

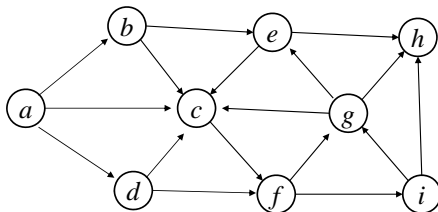
Name: _____ Student ID: _____ Algorithm ID: _____

Problem 1. (10 pts total) Find an optimal Huffman code for the following set of frequencies: a:1 b:2 c:3 d:5 e:7 f:11. What is the optimal cost?

Problem 2. (12 pts total) Given n items, with i th item worth v_i dollars and weighing w_i kilograms, a thief wants to take as valuable a load as possible, but he can carry at most W pounds in his knapsack. Suppose this thief is allowed to take any fraction of items.

- (a) (6 pts) Show that this fractional knapsack problem has the greedy-choice property.
- (b) (6 pts) Give a greedy algorithm to solve this problem. What is the time complexity of your algorithm?

Problem 3. (10 pts total) Determine a topological ordering of the nodes in the graph below, if such an ordering exists. State why it does not exist, otherwise. Show your work!



Problem 4. (12 pts total) Consider the chessboard shown below. Some squares are shaded, denoting blockages, and any tour must not visit these shaded squares. We wish to determine a shortest path, if one exists, that starts at the square designated by s and after visiting **the minimum number of squares**, ends at the square designated by t . Formulate this problem on an appropriately defined graph. Give **an efficient algorithm** to solve this problem. What is the time complexity of your algorithm?

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