

# Final- Standard 21

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## 1 Instructions

- The solutions **should be typed**, using proper mathematical notation. We cannot accept hand-written solutions. Here's a short intro to L<sup>A</sup>T<sub>E</sub>X.
- You should submit your work through the **class Canvas page** only. Please submit one PDF file, compiled using this L<sup>A</sup>T<sub>E</sub>X 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).
- You **may not collaborate with other students. Copying from any source is an Honor Code violation. Furthermore, all submissions must be in your own words and reflect your understanding of the material.** If there is any confusion about this policy, it is your responsibility to clarify before the due date.
- Posting to **any** service including, but not limited to Chegg, Discord, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.
- You **must** virtually sign the Honor Code (see Section 2). Failure to do so will result in your assignment not being graded.

## 2 Honor Code (Make Sure to Virtually Sign)

**Problem 1.**     • 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, Michael Ghattas.*

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### 3 Standard 21- Dynamic Programming: Identify Precise Subproblems

**Problem 2.** Suppose we have  $n$  stairs to climb. In a single jump you may choose to jump up either 1, 2, 3, or 4 stairs. Your goal is to count the total number of different ways to jump the  $n$  stairs. Note that your starting position is on the ground floor (stair 0) and not on the first stair. Clearly identify the precise sub-problems to consider. That is, what is the recursive structure to leverage when designing a dynamic programming algorithm?

*Answer:*

- The recursive function is  $T(k)$  = the number of ways to jump  $k$  stairs. The final answer will be  $T(n)$
- The base case  $k \leq 4$  can be worked out by hand;  $T(1) = 1$ ,  $T(2) = 2$ ,  $T(3) = 4$ ,  $T(4) = 7$
- When  $k > 4$ , the last jump came from one of stairs;  $k - 1$ ,  $k - 2$ ,  $k - 3$ ,  $k - 4$ . So  $T(k)$  depends only on  $T(k - 1)$ ,  $T(k - 2)$ ,  $T(k - 3)$ ,  $T(k - 4)$ , and can be computed directly from those three values, as it is their sum.

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