UCS301 Data Structures Lab

Assignment 9 (Graphs)

A graph G is defined as a pair (V, E) where V is a set of nodes/vertices and E is a set of edges connecting pairs of vertices. Graphs may be directed or undirected and may have weighted or unweighted edges. They can be represented using an adjacency matrix, adjacency list, or edge list.

Write a program to implement the following graph algorithms:

1. Breadth First Search (BFS)
2. Depth First Search (DFS)
3. Minimum Spanning Tree (Kruskal and Prim)
4. Dijkstra's Shortest Path Algorithm

Additional Questions

1. Graph Traversal Count

Given an undirected graph G(V, E) with V representing the number of vertices numbered from 0 to V-1 and E representing the number of edges, what is the task? Each edge connects two vertices u and v.

Task: Determine the number of connected components in the graph.

Input format: V E followed by E lines of (u v) pairs.

Example:

Input: V=5, E=3, edges=[[0,1],[1,2],[3,4]]

Output: 2

2. Shortest Path in Grid

You are given a weighted grid size of m x n. Each cell contains a non-negative cost. Interpret the grid as a graph where each cell is a node and edges exist between adjacent horizontal/vertical cells with weights equal to the destination cell cost.

Task: Determine the minimum total cost from (0,0) to (m-1,n-1) using Dijkstra.

Example:

Input: grid=[[1,2,3],[4,5,6],[7,8,9]]

Output: 21

3. Network Delay Time

You are given a directed weighted graph G(V, E) and an array times[] where times[i] = (u, v, w) represents an edge from node u to node v with weight w.

Task: Given a starting node K, find how long it takes for all nodes to receive the signal.

If some nodes cannot be reached, return -1.

Example:

Input: N=4, K=2, times=[[2,1,1],[2,3,1],[3,4,1]]

Output: 2

4. Number of Islands

You are given a 2D grid of size M x N consisting of characters '0' and '1'. A group of connected '1's horizontally or vertically represents a piece of land, forming an island.

Task: Count the total number of islands present in the grid using BFS/DFS.

Example:

Input: grid=[[1,1,0],[0,1,0],[1,0,1]]

Output: 3