Analysis of Algorithms
CS 375, Fall 2022
Small Assignment 0
Due **BY THE BEGINNING OF CLASS** Wednesday, September 14

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

  `CS375_SA0_<userid>.pdf`

  where `<userid>` is replaced by your Colby userid—for example, my file would be called `CS375_SA0_eaaron.pdf`.

  Additional submission instructions will be emailed to you soon, including where to submit your PDF file.

- As usual in CS375, if an exercise is given by number (e.g., "Exercise 1.2.3 (pg. 14)"), that refers to our CLRS textbook unless stated otherwise.

- From your textbook (CLRS), please read:
  - Appendices A.1 and B.1.
  - Chapter 1 and 2.1.

- *A general note for CS375:* As always, please present answers cleanly and explain them thoroughly, giving all details needed to make your answers easy to understand. Graders may not award full credit to incomplete or illegible solutions, or answers without explanations. Clear communication *is* the point, on every assignment.

  Please feel free to ask me any questions about explanations that might come up!

Exercises

1. **Set exercises!** Familiarity with sets and set operations is important for Computer Science in general—and for algorithm design and complexity analysis in particular—so here are some warm-up exercises. Give a short explanation for every answer—less than one sentence could suffice, as long as it demonstrates understanding of the relevant definition(s) / reasons for the answer.

   For the exercises below, let $A = \{x, y, z\}$ and $B = \{x, y\}$.

   (a) True or False: $A \subseteq B$?
   (b) True or False: $B \subseteq A$?
   (c) True or False: $B \subseteq B$?
   (d) What is $A \cup B$? (Explicitly show the elements of $A \cup B$.)
   (e) What is $A \cap B$? (Explicitly show the elements of $A \cap B$.)
   (f) What is $A \times B$? (Explicitly show the elements of $A \times B$.)
   (g) What is $\mathcal{P}(B)$, the power set of B? (Explicitly show the elements of $\mathcal{P}(B)$.)

2. Exercise 1.2.3 (pg. 14). (We need only consider natural number values of n, and we can make the usual assumption that all input sizes are greater than 0.)

3. As happens sometimes in theoretical CS exercises, this one begins with a *completely gratuitous* and *totally made-up* backstory: The Scientific Advancement Department at the Portland Institute of Technology (which, to be clear, does not actually exist) has asked for your help. The entire department will soon be traveling—they'll be going to major European cities with well-developed subway systems, such as London, England or Paris, France—and they've asked you to come up with an algorithm to find the best route for a subway passenger to take from one subway station to another.

   (a) The statement of this computational problem isn't fully, unambiguously specified, which happens frequently with real-world computational problems. (I've experienced it myself, several times in my research.) But you can help! What are some reasonable criteria that could be used for defining the "best" route? Give 2–3 examples.

   (b) How would you use a graph as part of modeling and solving this problem? (Feel free to look over Appendix B.4 for a review of graph concepts, if you'd like.)