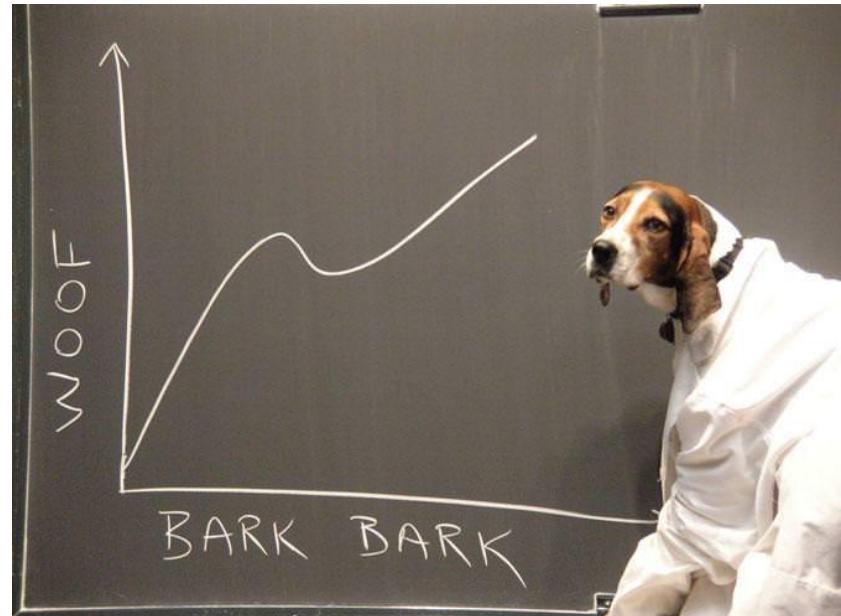
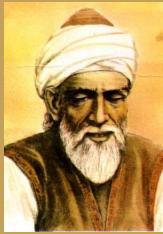
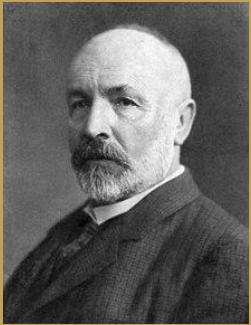


CMSC250  
Spring '21

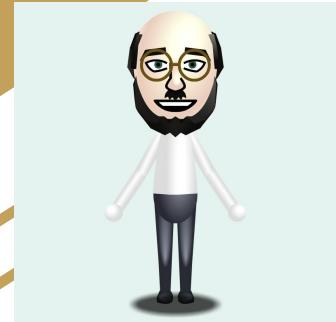
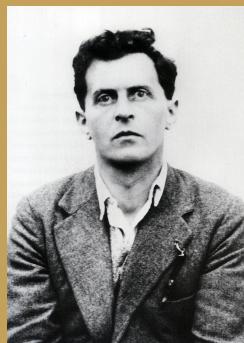
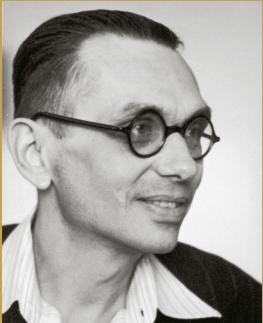
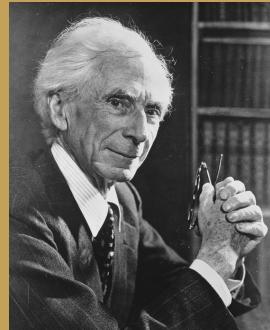
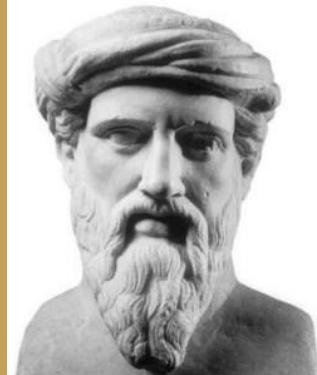
PANDEMIC  
POLITICAL ARMISTICE  
DISCRETE MATHEMATICS



[Google slides link if the PPTX/PDF doesn't work](#)



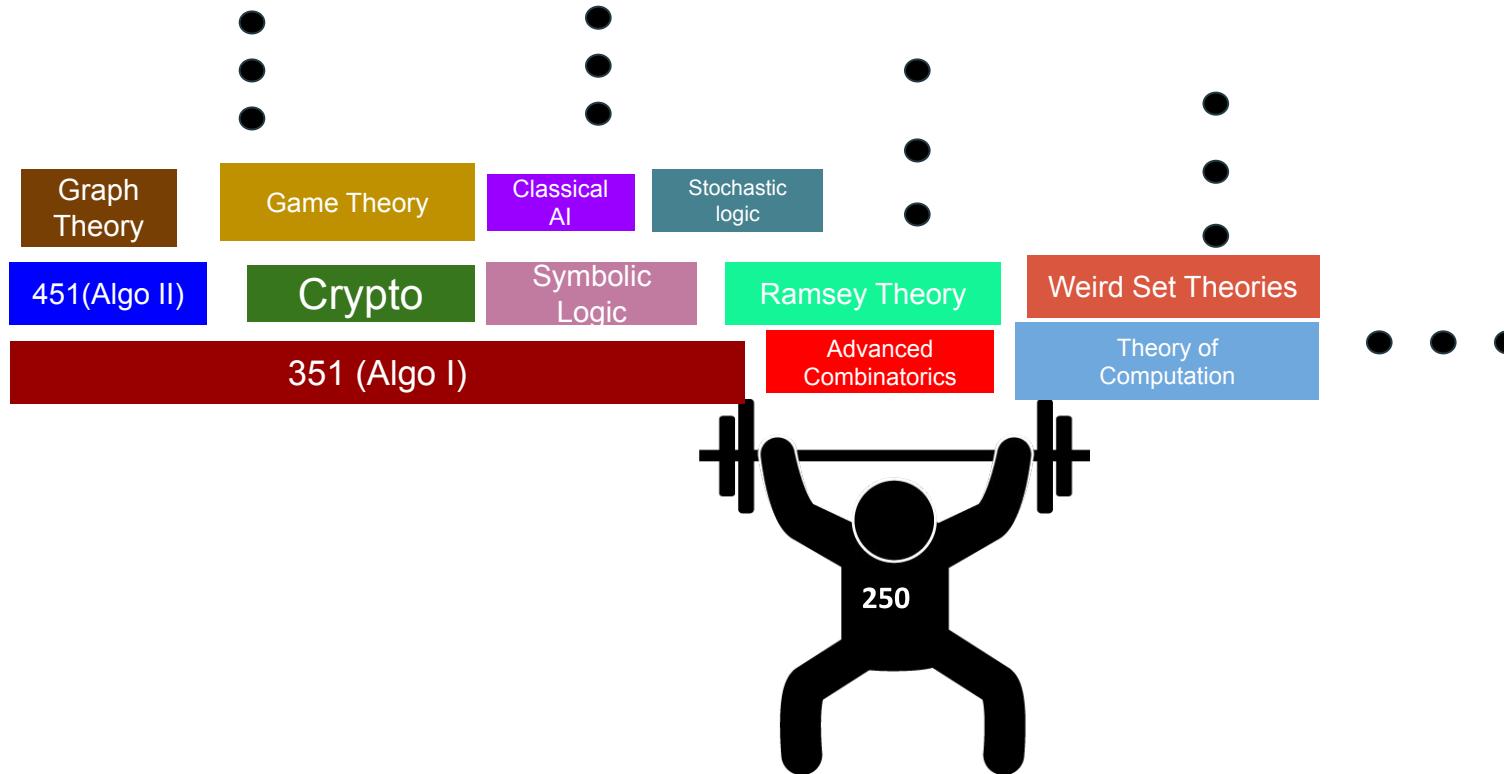
# Welcome!



# The course



# Goal of 250



# Meet the TA staff!



**Emily Gong**  
MSc  
Admin Assistant,  
Grader



**Neyaz Ahmed,**  
Msc  
Grader



**Erika Melder**  
Msc  
Assignment Creator,  
Tutor



**Nathaniel Grammel**  
PhD  
TBD



**Juan Luque**  
PhD  
Tutor



**Justin Goodman**  
MSc  
Discussion Session  
Coordinator,  
Tutor



**Anvitha Bhat**  
MSc  
Tutor



**Parsa Saadatpanah**  
PhD  
Grader



**Danielle Eliav**  
TBD



**Aranya Banerjee**  
TBD



**Navkaran Bindra**  
BSc  
TBD



**Tu Luan**  
PhD  
Grader



**Vaibhav Gupta**  
BSc  
Grader



**Bryce Toole**  
MSc  
Tutor



**William Cao**  
BSc  
Grader



**Auguste Gezalyan**  
PhD  
Tutor



**David Chan**  
PhD  
TBD



**Yang (Trista) Cao**  
PhD  
Grader



**Jason Kuo**  
MSc  
Grader



**William Gerst**  
BEng  
Tutor



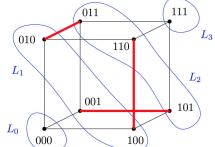
**Sally Zhao**  
BSc  
Tutor



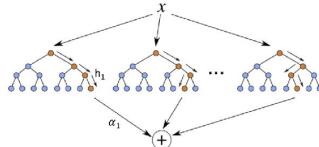
**Susan Liu**  
BSc  
Tutor

# Your instructor

- Jason Filippou (“Phil-ee-pooh”).
- Preferred pronouns: I prefer people don’t address me, talk to / about me or acknowledge my presence at all. Beyond that, *he, him, his*.
- Pros: knows cons.
- Cons: None.



CMSC250: Discrete Structures



CMSC420: Advanced Data Structures



Nationality



Religion #1



Religion #2



HELLENIC REPUBLIC  
National and Kapodistrian  
University of Athens

Alumni (BSc)



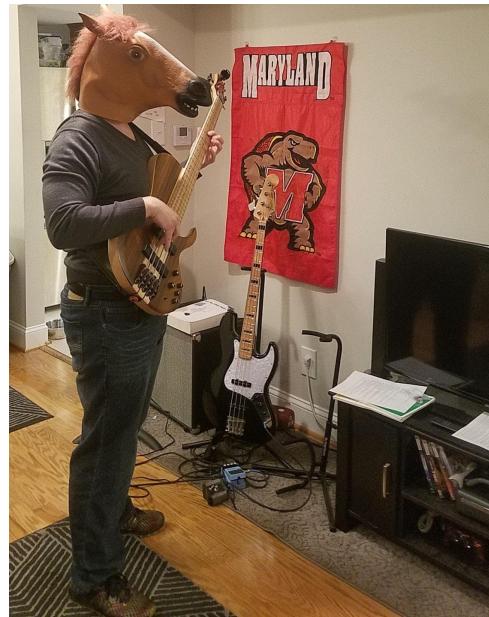
Former Research  
Fellow



SciPy, Pandas for  
CV / ML projects



SpringBoot for  
RESTful web services



Natural habitat

# 1st week schedule

- Check out intro video if you haven't already.
- This first week:
  - No homework given
  - No discussion session Monday (yesterday)
  - We **will** have a discussion session Wednesday (tomorrow)!
  - You **will** have a short, autograded quiz on Friday morning, to be handed in through Monday evening.
  - Content of the quiz: Our two first lectures.
- Office hours will begin Wednesday (tomorrow).
  - Mine: Mon, Fri, 9 - 11AM. Organized some Zoom links on ELMS.
  - TAs': By the time of this lecture, we might have already shared a spreadsheet with you.
- ADS - assisted students: thank you for contacting me.
  - Received a lot of ADS e-mail, sorting through all student cases.
  - Do my Friday Office Hours work for chatting, if we need to?

# Your patience appreciated....

- ≈ 200 of you joined a few days ago, and we scrambled for new TAs! 😊  
OOOF
- Also, some sections are quite small and thus prone to merging. 2x 😊  
OOOF
- But no matter what happens, we have TAs ready to go and fill in any gaps.



# Tech



## canvas

Announcements and gradebook management (automatically added when you register in class)

## piazza

Class forum (automatic invite with your ELMS e-mail)

## zoom

Lectures / Office Hours



## LATEX

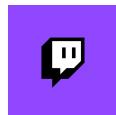
Oh yeah

Assignment upload and grading (automatic invite with your ELMS e-mail)

Offline videos (tutorials, cool stuff)



## Instructor & TA Tools



Class brand promotion



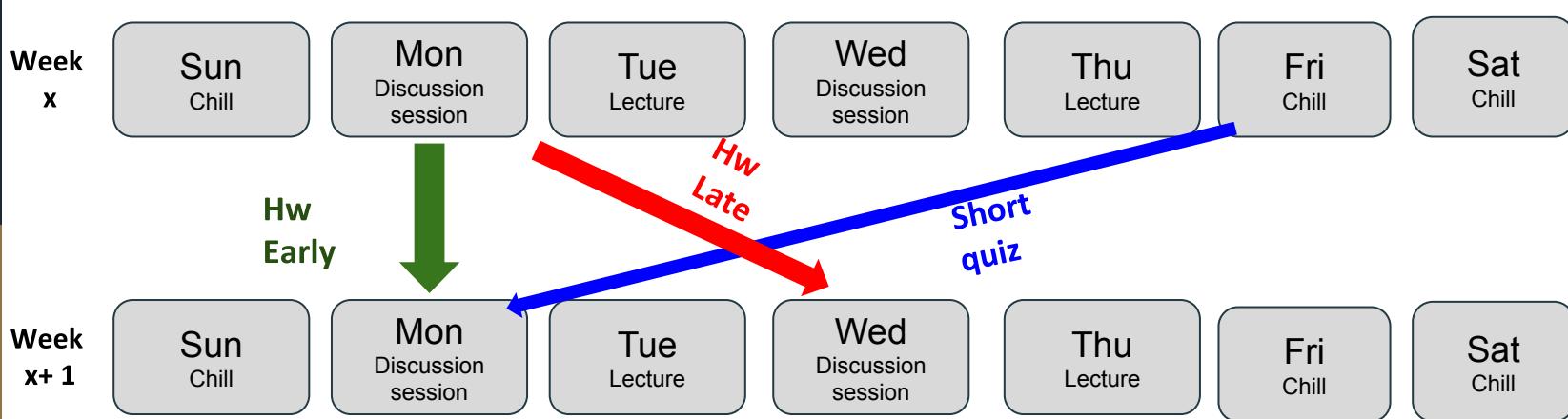
And now a message from our sponsor





Exams, homeworks, quizzes,  
etc

# Your weekly 250 schedule



- Homeworks: 20% of total grade
  - Late penalty for a homework is 50% off
- Quizzes: 10%

# Homework Submission

LATEX

- Submit in any sheet you have, and **appropriately label** your answers before you upload on Gradescope.
  - We will post a video tutorial for doing this effectively!
- ***And now, for the first time ever in CMSC250 (\*), you can submit your homeworks in LaTeX for 10% extra credit each!***
  - We will post the LaTeX sources for the homeworks on ELMS.
  - Jason will give you a short LaTeX tutorial geared towards the template we use.
  - We will NOT teach you LaTeX; here's the standard reference.
    - <https://tex.stackexchange.com/> is a great resource for Q / A
    - <https://www.overleaf.com/> is a browser-based frontend for LaTeX.

(\*) Nope.

# Quiz submission... TBD

- Thinking of leveraging Gradescope-native quizzes. We'll see.

# Exams

- Two midterms (both 20%)
  - Wednesday, **Mar 3**
  - Wednesday, **Apr 14**
  - We have **not** decided how we will administer those yet.
- One final (30%)
  - TBD
  - We have also **not** decided how to administer the final yet.

# Change in ordinary 250 curriculum

Logic

Sets

Proofs

Induction

Relations  
/ Functions

Combinatorics

Countability  
 $O()$  notation /  
Graphs / other

# Change in ordinary 250 curriculum



Logic

Sets

Proofs

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Relations  
/ Functions

Combinatorics

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# Change in ordinary 250 curriculum

Combinatorics

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# Change in ordinary 250 curriculum

Combinatorics

Logic

Sets

Proofs

Induction

Relations  
/  
Functions

Countability  
/  $O()$  notation /  
Graphs / other

## *Rationale:*

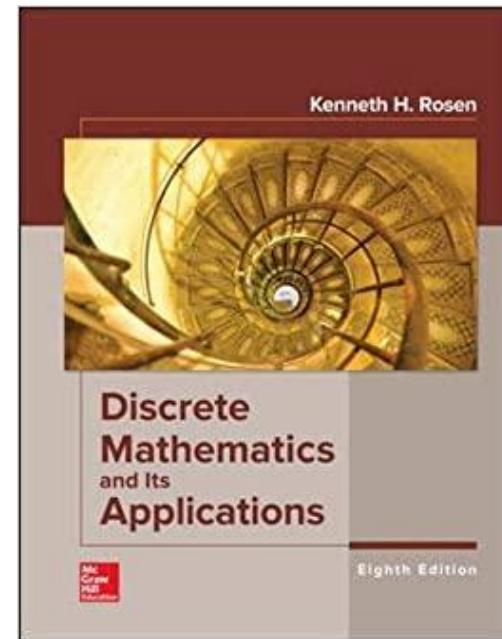
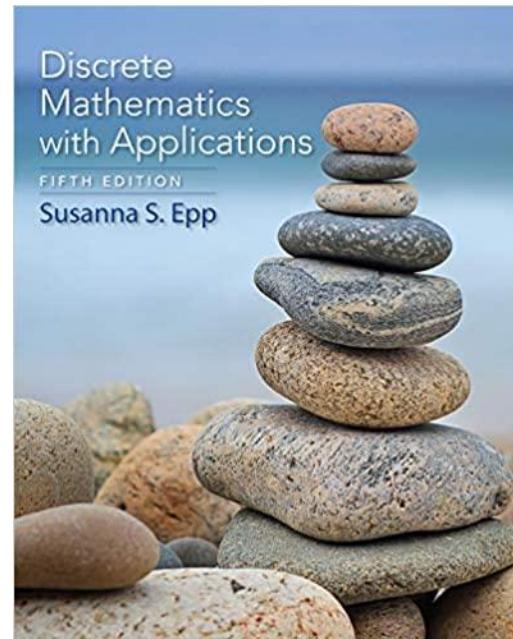
- Offer more honest communication about relative hardness of course.
- Logic / Sets fundamental in CS, but a LOT easier than induction / combinatorics

# Textbooks (recommended)

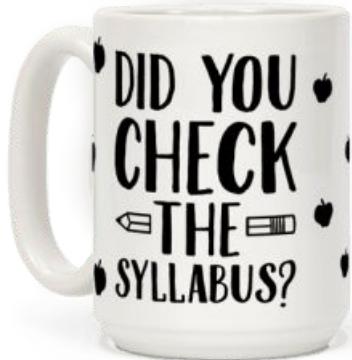
We have a large bank of recommended homework problems for both

Rosen: A bit harder, definitely more extensive, and more “Chaotic” w.r.t course structure

Epp: Follows traditional course structure a bit better.



# For the rest...



**250 slides**

---

**250 syllabus**

imgflip.com





#bringitback



“Discrete?”



“Discrete?”

# “Discrete?”

1, 2, 3, 4, ...., 100, ....

# “Discrete?”

1, 2, 3, 4, ...., 100, ....

..., -80, -79, ..., -1, 0, 1, ...., 50, ....

# “Discrete?”

1, 2, 3, 4, ...., 100, ....

..., -80, -79, ..., -1, 0, 1, ...., 50, ....

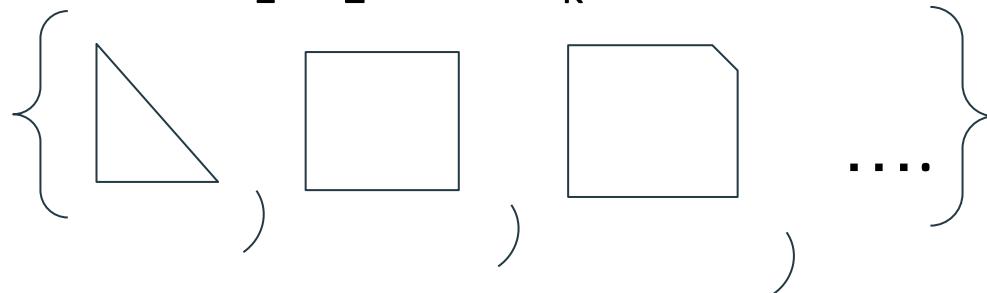
$\{s_1, s_2, \dots, s_k\}$

# “Discrete?”

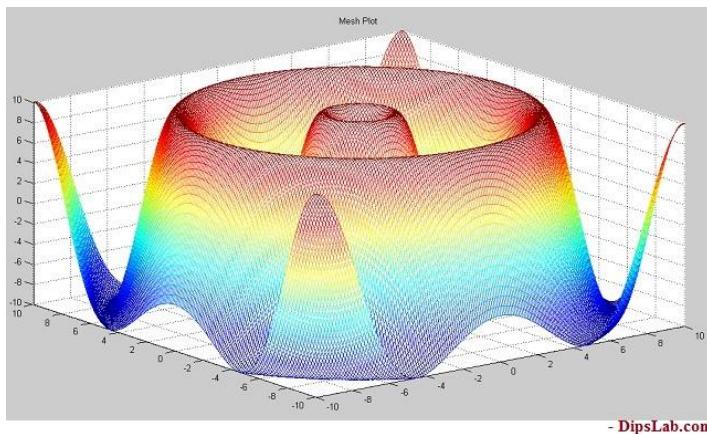
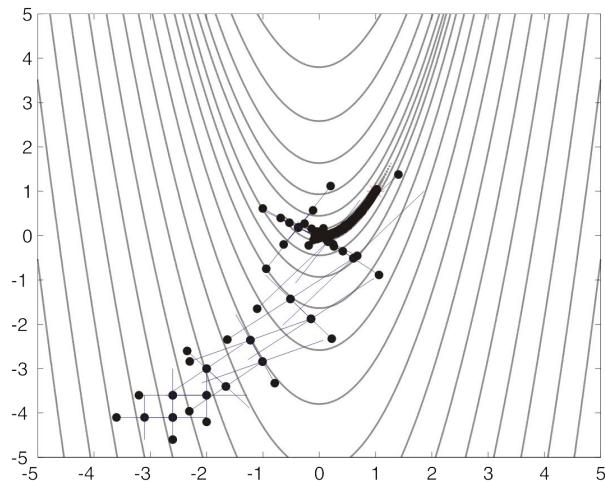
1, 2, 3, 4, ...., 100, ....

..., -80, -79, ..., -1, 0, 1, ...., 50, ....

$\{s_1, s_2, \dots, s_k\}$



... vs “continuous”



- DipsLab.com

# In a nutshell

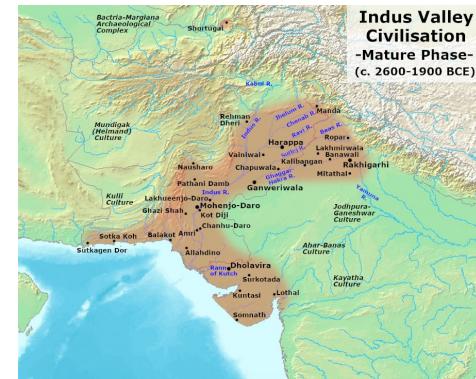
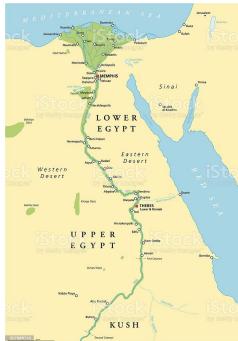
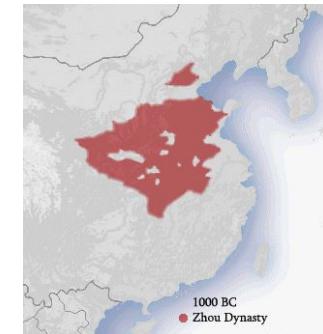


$$\begin{aligned} & \int (-4x^3 - 8x^2 - 4) dx \\ &= -4 \int x^3 dx - 8 \int x^2 dx - 4 \int 1 dx \\ &= -4 \frac{x^4}{4} - 8 \frac{x^3}{3} - 4 \frac{x^1}{1} + C \\ &= -x^4 - \frac{8}{3}x^3 - 4x + C \end{aligned}$$

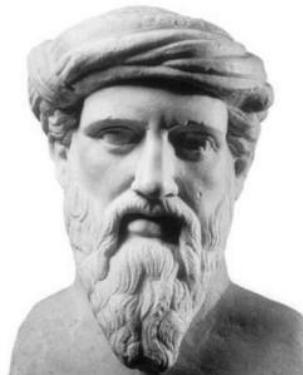
$$\begin{aligned} \frac{k(k+1)}{2} + (k+1) &= \frac{k(k+1) + 2(k+1)}{2} \\ &= \frac{(k+1)(k+2)}{2} \\ &= \frac{(k+1)((k+1)+1)}{2}. \end{aligned}$$

# In history

This entire math thing began **very practically**.



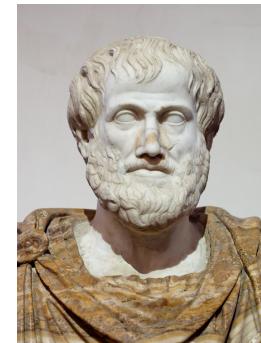
# Enter Greeks



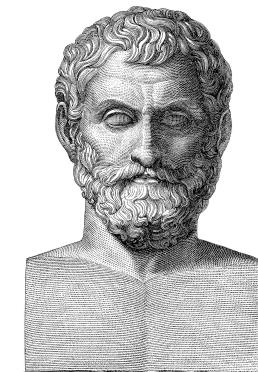
Pythagoras



Euclid



Aristotle



Thales

# The variable

- François Viète, Renaissance - era French mathematician is often credited as the first person who systematically used letters to *name unknowns*, which we now call *variables*
- But the Ancient Greeks were the first people to understand this idea deeply.
  - They didn't explicitly say "*multiply w by h to get area*", but they *did* understand that to do so is correct even if you don't have all the numbers a priori!
- Famous example: square root of 2.

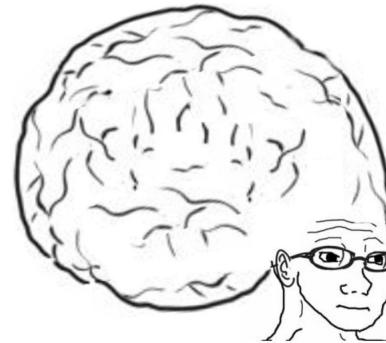
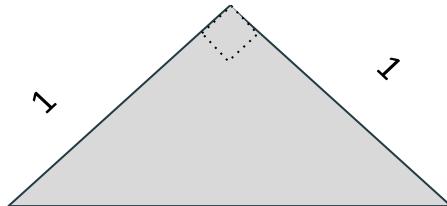
# Reasoning about root 2 - Practically

- Babylonians:
  - Came up with an algorithm for **approximating ANY** root as well as one can!
  - We still use this method today!

1	Y	11	YY	21	YY	31	YY	41	YY	51	YY
2	YY	12	YY	22	YY	32	YY	42	YY	52	YY
3	YYY	13	YYY	23	YYY	33	YYY	43	YYY	53	YYY
4	YY	14	YY	24	YY	34	YY	44	YY	54	YY
5	YY	15	YY	25	YY	35	YY	45	YY	55	YY
6	YY	16	YY	26	YY	36	YY	46	YY	56	YY
7	YY	17	YY	27	YY	37	YY	47	YY	57	YY
8	YY	18	YY	28	YY	38	YY	48	YY	58	YY
9	YY	19	YY	29	YY	39	YY	49	YY	59	YY
10	X	20	X	30	X	40	X	50	X	59	X

# Reasoning about root 2 - “Purely”

- Greeks:
  - Take a right and isosceles triangle, with sides length 1. By pythagorean theorem, the hypotenuse has length  $\sqrt{2}$ .
  - The more they reasoned about the length of this hypotenuse, they found it is **“immeasurable”** w.r.t the other sides (i.e they couldn't find a **fraction** to relate their lengths)!
  - Without a single calculation or an example of any kind, Euclid proved that there is no fraction that fully characterizes the root of 2, no matter how much you try!
  - So the Babylonians would have to spend exactly one infinity to reach their goal!



# Euclid's proof of Pythagorean Theorem

(he also proved that root 2 is irrational, a proof we'll work a lot on)

## Ancient Greek

ΕΥΚΛΕΙΔΗΣ: 204. ...

[1.47] ἐν τοις ὄρθογωνίαις τριγώνοις τὸ ἀπό τῆς τὴν ὄρθην γωνίαν ὑποτείνουσής πλευρᾶς τετράγωνον ίσον ἔστι τοῖς ἀπό τῶν τὴν ὄρθην γυνίαν περιεχουσῶν πλευρῶν τετραγώνοις.

ἔστοι τρίγωνον ὄρθογόνιον τὸ ΑΒΓ ὅρθην ἔχον τὴν ὑπὸ ΒΑΓ γυνίαν· λέγω, ὅτι τὸ ἀπό τῆς ΒΓ τετράγωνον ίσον ἔστι τοῖς ἀπό τῶν ΒΑ, ΑΓ τετραγώνοις.

ἀναγεράφω γάρ ἀπό μὲν τῆς ΒΓ τετράγωνον τὸ ΒΔΕΓ, ἀπό δὲ τῶν ΒΑ, ΑΓ τὸ ΗΒ, ΘΓ, καὶ διὰ τοῦ Α ποτέρον τῶν ΒΔ, ΓΕ παραλλήλος ἥμβω η ΑΓ καὶ ἐπειργόντων αἱ ΑΔ, ΖΓ, καὶ ἐπειρ οὕτω τῷ ΒΑ καὶ τῷ πρὸς αὐτή σημειῷ τῷ Α δύναται αἱ ΑΓ, ΑΗ μή ἐπι τῷ αὐτῷ μέρῃ κείμενα τὰς ἐφεξῆς γυνίας δυοιν ὥρθαις ίσαις ποιούσαις ἐπί εὐθείας ἄρα ἔστιν η ΓΑ τῇ ΑΗ. διὰ τὰ αὐτὰ δῆ καὶ η ΒΑ τῇ ΑΘ ἔστον ἐπί εὐθείας, καὶ ἐπειρ ίση ἔστιν η ὑπὸ ΔΒΓ γυνία τῇ ὑπὸ ΖΒΔ —ὅρθη γάρ ἕκατεραι— κοντὶ προσκείσανται ἡ ὑπὸ ΑΒΓ· δηλαδή άρα η ὑπὸ ΔΒΑ δῆλη τῇ ὑπὸ ΖΒΓ ἔστον ιση, καὶ ἐπειρ ίση ἔστιν η μὲν ΔΒ τῇ ΒΓ, η δῆ ZB τῇ ΒΑ, δύο δῆι αἱ ΔΒ, ΒΑ δύο ταῖς ΖΒ, ΒΓ ίσαι εἰσὶν ἕκατέραι ἕκατεραι· καὶ γυνία η ὑπὸ ΔΒΑ γυνίτη τῇ ὑπὸ ΖΒΓ ιση· βάσις άρα η ΑΔ βάσει τῇ ΖΤ̄ (ἐστιν) ιση, καὶ τὸ ΑΒΔ τριγώνον τῷ ΖΒΓ τριγώνῳ ἔστον ίσον· καὶ (ἐστιν) τοῦ μὲν ΑΒΔ τριγώνου διπλάσιον τὸ ΒΑ παραλλήλογραμμον· βάσιν τὸ πάρη τὴν αὐτὴν ἔχουσα τὴν ΒΔ καὶ ἐν ταῖς αὐταῖς εἰσὶ παραλλήλοις ταῖς ΒΔ, ΑΓ· τοῦ δὲ ΖΒΓ τριγώνου διπλάσιον τὸ ΗΒ τετράγωνον· βάσιν τε γάρ πάλιν τὴν αὐτὴν ἔχουσα τὴν ΖΒ καὶ ἐν ταῖς αὐταῖς εἰσὶ παραλλήλοις ταῖς ΖΒ, ΗΓ· (τὰ δέ τῶν ίσαιν διπλάσια ἵσταται· ἔστιν)· ίσον ἄρα ἔστι καὶ τὸ ΒΔ παραλλήλογραμμον τῷ ΗΒ τετραγώνῳ· ὅμοιως δῆ ἐπιζευγμένων τῶν ΑΕ, ΒΚ δειχθήσεται καὶ τὸ ΓΔ παραλλήλογραμμον ισον τῷ ΘΓ τετραγώνῳ· δῶν ἄρα τὸ ΒΔΕΓ τετράγωνον ισον τοῖς ΗΒ, ΘΓ τετραγώνοις ἔστιν· καὶ ἔστι τὸ μὲν ΒΔΕΓ τετράγωνον ἀπό τῆς ΒΓ ἀναγράφεν, τὸ δὲ ΗΒ, ΘΓ ἀπό τῶν ΒΑ, ΑΓ· τὸ άρα ἀπό τῆς ΒΓ πλευρᾶς τετράγωνον ίσον ἔστι τοῖς ἀπό τῶν ΒΑ, ΑΓ πλευρῶν τετραγώνοις.

ἐν τοις ὄρθογωνίαις τριγώνοις τὸ ἀπό τῆς τὴν ὄρθην γυνίαν ὑποτείνουσής πλευρᾶς τετράγωνον ίσον ἔστι τοῖς ἀπό τῶν τὴν ὄρθην γυνίαν περιεχουσῶν πλευρῶν τετραγώνοις· ὅπερ ἔδει δεῖξαι.

## Modern Greek translation by a dude called Stavros

Σταύρος Τσιτσιρίδης

Σταύρος Τσιτσιρίδης

Σταύρος Τσιτσιρίδης

Σταύρος Τσιτσιρίδης

Σταύρος Τσιτσιρίδης

- Jason can give an English translation if you ask real nice
- Notice the distinct lack of any numbers. It's a proof. You shouldn't need specific numbers to "make it work".
- Till the Greeks, nobody had figured that out.

# Rest of this week

- Wednesday: your **first discussion session**, at your allotted time.
  - Check the discussion session spreadsheet that was shared with you on ELMS yesterday night.
- Thursday: our second lecture, in **combinatorics**.
- Office Hours spreadsheet posted on ELMS some time today.
- Friday: expect a quiz on first week's lecture content.
- Thanks a ton for stopping by, **EH?**