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Assignment Topic: Greedy Algorithms

Question 1: Write an algorithm for Water Distribution Problem: You are given container full of water. Container can have limited amount of water. You also have N bottles to fill. You need to find the maximum numbers of bottles you can fill. Input contains number of bottles(N) to be filled, capacity of the container(CC) and the capacity of the bottles(CBi) and Outputs the maximum number of bottles you can fill.

For Eg: N = 5, CC = 10
CB1 =8, CB2 =5, CB3 =4, CB4 =3, CB5 =2
Output : 3 bottles [CB2 , CB4 , CB5]

Question 2: What is an optimal Huffman code for the following set of frequencies

a:45 b:13 c:12 d:16 e:9 f:5 g:15 h:21

Construct the Huffman tree for the above symbol: frequency and tabulate the prefix code for each symbol.

Question 3:

A. Imagine you live in a country where the coin denominations are 1 cent, 4 cents, and 5 cents. Consider the problem where you are given some value n and you want to make change for this value, using the smallest number of coins. Show that the greedy algorithm (use the largest value coins first) for making change fails for these denominations
B. Consider the following coin denominations: 1, 3, 5, 10, 22, 50. Can the greedy method be used to find the smallest number of coins of these denominations with total value equal to some number B? Why?

Question 4: A ski rental agency has m pair of skis, where the height of the i^{th} pair of skis is s_i. There are n skiers who wish to rent skis, where the height of the i^{th} skier is h_i. Your goal is to assign skis to skiers so that the sum of the absolute differences of the heights of each skier and her skis is minimized.

A. Give the most effecient algorithm you can to obtain an optimal solution to this problem when m = n.
B. Now consider this problem when m n. Prove whether or not the following greedy algorithm is optimal.

Let H be the set of heights for the skiers
Let S be the set of ski lengths
Repeat until each skier has skis
Pick a height h in H and ski length s in S such that
| h-s | is the minimum possible
Match the person with height h to skis of length s
Remove h from H
Remove s from S

Question 5: You have n people who can work at a store, where person i will work from time b_i until time e_i. Also, you are given an opening time b and closing time e for the store. The goal is to find the minimum number of people to work for the day so that at least one person is at the store between times b and e. You can assume that for all i, $b_i >= b$ and $e_i <= e$. Give a greedy algorithm that optimally solves this problem. (Your solution should include a clear description of the algorithm, give the time complexity of the algorithm).