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Experiment	2
Aim	To understand and implement greedy Approach
Objective	1) Learn GREEDY Approach 2) Implement Greedy approach problem 3) Solve Greedy approach problem
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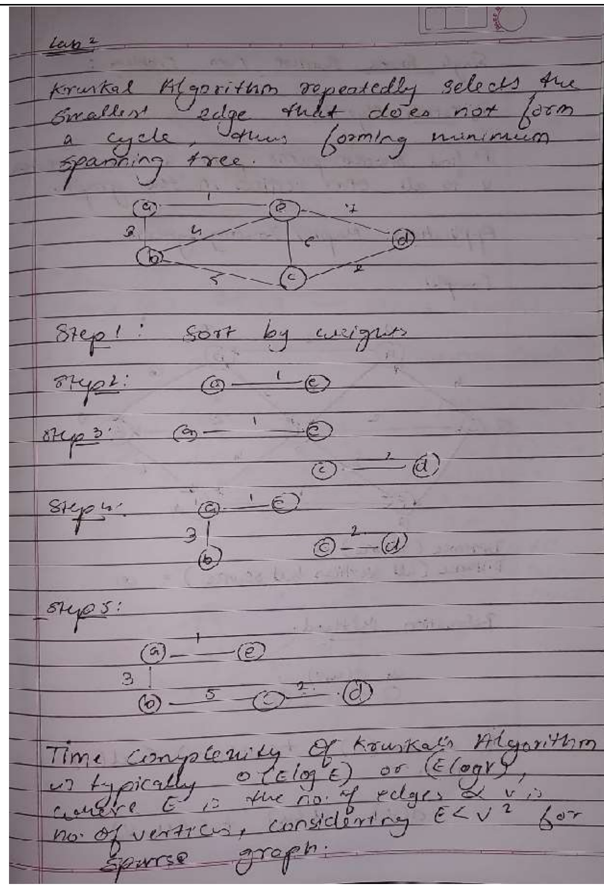
Algorithm and explanation of the technique used	Sort all the edges in non-decreasing order of their weight. Pick the smallest edge. Check if it forms a cycle with the spanning tree formed so far. If the cycle is not formed, include this edge. Else, discard it. Repeat step#2 until there are (V-1) edges in the spanning tree **Kruskal's Algorithm:** KRUSKAL(G): A = ∅ For each vertex v ∈ G. V: MAKE-SET(v) For each edge (u, v) ∈ G.E ordered by increasing order by weight(u, v): if FIND-SET(u) ≠ FIND-SET(v): A = A ∪ {(u, v)} UNION(u, v) return A



Code

```
import java.util.*;
class Edge implements Comparable<Edge> {
    char src, dest;
    int weight;

    Edge(char src, char dest, int weight) {
        this.src = src;
        this.dest = dest;
        this.weight = weight;
    }
    public int compareTo(Edge compareEdge) {
        return this.weight - compareEdge.weight;
    }
}

class DisjointSet {
    Map<Character, Character> parent;

    DisjointSet() {
        parent = new HashMap<>();
    }

    void makeSet(char vertex) {
        parent.put(vertex, vertex);
```

```
    }
    char find(char vertex) {
        if (parent.get(vertex) == vertex)
            return vertex;
        return find(parent.get(vertex));
    }
    void union(char vertex1, char vertex2) {
        char parent1 = find(vertex1);
        char parent2 = find(vertex2);
        parent.put(parent1, parent2);
    }
}

class Main {
    public static void main(String[] args) {
        Edge[] edges = {
                new Edge('a', 'b', 3),
                new Edge('a', 'e', 1),
                new Edge('b', 'c', 5),
                new Edge('b', 'e', 4),
                new Edge('c', 'd', 2),
                new Edge('e', 'd', 7),
                new Edge('e', 'c', 6)
        };

        Arrays.sort(edges);
        DisjointSet disjointSet = new DisjointSet();
        for (char c = 'a'; c <= 'h'; c++) {
            disjointSet.makeSet(c);
        }
        // Kruskal's algorithm
        List<Edge> minimumSpanningTree = new ArrayList<>();
        for (Edge edge : edges) {
            char srcParent = disjointSet.find(edge.src);
            char destParent = disjointSet.find(edge.dest);
            if (srcParent != destParent) {
                minimumSpanningTree.add(edge);
                disjointSet.union(edge.src, edge.dest);
            }
        }
        for (Edge edge : minimumSpanningTree) {
            System.out.println(edge.src + " - " + edge.dest + ": " +
edge.weight);
        }
    }
}
```

Output	`"C:\Program Files\Java\jdk-21\bin\java.exe"`
	`a - e: 1`
	`c - d: 2`
	`a - b: 3`
	`b - c: 5`

Justification of the complexity calculated	The time complexity of Kruskal's algorithm is mainly influenced by the sorting of edges, which takes O(E log E) time, where E represents the number of edges in the graph. Additionally, the union-find operations contribute a nearly constant factor per operation. Overall, the time complexity of Kruskal's algorithm is O(E log E), which can be simplified to O(E log V) for sparse graphs, where V is the number of vertices in the graph.
Conclusion	Kruskal's Algorithm is one technique to find out minimum spanning tree from a graph, a tree containing all the vertices of the graph and V-1 edges with minimum cost. The complexity of this graph is (VlogE) or (ElogV). With a time complexity of O(E log E) or O(E log V), it offers a practical solution for a wide range of graph structures, making it a versatile and effective tool for network optimization problems.