CS 5114 Theory of Algorithms, Spring 2020
Homework 2: Due on 18 Feb. 2020, 1pm

I pledge that this test/assignment has been completed in compliance with the Graduate Honor Code and that I have neither given nor received any unauthorized aid on this test/assignment.

Name (Print): _____

Signed: _____

1. **(20%)** Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is $\langle 5, 10, 3, 12, 5, 50, 6\rangle$. Show your answer of m and s tables as shown in Figure 15.5 (p. 376).

2. **(20%)** Determine an LCS (Longest Common Subsequence) of $X = \langle A, M, P, U, T, A, T, I, O, N\rangle$ and $Y = \langle S, P, A, N, K, I, N, G\rangle$. Show your answer of c and b tables as shown in Figure 15.8 (p. 395).

3. **(20%)** Consider a modification of the rod-cutting problem in which, in addition to a price p_i for each rod, each cut incurs a fixed cost of c. The revenue associated with a solution is now the sum of the prices of the pieces minus the costs of making the cuts. Give a dynamic-programming algorithm to solve this modified problem.

4. **(20%)** Suppose that the splits at every level of quicksort are in the proportion $1 - \alpha$ to α where $0 < \alpha \leq 1/2$ is a constant. Show that the minimum depth of a leaf in the recursion tree is approximately $-\lg n / \lg \alpha$ and the maximum depth is approximately $-\lg n / \lg(1 - \alpha)$. (Don't worry about integer round-off.)

5. **(20%; 5% for each)** Determine the break-even point for an array-based list and linked list implementation for lists when the sizes for the data field, a pointer, and the array-based list's array are as specified. State when the linked list needs less space than the array.

   (a) The data field is eight bytes, a pointer is four bytes, and the array holds twenty elements.

   (b) The data field is two bytes, a pointer is four bytes, and the array holds thirty elements.

   (c) The data field is one byte, a pointer is four bytes, and the array holds thirty elements.

   (d) The data field is 32 bytes, a pointer is four bytes, and the array holds forty elements.