CS3221 Exam 2, Spring 2026

Your name:

Q1: For what sort of graph would an adjacency matrix be more space-efficient than an adjacency list? Why? Be specific.

Q2: If you do a DFS search and classify edges on a graph with 12 vertices and 15 edges, how many edges will be tree edges? Prove it.

Q3: Prove that every tree with directed edges directed from root to leaves has a topological ordering.

Q4: Given a connected, weighted, undirected graph G, prove that for any cycle in G, the minimum spanning tree of G excludes the maximum-weight edge in that cycle.

Q5: You are given a connected, undirected graph G with weighted edges and a minimum spanning tree T of G. The weight of a single edge e is decreased. Describe an algorithm to update the minimum spanning tree efficiently.

Q6: Describe and analyze an algorithm to compute the maximum-weight spanning tree of a given edge-weighted graph G.

Q7: You are given a directed graph with edge weights that may be negative. Describe an algorithm to determine whether there exists a path from s to t with total weight exactly equal to k (for some given k), assuming you only need to answer yes/no.

Q8: Given a flow network where every edge has capacity 1, what is the relationship between the value of the maximum flow and the number of edge-disjoint paths from s to t?