University of Washington
Department of Computer Science and Engineering
CSE 521, Winter 2000

February 9, 2000

Homework 6, **Due Wednesday, February 16, 2000**

Reading Read chapter 27.

Problem 1. Buying library shelves:

A library decides to store its books according to their size in order to minimize storage costs.

Suppose the book heights are $H_1, H_2, \ldots, H_n$ with $H_1 < H_2 < \cdots < H_n$, and let L_i be the shelf length required to hold all the books of height H_i. If we order shelving of height H_i, the cost of ordering x_i units is $F_i + C_i x_i$; F_i is a fixed ordering cost (and is independent of the length ordered) and C_i is the cost of the shelf per unit length. Notice that to save the fixed cost of ordering, we might not order shelves of every possible height because we can use a shelf of height H_i to store books of smaller height. We want to determine the length of shelving of each class to minimize the total cost of shelving.

a) Formulate this problem as a shortest paths problem.

b) Suppose that you are only allowed to use K distinct shelf heights, can the problem still be formulated as a shortest paths problem?

Problem 2. Cluster analysis:

Consider a set of n scalar numbers $a_1, a_2, \ldots, a_n$ arranged in non-decreasing order of their values. We wish to partition these numbers into clusters of consecutive elements from the list such that each group has at least p elements. The score of a cluster is the sum of the squared deviation of its numbers from their cluster mean, and we wish to find a partitioning which minimizes the sum of the cluster scores.

Show how to formulate this problem as a shortest paths problem.

Problem 3. Closed semi-rings:

Page 576, Exercise 26.4-6.

Problem 4. Transitive closure:

Page 576, Problem 26-1.

Problem 5. Network flow:

Page 586, Exercise 27.1-6.

Problem 6. Multicommodity flow:

Page 587, Exercise 27.1-9.