Practice Problems for the Final Exam

Here is a list of what I would consider to be problems for the final exam that cover most of the core topics. I have broken these down based on major concepts we have studied this semester. "PP" refers to "Practice Problem" and "Q" refers to "Quiz".

Graphs, DFS, and Shortest Paths:

- PP-1, Problem 3 and Q-1, Problem 4 (DFS trace)
- PP-2, Problem 1 (Strong components trace)
- PP-2, Problem 2 and Q-1, Problem 5 (Counting paths in a DAG)
- Q-1, Problem 3 (Bellman-Ford)

Greedy Algorithms:

- PP-3, Problem 4 (Greedy algorithm for scheduling stops)
- PP-3, Problem 5 and PP-4, Problem 1(a) (Greedy algorithms for layout/scheduling)
- Q-2, Problem 2 (Greedy algorithm for filling bottles)
- PP-4, Problem 3 (Gonzalez's algorithm)
- PP-4, Problem 5(a) and (b) (Hitting sets and set cover)
- PP-4, Problem 5(c) (Greedy algorithm for stabbing intervals)

Dynamic Programming:

- PP-6, Problem 2 (DP algorithm for LCS variants)
- PP-6, Problem 3(b) (DP algorithm for Typesetting)
- Q-3, Problem 2 (DP algorithm for shortest common subsequence)
- Q-3, Problem 3 (DP algorithms for longest non-increasing subsequence)
- PP-8, Problem 1(b) (DP algorithm for cutting chips)

Network Flow:

- Q-3, Problem 5 (Residual network and augmentation)
- PP-8, Problem 4 (Converting between vertex and edge capacities)
- PP-9, Problem 1 (Leaky network)
- PP-10, Problem 2 (Drone delivery reduction to circulations)
- PP-10, Problem 4 and Q-4, Problem 2 (Blocking paths using network flow)
- Q-4, Problem 5 (Bucket redistribution using network flow)

NP-Completeness:

- PP-11, Problem 2 and Problem 3 (Using oracles to solve optimization problems)
- PP-11, Problem 5 and Q-4, Problem 4 (High-degree independent set is NP-complete)
- PP-12, Problem 1 and Q-5, Problem 1 (Variants of Hamiltonian cycle are NP-complete)
- PP-12, Problem 4 (Zero-cycle is NP-complete)

Approximation Algorithms:

- PP-13, Problem 2 (Greedy heuristic for Dominating set)
- Q-5, Problem 3 (Special set-cover approximation)
- Q-5, Problem 4 (Metric MST approximation)
- Q-5, Problem 5 (Subset sum approximation)