

Algorithm Design and Analysis
CS 376, Spring 2023

Smaller Assignment 6

Due **BY THE BEGINNING OF CLASS** Wednesday, March 1

- For this Smaller Assignment, the standard conventions apply: Please submit your typewritten answers in a PDF file named

CS376_SA6_<userid>.pdf

where <userid> is replaced by your Colby userid. **Please be sure to give your full userid, including the numbers representing your class year.**

To submit this assignment, place the properly named file in your **Private** directory in your CS376 filespace on **filer**. **Please make sure all Problem Set and Smaller Assignment submissions are to your Private folders!**

- *A general note for CS376:* When writing up your homework, **explain your answers clearly and thoroughly**, giving all details needed to make your answers easy to understand. Clear communication *is* the point, on every assignment.

Unless explicitly specified otherwise, answers in CS376 should be accompanied by explanations; as part of this, in general, when you present an algorithm, give an accompanying correctness argument. Answers without convincing explanations that show command of the relevant concepts may not receive full credit. Please feel free to ask me any questions about explanations that might come up!

Exercises

1. (A problem solving puzzle!) There are four people who want to cross a bridge, all of which begin on the same side. They have 17 minutes to get to the other side. As is common in these kinds of puzzles, however, there's a catch!

Because the bridge is old and weakened by time, a maximum of two people can cross the bridge at one time. Moreover, it's night time, and they have one—only one—flashlight. Any time people cross (whether one person or two people), they must have the flashlight with them, and the flashlight must be walked back and forth over the bridge (it can't, e.g., be thrown from one side to the other).

Person 1 takes 1 minute to cross the bridge, person 2 takes 2 minutes, person 3 takes 5 minutes, and person 4 takes 10 minutes. If a pair crosses the bridge together, they must walk together at the pace of the slower person.

Can all four of them get to the other side in 17 minutes? If so, how? If not, why not? Be sure to explain your answer!

(Note: A popular Algorithms textbook notes that, according to a rumor on the Internet, interviewers at a well-known software company located near Seattle have given this problem to interviewees!)

2. For each of the following assertions, say if they are True or False, and explain your answer fully using the formal definitions of asymptotic complexity. As part of that, if the assertion is true, make sure to give *witness* values for every existential quantifier.

(a) $\frac{n(n+1)}{2} \in O(n^3)$

(b) $\frac{n(n+1)}{2} \in O(n^2)$

(c) $\frac{n(n+1)}{2} \in \Theta(n^3)$

(d) $\frac{n(n+1)}{2} \in \Omega(n)$