Algorithm Analysis, Term I/2018-19

Assignment 4

Due: Fri, Nov 16 @ 11.59pm

Directions:

- Your solutions must be typeset. LaTeX is recommended.
- You must upload your solutions as a PDF file on Canvas before the deadline.
- You don't have to include your solutions to the programming problems in the PDF file.

Problem 1

In class, we discussed the rod-cutting problem. 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.

Problem 2

A *contiguous subsequence* of a list S is a subsequence made up of consecutive elements of S. For instance, if S is

$$5, 15, -30, 10, -5, 40, 10,$$

then $15, -30, 10$ is a contiguous subsequence but $5, 15, 40$ is not. Give a linear-time algorithm for the following task:

Input: A list of numbers, $a_1, a_2, \ldots, a_n$.
Output: The contiguous subsequence of maximum sum (a subsequence of length zero has sum zero).

For the preceding example, the answer would be $10, -5, 40, 10$, with a sum of 55.

Hint: For each $j \in \{1, 2, \ldots, n\}$, consider contiguous subsequences ending exactly at position j.

Problem 3

A **palindrome** is a nonempty string over some alphabet that reads the same forward and backward. Examples of palindromes are all strings of length 1, `civic`, `racecar`, and aibohphobia (fear of palindromes).

Give an efficient algorithm to find the longest palindrome that is a subsequence of a given input string S. For example, given the input `character`, your algorithm should return `carac`. What is the running time of your algorithm?

Problem 4

Complete the problems from the following contest: https://www.hackerrank.com/muic-t1-2018-hw4.