

Theory of Computation

CS 378, Fall 2022

Small Assignment 0

Due **BY THE BEGINNING OF CLASS** Tuesday, September 13

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

CS378_SA0_<userid>.pdf

where <userid> is replaced by your Colby userid—for example, my file would be called CS378_SA0_eaaron.pdf.

To submit this Small Assignment, please use our standard HW submission process: Place the properly named file in your **Private** directory in your CS378 filespace on **filer**. (That is, go to filer.colby.edu/Courses/CS378 to find your folder in the course's filespace; you should find a sub-folder called **Private** in your filespace.) **Please make sure all Problem Set and Smaller Assignment submissions are to your Private folders!**

- As usual for small assignments in CS378 this semester, this is due by the beginning of the next class meeting, and it will be marked on a $\checkmark + / \checkmark / \checkmark - / 0$ scale.
- *A general note for CS378:* As always, please present answers cleanly and **explain them clearly and thoroughly**, giving all details needed to make your answers easy to understand; typed-up (rather than handwritten) answers are required, and using L^AT_EX to typeset your answers is appreciated. (Feel free to talk with your Prof. about using L^AT_EX!) Graders may not award full credit to incomplete or illegible solutions. Clear communication *is* the point, on every assignment.

In general in CS378, 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!

Exercises

1. Give a fully detailed proof that for all sets S , S is a subset of itself. I.e., prove **Claim:** $\forall S. S \subseteq S$.

Be sure to show all steps and explicitly state a reason for every step.

2. Sipser, Exercise 0.3 (page 26). (This is to make sure we're all comfortable with basic set operations. For this exercise, you do not need to explain or justify your answers.)
3. 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?
- 4. 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!)
- 5. Let $p = \text{True}$, $q = \text{False}$, $r = \text{True}$. What do the following propositional logic expressions evaluate to?

(See also Sipser, pg. 14–15. This exercise is to make sure we're all familiar with the definition of propositional logic expressions. For this exercise, you do not need to explain or justify your answers.)

- (a) $p \wedge \neg r$
- (b) $p \rightarrow q$
- (c) $q \leftrightarrow p$
- (d) $q \leftrightarrow \neg \text{True}$
- (e) $r \vee (p \wedge q)$
- (f) $(p \vee r) \rightarrow ((p \vee q) \wedge r)$
- (g) $\text{True} \rightarrow r$
- (h) $\text{False} \rightarrow q$