

ECE 512 – Topics in Data Science

Homework 5

Dror Baron and Hangjin Liu; Fall 2023

Due: October 11, 2023

Administrative instructions:

- For any clarification or doubts, the TA Hangjin Liu (hliu25 AT ncsu DOT edu) is in charge of homework and projects. She should be your first point of contact on homework- and project-related issues.
 - The homework can be submitted individually, in pairs, or triples.
 - You should submit electronically through Moodle by midnight the day that the homework is due.
 - Please justify your answers carefully.
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- Rod cutting problem.** Recall our rod cutting problem from the slides, where we formed the optimal partition (cut) of a rod of length 4. Put together a program that solves this problem for an input rod of arbitrary length n . To make the problem a bit different from the book, use the following prices for rods: $p_1=1$, $p_2=3$, $p_3=5$, $p_4=6$, $p_5=11$.
 - Develop the dynamic programming formulation for this problem as needed.
 - Implement it. Show the results for $n=96$ and $n=100$. (Hint: an alert student can probably work out the solution for $n=100$; make sure the algorithm returns the same answer.)
 - Discuss the asymptotic computational complexity.
 - Run the program on different values of n , plot the run time, and show empirically that the computational complexity provides the correct growth rate. (If it does not, you'll need to revisit your design and analysis.)
 - Read about the golden section search, and implement a line search algorithm based on these principles. Compare the speed of your implementation and the one we discussed in class with respect to running times.
 - Shirt Dude sells two types of shirts to NC State students. It costs Shirt Dude \$8 and \$14 to produce shirts of types A and B, respectively. Suppose further that one shirt A yields a profit of \$2 while shirt B yields a profit of \$3. Shirt Dude's factory can only produce 2,000 shirts per month, and he is willing to stock \$20,000 of merchandise. Please help maximize Shirt Dude's profits by expressing this as a linear programming problem. (There is no need to provide numerical answers, just express it in canonical form.)