Homework 4

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CS331 Algorithms and Complexity

Problem Q1. Suppose you're consulting for a company that manufactures PC equipment and ships it to distributors all over the country. For each of the next n weeks, they have a projected $supplys_i$ of equipment (measured in pounds), which has to be shipped by an air freight carrier.

Each week's supply can be carried by one of two air freight companies, A or B.

- Company A charges a fixed rate r per pound (so it costs $r \cdot s_i$ to ship a week's supply s_i
- Company B makes contracts for a fixed amount c per week, independent of the weight. However, contracts with company B must be made in blocks of four consecutive weeks at a time.

Give a polynomial-time algorithm that takes a sequence of supply values $s_1, s_2, \ldots, s_n$ and returns a *schedule* of minimum cost.

Problem Q2(a). Assume that you have to make change for N, and that you have an infinite supply of each $C = c_1, c_2, \ldots, c_n$ valued coins where $1 \leq c_i \leq N - 1$. Compute the minimum number of coins required to make the change. Provide an algorithm which solves the problem using dynamic programming, prove correctness and runtime.

Problem Q2(b). Solve the same problem, but this time assume you have a limited supply p_i of each coin c_i Provide a dynamic programming algorithm, do not prove correctness or runtime.

Problem Q2. Assume $C = 1, 2, \ldots, 2^m$ and $N < 2^{m+1}$. For this special case, give an $O(m)$ time algorithm that solves the problem in (a).

Problem Q3. An opportunity cycle is one where the product of the ratios along the cycle is greater than 1. Give a polynomial-time algorithm to find an opportunity cycle in a graph, if one exists.