Course Intro

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CS 0220 2024

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Overview

Who we are

- Instructor: Robert Lewis (call me Rob!)
- HTAs: Tyler Gurth, Allie Masthay, Joseph Rotella, Jania Vandevoorde, Carmen Yu
- UTA/STAs: Grant Landon, Sam Shulman
- UTAs: 22 friendly faces :)

Our Website: Dinosaurs!

- Class goals.
- Course outline.
- Meet the UTAs!
- Collaboration policy.
- Assignments, dates and deadlines.
  - Homework released Thursdays, due following Wednesday at 11:59pm
  - Midterm: March 15
  - Final: May 9
- Attendance policy.
  - Lectures encouraged, not required. Recitations required.
- Recitations.
- TA hours.

Recitations

- Lectures for the "what" and the "why"; recitations for the "how".
- Required, in person or virtual: you'll sign up for a particular section.
  - One "makeup" section, in case of illness/quarantine/...
- The first one (during shopping period): go to any section.
- Afterward, we'll ask you to sign up for a particular section, to help us load balance.

Other sites

Details, links on main site!

- EdStem: Best way to get quick answers. Key announcements there, too.
- Gradescope: Handins, homework grading.
- Overleaf (optional): LaTeX without installation.
- Top Hat: for in-class polling, not for attendance.

Class goals

CS can feel like a very applied field. Why learn math?

- Problem solving
- Communication
- Collaboration

A key result of this class: you'll have a *vocabulary* for discussing certain kinds of problems that appear in many different contexts, and a toolbox of general approaches for solving them.

A vital point of computer science (academic, industry, hobbyist): *communication*.

Proof assistants

A big experiment this semester: we're going to use a proof assistant called Lean at various points, for class demos and some homework assignments.

We're trying to figure out how to do this right.

Upsides:

- Get instant and interactive feedback on proofs.
- Learn a bit about a kind of tool that's growing in popularity.
- Pilot a new way of learning discrete math!

Downsides:

- ?

Our expectations from you

- No mathematical background is assumed. We're not doing calculus, statistics, ...
- Approach things with an open mind.
- Try to communicate clearly and concisely.
- Respect your classmates and TAs: we're in this together.

- Let us know how you're doing!

Ethics in Discrete Math

- Two STAs this semester. Why?
- Math often seen as a "neutral" or "pure." It's more complicated than that.
- Math becomes relevant when it is applied to the real world. Doing so **always** requires simplifications.
- Issues arise via: (1) flawed assumptions when bridging between theory and reality, (2) ethical flaws in understanding the "end-goal" application, and more.
- Keep uses in mind. The largest employer of mathematicians in the US is the NSA, which has clear ethical implications.
- We'll be asking you to consider potential ethical implications of the topics we cover and the importance of considering issues in advance.

Odd times odd

If we multiply two odd numbers together, is the result always odd? Always even? Sometimes one, sometimes the other?

- Poll. How approach a problem like this one?
- Check a few cases to see if you believe it.
  $3 \times 5 = 15$, $7 \times 3 = 21$. One times anything is the same, so, if it was odd, it stays odd. So far so good.
- Go to definitions. What does odd actually mean, mathematically? A number is *odd* if it can be written $2k + 1$ for an integer k.
- Use definitions to express the problem.
  We have two odd numbers: $2k_1 + 1$, $2k_2 + 1$.
  What can we say about their product?

Odd times odd

We have two odd numbers: $2k_1 + 1, 2k_2 + 1$.
What can we say about their product?

$$\begin{aligned}(2k_1 + 1)(2k_2 + 1) &= 4k_1k_2 + 2k_1 + 2k_2 + 1 \\ &= 2(2k_1k_2 + k_1 + k_2) + 1 \\ &= 2k_3 + 1,\end{aligned}$$

Since $k_3 = 2k_1k_2 + k_1 + k_2$ is an integer, the product is odd.

Bad "proof"

Each step must be done carefully to avoid going off the rails.

Pick any y and let $x = 2y$	x	$=$	$2y$
Multiply by $-x$	$-x^2$	$=$	$-2xy$
Add $2x^2$	x^2	$=$	$2x^2 - 2xy$
Subtract $2xy$	$x^2 - 2xy$	$=$	$2x^2 - 4xy$
Factor	$x(x - 2y)$	$=$	$2x(x - 2y)$
Cancel common terms	1	$=$	2

Conclusion: Math is over. If we can conclude $1 = 2$, we can conclude *anything*.

What makes a proof bad?

We can identify the mistake in that particular bad proof.

But what makes a proof good or bad in general? What are the *rules* for writing good proofs?

Where do these rules come from? Who enforces them?