Problem Set 1 – Due Wednesday, January 12, at 5 pm

Recall from our syllabus all of the following. That your homework must be turned in with Gradescope, one problem per page, with LaTeX typesetting strongly recommended. Recall that you may work with zero or one partners. In the latter case, you turn in a single assignment for the two of you, entering both names into Gradescope. Also remember that if you get ideas from anyone other than your named partner, your professor, or a TA, you need to acknowledge them. And recall that any use of old problem-set solutions constitutes academic misconduct.

1. (a) Setup accounts on (i) Piazza, (ii) Gradescope, (iii) Overleaf, and (iv) zyBooks. (b) Post a short message on Piazza for your dear classmates to read. Use an existing thread for this (unless you are the first to post). (c) Create a first LaTeX file, get a pdf output from it, and admire its beauty. (d) Start reading our zyBook, doing the participation activities as you go. (e) Finally, indicate as your solution Problem 1 the date when you finished doing all these things. Sooner is better. *Note: this problem assumes you are using Overleaf and the zyBook. If you are not, omit those parts.*

2. Typeset (a)–(e) exactly as they appear below (apart from font size or the location of line breaks, which I don't care about). All the LaTeX you need will be covered in the first discussion section. Useful LaTeX commands: \emph, \phi, \mathbb, \sum, \frac, \log, \in, \subseteq, \neg, \land, \lor, and \overline. *Note: this problem assumes you are using LaTeX. If you are not, approximate what you see with some alternative tool, or write it by hand and scan it along the other three problems.*

(a) A *truth assignment* for an n-variable formula ϕ is a function t from the variables appearing in ϕ to the set of boolean values $\mathbb{B} = \{0, 1\}$. There are 2^n possible truth assignments for an n-variable formula—a function that grows extremely rapidly.

(b) The fact that $\sum_{i=1}^{n} 2^i = 2^{n+1} - 1$ follows from the representation of numbers in binary.

(c) We can give multiple proofs that

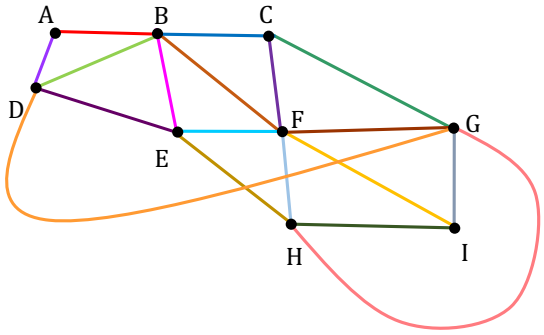
$$\sum_{k=1}^{n} = \frac{k(k+1)}{2}.$$

(d) Is it true that $1 + 1/2 + 1/3 + \cdots + 1/n \in O(\log n) \subseteq O(n)$?

(e) One of De Morgan's laws says that $\neg(P \land Q) = \neg P \lor \neg Q$. But is it prettier to write it $\overline{PQ} = \overline{P} \lor \overline{Q}$?

3. Ava bicycles from Davis to Winters at 20 mph. She arrives at Steady Eddy's only to discover that it is closed. Dejected, she rides back at 15 mph. What is her average speed over the entire trip?

4. How many paths are there from vertex A to vertex I such that, as one walks the indicated path, the letter-names of the vertices keep increasing? For example, ABCFI is a valid path, but ADFGHI and ABCGFI are not.



(Note: The color of an edge has no significance; I just got carried away coloring. Edges that cross one another are distinct; you can't go from one to another.)

5. We write $P \to Q$ to mean $\neg P \vee Q$. Make truth tables for $A \to (B \to C)$ and for $(A \to B) \to C$. Are these formulas equivalent?