Welcome to CS103A!

- Two handouts!
- Find a nice group of people to work with!
  - Break apart into groups of three or four.
  - No one should be all by their lonesome selves. If you have a pair, adopt someone who's going solo. 😊
What is this course all about?
Course Objectives

- Provide extra practice and review of the content from CS103.
- Explore problem-solving strategies useful in mathematics.
- Improve teamwork skills for mathematics.
Course Staff

**Instructor**
Amy Liu (*liuamyj@cs.stanford.edu*)

**TAs**
Amanda Spyropoulos (*CS103 Head TA*)
Anthony Galczak
Fei Fang
Jessica Guo

*Staff Email List: cs103a-aut1920-staff@lists.stanford.edu*
Class Website

http://cs103a.stanford.edu
Class Format

- You'll spend most of your time in CS103A working through extra practice problems in small groups.
- Usually we'll start of with a quick review of the material from the past week.
- We'll then turn you loose to work on problems in groups, periodically coming back together as a group.
Assignments

• Each week during CS103A, we’ll release a small set of problems:
  – *Practice Problems* – not collected
  – *Homework Problems* – due the next week
  – *Attendance Problems* – due the next week

• The expectation is that you come to class caught up on lectures and having completed the Homework and Attendance Problems for the week.

• We’ll spend the first part of class discussing the Attendance Problems in your groups, where you’ll each be responsible for explaining one of the questions.
Grading

• Your grade will be computed as follows:
  - 50% for the **Homework Problems**: We’ll grade these problems on a 0 / ✓ / ✓+ scale.
  - 50% for the **Attendance Problems**: After discussing in your groups, you may optionally choose to change your answers. You’ll then turn in the problems and we’ll grade them for correctness.

• To receive credit for CS103A, you must score at least an **80%** across the assignments.

• Additionally, you must attend at least **eight** of the ten class meetings.
Introduction:
How to Approach Mathematics
Proof-Based Mathematics

- Most high-school math classes – with the exception of geometry – focus on calculation.
- CS103 focuses on argumentation.
- Your goal is to see why things are true, not check that they work in a few cases.
- Be curious! Ask questions. Try things out on your own. You'll learn this material best if you engage with it and refuse to settle for a “good enough” understanding.
Mathematical Prerequisites

- On Monday in CS103, we handed out a “Mathematical Prerequisites” handout. We recommend that you read over it and ask us questions.
- We will *not* be referencing concepts from linear algebra, calculus, trigonometry, etc. in CS103 or CS103A. You should be good to go with basic algebra and innate curiosity.
Mental Traps to Avoid

• “Everyone else has been doing math since before they were born and there is no way I'll ever be as good as them.”

• “A small minority of people are math geniuses and everyone else has no chance at being good at math.”

• “Being good at math means being able to instantly solve any math problem thrown at you.”
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“Being good at math means being able to instantly solve any math problem thrown at you.”
“A little slope makes up for a lot of y-intercept.”
- John Ousterhout
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Pro Tip #1:

Never Confuse Experience for Talent
Pro Tip #2: Have a Growth Mindset
Fun Math Question

Suppose you improve at some skill at a rate of 1% per day. How much better at that skill will you be by the end of the year?

After one day, you're 1.01 times better. After two days, you're \((1.01)^2\) times better.

After one year, you'll be \((1.01)^{365} \approx 37.8\) times better!
Pro Tip #3:

Avoid an Ingroup/Outgroup Mindset
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Simple Open Problems

• Math is often driven by seemingly simple problems that no one knows the answer to.

• Example: the **integer brick problem**:

  Is there a rectangular brick where any line connecting two corners has integer length?

• Having open problems like these drives the field forward – it motivates people to find new discoveries and to invent new techniques.
Don't Psych Yourself Out

- It is *perfectly normal* to get stuck or be confused when learning math.
- We've all been on the Struggle Bus. Don't be afraid to ask for help!
Getting Good at Math

- **Engage with the concepts.** Work through lots of practice problems. Play around with new terms and definitions on your own time to see how they work.

- **Ask for help when you need it.** We're here to help you. We want you to succeed, so let us know what we can do to help!

- **Work in groups.** Get help from your problem set partner, the TAs, and your CS103A buddies.
Today's Plan

- Review some concepts from high-school mathematics (different types of numbers, polynomials, and inequalities.)
- Review set theory concepts from the first lecture.
- Play around with those concepts to get a familiarity with how they work.
Recommendations

• Read the “Guide to Elements and Subsets” on the course website for practice with the $\in$ and $\subseteq$ relations.

• Read the “Mathematical Prerequisites” handout for a review of some key mathematical ideas.

• Read Chapter 1 of the course notes for a more thorough introduction to the concepts from the first lecture.
A brief intermission:
A magic trick!
Thinking About Problems

● Is there some sort of pattern or underlying structure?

● Does this procedure always work? What happens if I tweak the initial assumptions? (in this scenario, what if I flipped two or more cards? What if I changed the size of the grid?)

● Why, fundamentally, does this work? How come the bottom right hand card is always consistent with the added row and column?
A Cool Application

- Error correcting codes leverage this same concept of sending some extra redundant information to allow messages to be transmitted over unreliable channels.
Back to set theory!
Set Theory Concept Check

• If you haven’t already, take a minute or two to introduce yourself to your group!

• As a warmup, briefly recap the following set theory symbols one by one within your group:

\[ \in \quad \notin \quad \emptyset \quad \mathbb{N} \quad \mathbb{Z} \quad \mathbb{R} \quad \cup \quad \cap \quad - \quad \Delta \quad \subseteq \quad \subseteq \quad \emptyset \quad | \quad | \quad \aleph_0 \]

Go around in a circle and have someone explain what the symbol means and give an example of how it might be used.
Attendance Problems 0

• Now, spend the next few minutes working through Attendance Problems 0 individually.

• Once everyone has had the chance to attempt everything on their own, discuss within your groups.

• Similar to the previous exercise, go around in a circle and have each person explain one problem.
Before You Leave...

Turn in:

- Attendance Problems 0

Pick up:

- Homework Problems 1
- Attendance Problems 1
- Solutions to Practice Problems 0