COS 454/554 Fall 2021 Quiz 1   40 pts.; 40 minutes; 4 questions; 6 pages.   2021-09-21 9:00 a.m.

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Name: _____

1. (1 pt.)
   ○ **Read all material carefully.**
   ○ *If in doubt whether something is allowed, ask, don't assume.*
   ○ You may refer to your books, papers, and notes during this test.
   ○ E-books may be used *subject to the restrictions* noted in class.
   ○ Computers are not permitted, except when used strictly as ebooks.
   ○ Network access of any kind (cell, voice, text, data, ...) is not permitted.
   ○ Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
   ○ Use class and textbook conventions for notation, algorithmic options, etc.

   Write your name in the space provided above.

WAIT UNTIL INSTRUCTED TO CONTINUE TO REMAINING QUESTIONS.

Do not write in the following table.

Q	Full	Score
1	1	
2	9	
3	20	
4	10	
total	40	

2. (9 pts.) Draw the subproblem graph for MEMOIZED-CUT-ROD(p, n) with $n = 10$ and the following array p.

length i:	0	1	2	3	4	5	6	7	8	9	10
price p_i:	0	2	3	7	8	9	14	15	16	17	20

3. (10 pts.) Recall the following algorithm for the cut-rod problem that was briefly discussed in class: Compute the value of price per unit length $(v(i))$ for each integer value of length $i \leq n$ (where n is the length of the rod given as input). Then repeatedly cut the remaining portion m of the rod at length $i \leq m$ with maximum $v(i)$.

Does this algorithm always produce the correct (optimal) solution?

If so, provide at least an informal proof or detailed explanation.

If not, provide and explain a small counterexample.

4. (20 pts.) Trace the execution of the MEMOIZED-CUT-ROD(p, n) algorithm for $n = 10$ and the following pricing array of Question 2, repeated below.

Depict the state of the array r at least at three points during the execution:

(a) The first time MEMOIZED-CUT-ROD-AUX(p, n, r) returns when invoked with $n = 3$.
(b) As above, but with $n = 7$.
(c) At the very end.

length i:	0	1	2	3	4	5	6	7	8	9	10
price p_i:	0	2	3	7	8	9	14	15	16	17	20

[additional space for answering the earlier question]

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