CSCI 3104 Fall 2022
Instructors: Prof. Grochow and Chandra Kanth Nagesh

Quiz 8 S21

Due Date ..... Thursday Nov 10, 2022 8pm MT
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Quiz Code (enter in Canvas to get access to the LaTeX template) ..... **RTYZB**

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Instructions

- You may either type your work using this template, or you may handwrite your work and embed it as an image in this template. **If you choose to handwrite your work, the image must be legible, and oriented so that we do not have to rotate our screens to grade your work.** We have included some helpful LaTeX commands for including and rotating images commented out near the end of the LaTeX template.
- You should submit your work through the **class Gradescope page** only. Please submit one PDF file, compiled using this LaTeX template.
- You may not need a full page for your solutions; pagebreaks are there to help Gradescope automatically find where each problem is. Even if you do not attempt every problem, please submit this document with no fewer pages than the blank template (or Gradescope has issues with it).
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Problem HC.

- My submission is in my own words and reflects my understanding of the material.
- Any collaborations and external sources have been clearly cited in this document.
- I have not posted to external services including, but not limited to Chegg, Reddit, StackExchange, etc.
- I have neither copied nor provided others solutions they can copy.

I agree to the above, Tyler Huynh. □

21 Standard 21: Dynamic Programming - Identify Precise Subproblems

Problem 21. Consider the following problem:

> **Input:** A list $[v_1, \ldots, v_n]$ of values (each v_i is a positive number)
> **Output:** A subset $S \subseteq \{1, \ldots, n\}$ such that (1) no two adjacent items are in S (that is, S cannot contain both i and $i+1$), and (2) maximizing $\sum_{i \in S} v_i$, subject to (1).

For example, if the input is $[7, 4, 5]$, an optimal solution S is $\{1, 3\}$, with value $7 + 5 = 12$; if we had included item 2, then we could not include items 1 nor 3 because of the no-two-adjacent-items constraint (which would have resulted in a smaller value, namely 4).

Suppose you are going to solve this problem by dynamic programming; this can be done with a one-dimensional table T. **Clearly define** what subproblems $T[i]$ corresponds to, and which other indices j need to be considered when determining the value of $T[i]$.

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Input: A list $[v_1 \dots v_n]$ of positive values, Length n

Output: Subset $S \subseteq \{1, \dots, n\}$, such that i and i+1 cannot exist, maximize the value

To begin with we must consider the base cases for the problem where when:

Base Cases:

$n = 0$ - we take no value as it is just an empty list

$n = 1$ - we take the value at that index, such that we take v_1

$n = 2$ - we take the maximum value between the two different values at their respective indexes, such that max(v_1, v_2).

From this I will now begin to find the subproblems that T[i] corresponds to.

We can see that from this question the precise subproblems will be considering whether or not we pick the value at v_i where v_i represents the value in the list at index i. From this we cannot choose v_{i-1} where it is adjacent to this index.

Another subproblem would be whether or not we pick the value of v_i, since if we were to not choose this value, we can choose this values neighbors.

The indices of j needs to consider would be the value that is after v_{i+1}, where it would not be a neighbor of v_i.

Answer.

T[i] represents the maximum sum of values in the subset S when considering the sublist $[v_1 \dots v_i]$.

□