

Problem Set 3

CS 331

Due Monday, February 17

1. (Making Change) There's a Jupyter Notebook linked from the class webpage, at <https://www.cs.utexas.edu/~ecprice/courses/331/psets/makingchange.ipynb>. Run through it, fix the missing expressions in the code, and answer the questions.
2. You are planning to buy a set of fancy lenses for your DSLR camera. The camera store has n lenses, where lens i has a cost c_i and works over a range of focal lengths $[s_i, f_i)$. (If you're unfamiliar with cameras, you can think of "focal length" as "zoom level".) You would like to buy a set of lenses that covers a wide range $[L, H)$ of focal lengths, so every length in this range is supported by at least one of your lenses.

You may assume all the parameters are integers.

- (a) Give an $O(n(H - L))$ time dynamic programming algorithm to find the cheapest set of lenses that covers the entire range $[L, H)$.

Recall that you should:

- Define a subproblem, which you describe in English.
 - Give a recurrence to solve the subproblem.
 - Show that the recurrence is correct.
 - Describe how to solve the problem quickly, and analyze the resulting running time.
- (b) The camera store is now having an amazing sale, where every lens has the same cost $c_i = \$100!$ Give a simple *greedy* algorithm that finds the answer in $O(n \log n)$ time.
 - (c) (Optional): Show how to solve part (a) in $O(n \log n)$ time.