CSCE 411-502 Design and Analysis of Algorithms

Spring 2025

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Assignment # 4
(Due March 17)

1. Another way to do topological sorting on directed acyclic graphs is to repeatedly find a vertex of in-degree 0, output it, and remove it and all of its outgoing edges. Develop an $O(n + m)$-time algorithm using this approach. Your algorithm should also be able to tell when the input graph has cycles.

2. Develop a linear-time (i.e., $O(m + n)$-time) algorithm that solves the SINGLE-SOURCE SHORTEST PATH problem for graphs whose edge weights are positive integers bounded by 5. (**Hint.** You can either modify Dijstra's algorithm or consider using Breath-First-Search.)

3. Let G be a weighted graph. Let P be a path in G. The *bandwidth* of the path P is defined to be the minimum edge weight over all edges on the path P. Develop an algorithm that solves the following problem: given a weighted graph G and two vertices s and t, find a path from s to t whose bandwidth is the largest over all paths from s to t in G. (**Hint.** Consider the approach of Dijkstra.)