

## Homework Assignment 4

MCS/CS 401 Computer Algorithms I      **due on Monday, 07/18/2021 at 11:59 PM**

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Tag all questions on Gradescope after submitting the PDF file!

Read Chapters 15 and 16 thoroughly and solve the following problems.

**Problem 1.** Assume that you were given  $N$  cents ( $N$  is an integer) and you were asked to break up the  $N$  cents into coins consisting of 1 cent, 2 cents and 5 cents. Write a dynamic-programming based recursive algorithm, which returns the smallest (optimal) number of coins needed to solve this problem. For example, if your algorithm is called  $A$ , and  $N = 13$ , then  $A(N) = A(13)$  returns 4, since  $5+5+2+1 = 13$  used the smallest (optimal) number of coins. In contrast,  $5+5+1+1+1$  is **not** an optimal answer.

**Problem 2.** Draw the recursion tree for algorithm in Problem 1, where  $N = 7$ . Derive the complexity bound of the algorithm in Problem 1. You do not need to prove the complexity bound formally, just derive it by analyzing each component in your algorithm.

**Problem 3.** Construct a memoized algorithm for the problem described in Problem 1 and derive its time complexity. You do not need to prove the complexity bound formally, just derive it by analyzing each component in your algorithm.

**Problem 4.** Assume that you were given  $N$  cents ( $N$  is an integer) and you were asked to break up the  $N$  cents into coins consisting of 1 cent, 2 cents and 5 cents. Prove that a **greedy algorithm** always gives the optimal solution.

**Problem 5.** Assume that you were given  $N$  cents ( $N$  is an integer) and you were asked to break up the  $N$  cents into coins consisting of 1 cent, 6 cents and 7 cents. Prove that a **greedy algorithm** may not always give the optimal solution.

## Assignment Guidelines and Plagiarism Warning

This assignment will consist of 5 Problem and it is due on **due on Monday, 07/18/2021 at 11:59 PM!**

Your solution of this assignment must consist of a single, continuous PDF file, which you will upload to Blackboard/Gradescope on or before the above specified deadline.

This assignment must be solved **individually**. Under no circumstances are you allowed to copy or to collaborate with anyone else. **All submitted files will be automatically checked for plagiarism.** Regardless of who copied from whom, all caught in the act of plagiarism will be penalized, as specified in the course syllabus.

In particular, using internet resources of any kind is **not** allowed. Internet sites are routinely checked for similarity to your submission for content. Changing order or variable names will not prevent plagiarism detection. In addition, do not post any content of this

assignment to any internet sites or make it public in any other form. **The content of this assignment is not in the public domain!**

You are free, however, to use our course resources, such as lecture notes and our text book, during the solving of this assignment. If you have questions about this assignment come to my online office hours, or those of the Teaching Assistants, using the usual Blackboard link.