

Algorithm Design and Analysis
CS 376, Spring 2023

Smaller Assignment 1

Due **BY THE BEGINNING OF CLASS** Wednesday, February 8

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

CS376_SA1_<userid>.pdf

where <userid> is replaced by your Colby userid—for example, my file would be called CS376_SA1_eaaron.pdf. **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. If you're not already familiar with binary addition and multiplication, please read the resource about binary numbers, binary addition, and binary multiplication, linked from our course website's Additional Notes / Readings page. Then ...
 - (a) What's $101 + 1011$ in binary (i.e., when treating 101 and 1011 as binary numbers)? What is that answer when converted to decimal?
 - (b) What's $101 \cdot 11$ in binary? What is that answer when converted to decimal?
 - (c) What is the equivalent binary number for decimal number 378?
2. What is the relationship between the Boolean “and” operator and the binary multiplication operator? (Please give a short answer—a sentence or two should be enough!)
3. Prove that our recursive Sum algorithm from today's lecture returns $\frac{n(n+1)}{2}$ on all inputs n that meet its specifications.
4. Using our *IntBinTree* data structure (*IBT*, for short) from our lecture notes, write a recursive algorithm that takes as input an *IBT* T known to contain no negative values, and return the maximum value in T .

Input: IntBinTree T known to contain no negative values
Output: The maximum value in T

What did you decide that your algorithm should return on an empty tree as input? Explain your reasoning for that decision (a sentence or so should be sufficient) as part of your explanation of your algorithm. **You do not need to prove your algorithm correct for this exercise.**