CS3383, Winter 2019 Assignment # 7

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Faculty of Computer Science, UNB **Due time:** Wednesday, March/27/2019, 9:30 a.m

Student's full name: ..... Student ID:.....

Note:

- No submission after the due time will be accepted.
- The full credit will be given only for correct solutions that are described clearly.

Question 1 (8 marks) (Based on exercise 6.9 of DPU textbook) A certain string-processing language offers a primitive operation which splits a string into two pieces. Since this operation involves copying the original string, it takes n units of time for a string of length n, regardless of the location of the cut. Suppose that you want to break a string into many pieces. The order in which the breaks are made can affect the total running time. For example, if you want to cut a 20-character string at positions 3 and 10, then making the first cut at position 3 incurs a total cost of 20+17 = 37, while cutting at position 10 first has a better cost of 20+10 = 30.

Design and write, in pseudocode, a dynamic programming algorithm that, given the location of m cuts in a string of length n, finds the minimum cost of breaking the string into $m+1$ pieces at those cuts.

You can assume that the cut locations are sorted into ascending order, and that they are all positive integers.

Question 2 (12 marks) The post office sells stamps of a variety of different denominations (values), and different sizes. Consider a set of n stamps, where each stamp i has a specific denomination d_i and a size s_i. All denominations are distinct. All input numbers are positive integers. We can use stamp denominations multiple times.

When buying stamps that total to a given postage amount P, we want to minimize the total size of the stamps (to leave the most addressing space on the envelope).

(a) Design and write, in pseudocode, a dynamic programming algorithm that will, given the information about n stamps (denominations $\{d_i\}$ and sizes $\{s_i\}$) and a postage amount P, find the minimum total size of stamps that will add to exactly P (if such a set exists).

(b) Adapt your algorithm from (a) to find the set of stamps that produces the minimum.

(c) Analyze the running time (in terms of input size) of your algorithm from (a).

Question 3 (10 marks) (Exercise 6.2 of DPU textbook) You are going on a long trip. You start on the road at mile post 0. Along the way there are n hotels, at mile posts $a_1 < a_2 < \ldots < a_n$, where each a_i is measured from the starting point. The only places you are allowed to stop are at these hotels, but you can choose which of the hotels you stop at. You must stop at the final

hotel an which is your destination.

You'd ideally like to travel 200 miles each day, but this may not be possible, depending on the spacing of the hotels. If you travel x miles during a day, the penalty for that day is $(200 - x)^2$. You want to plan your trip so as to minimize the total penalty-the sum, over all travel days, of the daily penalties.

(a) Design and write, in pseudocode, an efficient dynamic programming algorithm that determines the optimal sequence of hotels at which to stop.

(b) Analyze the running time (in terms of input size) of your algorithm from (a).