CS 13

Mathematical Foundations of Computer Science

Introduction: A Review

Outline

1. Motivation

2. Administrivia

Outline

Overview

We're going to work our way through mathematical topics with a lens on how they're useful to computer science. Every topic will culminate in one or more applications of the math that we've been studying!

Difficulty

Our intention is to start around the difficulty of Ma1a and end around the difficulty of CS 21. If we are missing the mark, please do let us know.

Goals

- Improve your proof-writing skills
- Justify why you need math as a computer scientist
- Play with some cool applications!

Outline

- You can program at the level of CS 1

Our Expectations

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- You know what a proof is

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- You can program at the level of CS 1
- You know what a proof is
- You're interested in improving your skills at writing proofs to get ready for future courses

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- Course staff will hold an **obscene** number of office hours
- Prof. Blank's door is always open

Grading

Grading Breakdown

- written $= 30\%$
- applications $= 30\%$
- lecturcises $= 30\%$
- final $= 10\%$

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- You must typeset your solutions using LaTeXwith the template we provide.

Regrade Requests

To maintain consistency, all regrade requests should go directly to a Head TA (Yakov or Nico) via e-mail. Do not attempt to contact other TAs about grading questions.

- Office Hours!
  - OH are now in ANB 106 (which is called $(\text{CS})^2$ for Computer Science Collaboration Support).
  - OH The schedule has also changed a bit–we've removed office hours from days that were unpopulated and started them earlier at 3pm!
  - $(\text{CS})^2$ is a **new** dedicated space for undergraduates taking CS courses! If it's not in use for a course, you can just walk in and use it as a collaboration space! It has power, monitors to connect to, chargers, and dry-erase tables!
- Lecturcises! tl;dr: Some of the exercises in lecture will now be turned in (later in the week). See syllabus for full details.

Claim

Prove that for all sets X and Y, $\mathcal{P}(X) \cup \mathcal{P}(Y) \cup \mathcal{P}(X \cap Y) \subseteq \mathcal{P}(X \cup Y)$.

L R

$\mathcal{P}(\{1,2\}) = \{\emptyset, \{1\}, \{2\}, \{1,2\}\}$

$\forall x (x \in L \Rightarrow x \in R)$

Let x be arb.

Suppose $x \in L$.

Claim

Prove that if $f : A \to B$ is strictly monotone, then it is injective.

direct proof → $p \Rightarrow q$

proof by CP → $\neg q \Rightarrow \neg p$

$q \Rightarrow p$

Suppose f is strictly monotone.

[Comm: What does injective mean?

$f(x) = f(y) \Rightarrow x = y$

this is the same as

$x \neq y \Rightarrow f(x) \neq f(y)$]

Claim

For all $n \in \mathbb{N}$ and $x \in \mathbb{R}$ where $x > -1$, $(1+x)^n \geq 1+nx$