SPRING 2017: **COT 5407** Intro. to Algorithms

[Homework 6; Due March 21 via Email]

General submission guidelines and policies: Add the following signed statement. Without this statement, your homework will not be graded.

> I have adhered to the collaboration policy for this class. In other words, everything written down in this submission is my own work. For problems where I received any help, I have cited the source, and/or named the collaborator.

Read the handout on **Homework guidelines and collaboration policy** from your course website before you start on this homework. This is very important.
You only need to submit solutions to problems marked (**Regular**). All others are optional.

Problems

Note that all solutions to dynamic programming (DP) problems must show (a) the hierarchy of subproblems required to solve the problem, (b) the recurrence relation connecting the solutions of these subproblems along with some explanation for it, (c) the description of the data structure that will store solutions to previously solved subproblems, (d) the actual algorithm (i.e., detailed pseudocode), and (e) the time complexity analysis. State clearly any reasonable assumptions you make (as long as your assumptions don't oversimplify the problem).

43. (**Exercise**) Solve 16.2-7, page 428.

44. (**Exercise**) Solve 16.3-3, page 436.

Before you solve the remaining problems, read the **Note** at the top of this page.

45. (**Exercise**) Study sections 15.2 from the book and solve 15.1-5, page 370.

46. (**Regular**) It is the hurricane season. You have just bought a wooden board of length L (and standard width), which needs to be cut into n smaller pieces so that you can put it up as a hurricane shutter. The cuts are required to be at at locations $l_1, l_2, \ldots, l_n$ ft from the left end of the board. However, the store charges money for cutting. Their cutting rates are strange; if you cut a board of length x into two smaller pieces (of any lengths), you will be charged $\$x$.

    The cutting order will determine the cost of the cuttings required. For example, assume that your board is of length 10 ft and that you need to cut it at locations 2ft, 4ft and 7ft from the left end. If you cut it in that order, then your cost will be $\$10 + 8 + 6 = \$24$. On the other hand, if you cut it at 4ft first and then at 2ft and 7ft for the two smaller pieces, then the total cost will be only $\$10 + 4 + 6 = \$20$.

Design an algorithm to determine the optimal order of cuts required to minimize your total cutting costs. Analyze your algorithm.

47. (**Exercise**) Study sections 15.2 from the book and solve 15.2-1, page 378.

48. (**Regular**) Ms. Sana Macarena manages the advertising billboards on the Turnpike. The available locations of the boards are at mile markers $x_1, x_2, \ldots, x_n$. The revenues from placing a billboard at marker x_i is r_i for $1 \leq i \leq n$. Ms. Macarena wants to maximize her revenues by placing as many billboards as possible, subject to the constraint that no two billboards are within 5 miles of each other. Design an algorithm to help her pick the optimal set of billboard locations to advertise.

49. (**Regular**) Mr. Wei Tu Smart manages a computer conultancy starup. Every week during a n-week period, he has to choose the project that his team will work on. In week i, he has two choices, a *fast* project or a *slow* project. The fast projects will bring revenues $f_1, f_2, \ldots, f_n$, while the slow projects will bring revenues $s_1, s_2, \ldots, s_n$. The fast projects finish in a week, but the slow projects take two weeks to finish. Design an algorithm to help Mr. Smart maximize his revenues by pick the right choices of projects for each week.

50. (**Exercise**) To achieve mastery over DP, try to solve as many problems as possible from the end of the chapter (from bottom of page 404 through 412).

51. (**Exercise**) Write down detailed solutions for all the problems from your MidTerm exam. Make sure you address all details (proofs, constants, basic idea, pseudocode, analysis, etc.) – that would be good preparation for your next midterm exam.