

CS375 Weekly Assignment 0

Due Sep 13th 10PM ET

A general note for CS375: When writing up your homework, please write neatly and explain your answers clearly, giving all details needed to make your answers easy to understand. Graders may not award full credit to incomplete or illegible solutions.

You are encouraged to discuss the problems with your classmates, **but your submission should be your own**. When writing your solutions up, you should not be looking at any other student's submission.

Clear communication **is the point**, on every assignment. In general in CS375, unless explicitly specified otherwise, answers should be accompanied by explanations. Answers without explanations may not receive full credit. Please feel free to ask me any questions about explanations that might come up!

Necessary acknowledgements: many of these questions are reproductions or adaptations of questions of Eric Aaron's devising.

1. In general, I won't write it here but I always recommend doing the reading that is attached to the schedule on the most recent days.
2. O, Ω, Θ : These are the symbols that I expect I'll use almost every day, but we will more concretely define them in the coming classes. I'm expecting that everyone has used O in their 231 classes, and if you've taken it recently with me then probably you've used Ω and Θ . Regarding Ω and Θ , for now it suffices to think: $O \sim \leq$, $\Omega \sim \geq$, and $\Theta \sim =$, in an asymptotic sense where multiplicative constants are ignored. Nothing explicit to do for these yet, but we'll probably start with defining these symbols formally on monday.
3. $\sum$: This is sum notation. If you're unfamiliar with it, I recommend checking out appendix A in CLRS (linked on our course page). The wikipedia page (<https://en.wikipedia.org/wiki/Summation>) is also fine. Basically, you should think of the following two things as exactly equivalent:

$$\sum_{i=1}^n f(i)$$

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total = 0
for i in range(1, n + 1):
    total += f(i)
return total
```

Note that for the sum notation, the final term is included, while Python's range function doesn't include the final term. Here are some examples:

$$\sum_{i=1}^{10} i = 1 + 2 + \dots + 9 + 10 = 55$$

$$\sum_{i=1}^5 11 = 11 + 11 + 11 + 11 + 11 = 55$$

$$\sum_{i=1}^5 i^2 = 1 + 4 + 9 + 16 + 25 = 55$$

$$\sum_{i=1}^n 1 = 1 + 1 + \dots + 1 (n \text{ times}) = n$$

$$\sum_{i=1}^n i = 1 + 2 + \dots + (n-1) + n = \frac{n(n+1)}{2} \text{ (this is a classic formula you should know)}$$

For some warm-up:

A) evaluate the following sums:

i. $\sum_{i=1}^3 i^3$

ii. $\sum_{i=1}^{10} 10 - i$

iii. $\sum_{i=1}^n 2$

iv. $\sum_{i=1}^n (n - i)$

B) write the equivalent code for this double sum:

$$\sum_{i=1}^n \sum_{j=1}^m f(i, j)$$

4. Lastly, a problem that routinely appears in interviews, and is quite related to the webcomic that appears on our course webpage. A group of four out on a hike needs to cross a bridge that appears to be very old: observing the ropes, some quick mental maths reveal that only two people can cross at a time safely. To complicate matters, the sun has set and it is very dark, and due to a bunch of missing planks in the bridge the family decides that anyone crossing the bridge must have a flashlight with them, meaning that someone will need to keep ferrying the flashlight back and forth in order to help people cross. Looking at the battery life left on their flashlight, they see the flashlight will only last for precisely another 17 minutes. Unfortunately, one member of the group has injured themselves and will take 10 minutes to cross the bridge. The others will take 1, 2, and 5 minutes to cross. Under the constraint that when two people cross together they must move at the speed of the slower person (to shine the flashlight adequately), will the group be able to cross the bridge in 17 minutes? Why or why not?

Obviously this problem doesn't 'feel' very algorithms-y. However, I assert that it exercises the modality of thinking that is extremely important in this field, particularly with respect to constraint satisfaction.

For this exercise, explain the full thought process by which you arrived at your answer! Or, if you are not able to find a full answer, explain the thought process as far as you get with your reasoning. For example, one might say First, we thought about sending [blah blah blah], but we then realized [blah blah blah]. Then, to address that, we thought [blah blah blah], but that didn't work because of [blah blah blah]. Because of that, we . . . (Please try to avoid using the word blah in your answer!)