
But a graph with -ve weight may or may not result in incorrect graph





Complete correct path

1) Even if the node is deleted still check by



Conclusion	Hence, by completing this experiment I came to know about implementation of Prims and Dijkestra algorithm.