

Math 1553

Section M (M01-M05)

Georgia Tech Fall 2021

Dan Margalit

Me

About Me



DOB 03/06/1976

Sex M

Eyes HAZ

Hgt 5'-10"

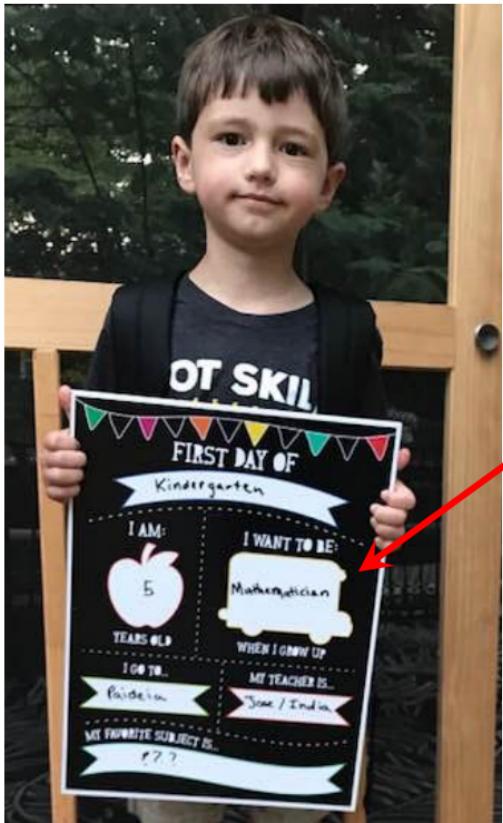
Wgt 145 lb

Donor ❤

More About Me



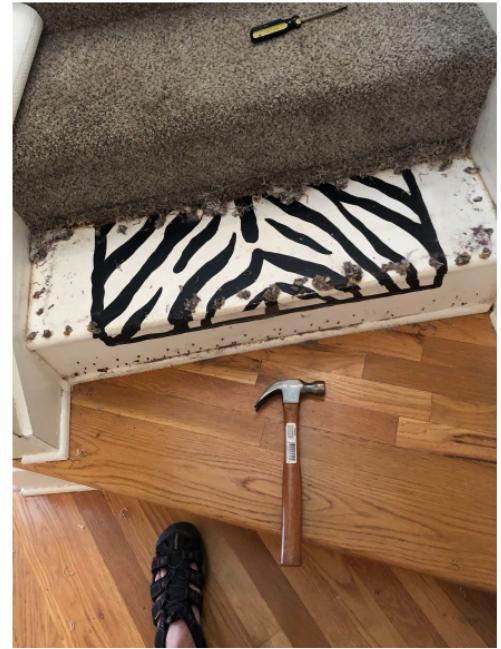
More About Me



Winning



Some things in my house



More kids



More About Me

I like...

More About Me

I like...

- Cake

More About Me

I like...

- Cake
 - Chocolate

More About Me

I like...

- Cake
 - Chocolate
 - Double Chocolate

More About Me

I like...

- Cake
 - Chocolate
 - Double Chocolate
 - Death by Chocolate

More About Me

I like...

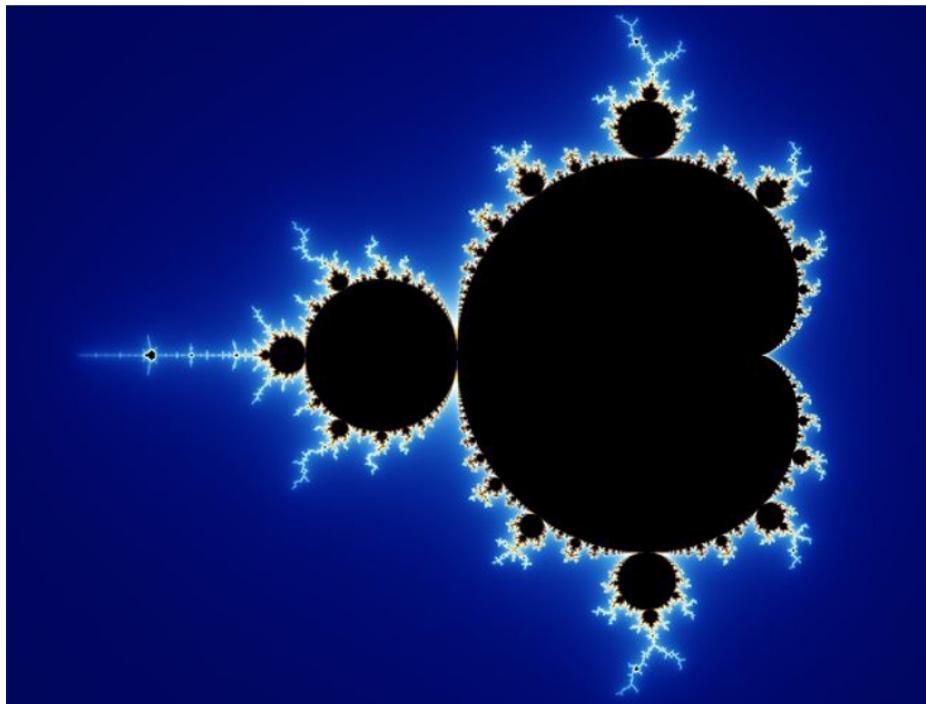
- Cake
 - Chocolate
 - Double Chocolate
 - Death by Chocolate
- Bringing me cake will not:
 - improve your grade
 - help you learn linear algebra

More About Me

I like...

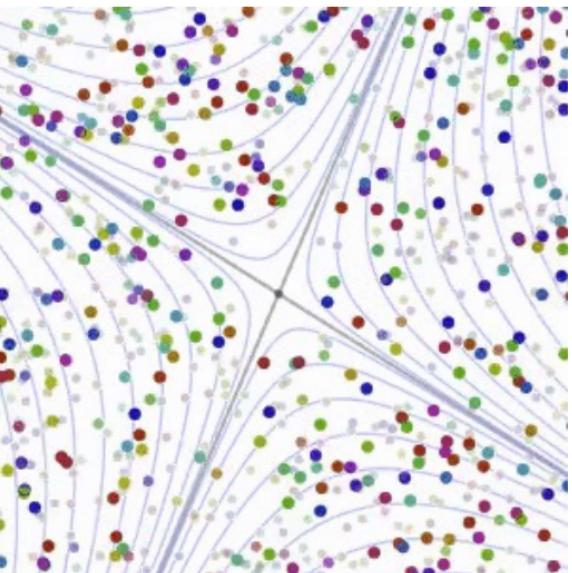
- Cake
 - Chocolate
 - Double Chocolate
 - Death by Chocolate
- Bringing me cake will not:
 - improve your grade
 - help you learn linear algebra
- Bringing me cake will:
 - allow me to eat cake

Even More About Me



The class

Textbook



Textbook

Interactive Linear Algebra

Dan Margalit & Joe Rabinoff

The textbook is **free** and **online**.

Math 1553 Combined
find my name
Click on website
for Sec M

Lay & MyMathLab are resources you can buy. I will **not** use them.

Canvas

Intro to Linear Algebra - MATH X +

gatech.instructure.com/courses/210776

MATH-1553-Combined > Syllabus

63 Student View

Fall 2021

Home Announcements Assignments Quizzes Grades People Files BlueJeans Pages Syllabus Piazza MyLab and Mastering GaTech Roster Well-Being Connect Mental Health Resources Outcomes

Intro to Linear Algebra - MATH-1553-Combined

Jump to Today Edit

The syllabus contains detailed information about course policies. In addition, we have a course calendar with a detailed schedule as part of a common course website containing additional details, tips, and links to resources.

Our textbook is the free online book [Interactive Linear Algebra](#) by Dan Margalit and Joseph Rabinoff.

The syllabus and calendar are subject to change without notice as the semester approaches (and also at the beginning of the semester), but we do not expect major changes.

Check out the [interactive row reducer](#).

Lectures and Instructors

Lecture A: Prof. Chris Jankowski
Lectures: MW 8:25-9:15 AM in Howey (Physics) L4
Office hours: Mondays 1:30-3:30 PM online [here](#) and Tuesdays 10:30 AM - 12:30 PM online [here](#).

Lecture B: Prof. Alperen Ozdemir
Lectures: Monday 8:25-9:15 AM online at <https://bluejeans.com/190597441> (also accessible through the BlueJeans tab on the left), and Wednesdays 8:25-9:15 AM in College of Business 300
Office hours: TBA

Lecture D: Prof. Alperen Ozdemir
Lectures: Monday 9:30-10:20 AM online at <https://bluejeans.com/265160847> (also accessible through

Course Status

Unpublish Published

Import Existing Content Import from Commons Choose Home Page View Course Stream Course Setup Checklist New Announcement New Analytics View Course Notifications

August 2021							
<	25	26	27	28	29	30	31
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31	1	2	3	4

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Discussions

Lecture G: Prof. Bo Lin
Lectures: MW 12:30-1:20 PM in Boggs B5 and also online at [here](#).
Office hours: Mondays at 3:30-4:30 PM [here](#) and Thursdays at 11:00 AM - 12:00 PM [here](#), online via Microsoft Teams. To access the live stream of lectures and office hours, please join the Microsoft Teams with code **dqzxal7**.

BigBlueButton (Formerly Conferences)

Collaborations

Modules

Settings

Lecture H: Prof. Guillermo Goldsztein
Lectures: Monday 12:30-1:20 PM online ([Join Monday lectures \(Microsoft Teams Meeting\)](#)) Or join by dialing +1 470-705-2566 Conference ID: 991133737), and Wednesdays 12:30-1:20 PM in Clough Commons 152
Office hours: Mondays at 3:00-3:50PM same link as lectures. Wednesdays at 9:00-9:50AM same link as lectures.

Lecture I: Prof. Guillermo Goldsztein
Lectures: Monday 2:00-2:50 PM online ([Join Monday lectures \(Microsoft Teams Meeting\)](#)) Or join by dialing +1 470-705-2566 Conference ID: 991133737), and Wednesdays 2:00-2:50 PM in Clough Commons 152
Office hours: Mondays at 3:00-3:50PM same link as lectures. Wednesdays at 9:00-9:50AM same link as lectures.

Lecture J: Prof. Ashley Wheeler
Lectures: MW 2:00-2:50 PM in Weber SST III 2
Office hours: TBA

Lecture M: Prof. Dan Margalit
Lectures: Online (Microsoft Teams) on a temporary basis. See email sent to Section M
Office hours: TBA

LINK TO SECTION M

Book
Advice
lecture slides

Studio Sections and Teaching Assistants

A1: Kalen Patton. Studio: Fridays 8:25 - 9:15 AM in Skiles 270
Office hours:

Intro to Linear Algebra - MATH X +

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Studio Sections and Teaching Assistants

A1: Kalen Patton. Studio: Fridays 8:25 - 9:15 AM in Skiles 270
Office hours:

A2: Zachary Brumbach. Studio: Fridays 8:25 - 9:15 AM in Skiles 271
Office hours:

A3: Geigh Zollicoffer. Studio: Fridays 8:25 - 9:15 AM in Skiles 154
Office hours:

A4: Tianhao Dai. Studio: Fridays 8:25 - 9:15 AM in Skiles 169
Office hours:

A5: Rayan Dabbagh. Studio: Fridays 8:25 - 9:15 AM in Skiles 171
Office hours:

A6: James Jutras. Studio: Fridays 8:25 - 9:15 AM in Skiles 256
Office hours:

B1: Joseph Cochran. Studio: Fridays 8:25 - 9:15 AM in DM Smith 207
Office hours:

B2: Ananda Badari. Studio: Fridays 8:25 - 9:15 AM in Skiles 170
Office hours:

B3: Jeremy Ortmann. Studio: Fridays 8:25 - 9:15 AM in Skiles 246
Office hours:

D1: Jeremy Ortmann. Studio: Fridays 9:30 - 10:20 AM in Skiles 268
Office hours:

Account

Dashboard

Courses

Calendar

Inbox 88

History

Commons

Help 6

Intro to Linear Algebra - MATH X +

gatech.instructure.com/courses/210776

Star · Puzzle · User · More

I6: JD Flynn. Studio: Fridays 2:00 - 2:50 PM in Skiles 255
Office hours:

J1: Jieun Seong. Studio: Fridays 2:00 - 2:50 PM in Skiles 154
Office hours:

J2: Ivan Rocha. Studio: Fridays 2:00 - 2:50 PM in Skiles 170
Office hours:

J3: Patrick Zugel. Studio: Fridays 2:00 - 2:50 PM in Skiles 246
Office hours:

M1: Ian Lewis. Studio: Fridays 3:30 - 4:20 PM in Skiles 257
Office hours:

M2: Patrick Zugel. Studio: Fridays 3:30 - 4:20 PM in Skiles 168
Office hours:

M3: Zachary Brumbach. Studio: Fridays 3:30 - 4:20 PM in Skiles 270
Office hours:

M4: Ivan Rocha. Studio: Fridays 3:30 - 4:20 PM in Skiles 271
Office hours:

M5: Jieun Seong. Studio: Fridays 3:30 - 4:20 PM in Skiles 154
Office hours:

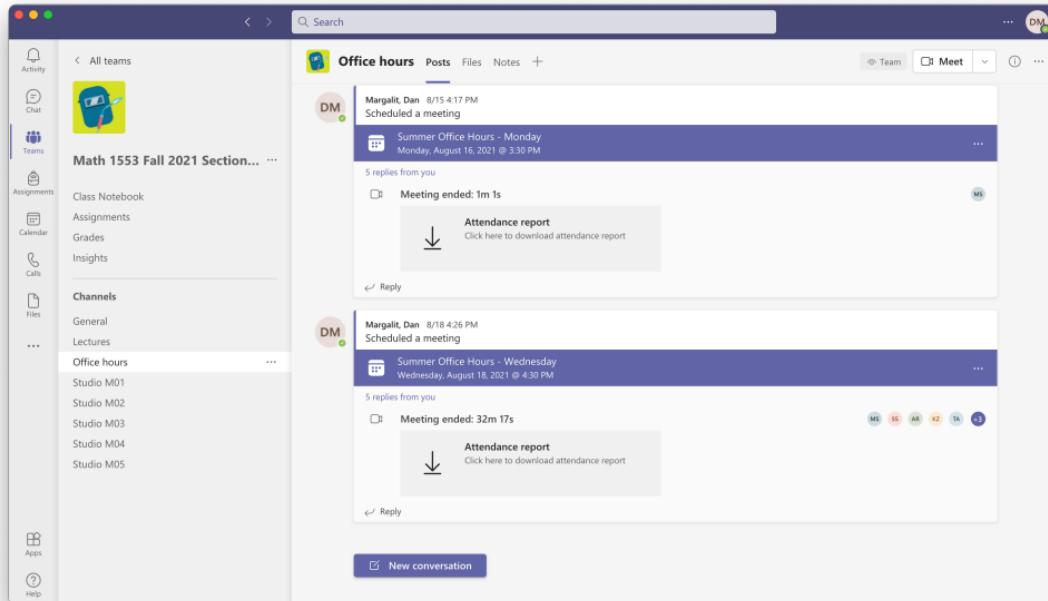
Course Summary:

Date	Details	Due
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Teams

Microsoft Teams

On Microsoft Teams, you can find the lectures and streamed/recoded studios.



Piazza

Piazza

- Accessible from Canvas
- If you have a question that is not specific to you, post on Piazza instead of email.
- In-class polls will be conducted on Piazza, not for a grade

The screenshot shows the Piazza web interface for a course titled "MATH-1553-COMBINED". The left sidebar contains links for Account, Dashboard, Courses, Calendar, Inbox, History, Commons, Help, Announcements, Assignments, Quizzes, Grades, People, Files, BlueJeans, Pages, Syllabus, Piazza, MyLab and Mastering, GaTech Roster, Well-Being Connect, and Mental Health Resources. The main content area displays a feed of posts, with one pinned post from "Search for Teammates!" dated 8/21/21. A sidebar on the right titled "Class at a Glance" shows statistics: 5 unread posts, 0 unanswered questions, and 0 unresolved followups. It also displays student enrollment information and links to download the app. At the bottom, there's a "Share Your Class" section and a "2021 Product Updates" section.

Your first assignment

Mathematical Autobiography

The first assignment is to post a mathematical autobiography on Piazza, due Fri. Tag: **margalit-autobio** Aim for a paragraph, not a couple of sentences.

Include:

- A recognizable photo of you
- Preferred nickname
- Your major
- Anything about you that you'd like to share
- About your relationship with Math, including previous courses

Can make visible
only to me if
you want.

Assessment

Grades!

Grades

Category	Percentage
Homework	15% (2 drops)
Quizzes	15% (1+ drops)
Midterms	45%
Final Exam	25%

If 85% of Section M does the CIOS at the end of the semester, a second quiz is dropped.

90% is an A, etc. Target scores may be moved in your favor.

Exams

See my web site
for old quizzes.

Exam	Date
Midterm 1	Sep 22 @ 8 pm – 9:15 pm <i>online</i>
Midterm 2	Oct 20 @ 8 pm – 9:15 pm <i>online</i>
Midterm 3	Nov 17 @ 8 pm – 9:15 pm <i>online</i>
Final Exam	Dec 14 @ 6 pm – 8:50 pm <i>online</i>

Notify me **ASAP** if you have a conflict.

Quizzes and Exams are administered on Canvas Quizzes

↳ large time window on Fri
have 15 mins to take.

Canvas
Quizzes.
Wed nights.

Quizzes

- There are 7 quizzes, 15 minutes long, on open 6:30 am – 8pm Fridays
- Administered on Canvas Quizzes
- Lowest quiz grade dropped (possibly one more, as above)
- Typical timing:

	Mon	Tue	Wed	Thu	Fri
Week N	Class		Class HW due on Week N-1 material		Quiz on Week N-1
Week N+1	Class		Class HW due on Week N material		Quiz on Week N

Homework

- WeBWorK ← on Canvas.
- Generally due on Tue at 11:59 pm
- Sometimes more than one section per week (keep track on WebWork)
- Normally as many tries as you want, but there are a handful of problems with a limited number of tries. The problem will say.
- Once you get told your answer is correct, you have credit on that problem forever.
- Two lowest scores dropped

webwork.math.gatech.edu

WeBWorK MATH-1553_SPRING2020

Logged in as 902781425. Log Out

WeBWorK MAA MATHEMATICAL ASSOCIATION OF AMERICA

MAIN MENU

Courses

Homework Sets

User Settings

Grades

Instructor Tools

Classlist Editor

Hmwk Sets Editor

Library Browser

Statistics

Student Progress

Scoring Tools

Email

File Manager

Course Configuration

Help

?

Report bugs

webwork / MATH-1553_SPRING2020

MATH-1553_SPRING2020

Homework Sets	
Name	Status
<input type="checkbox"/> 0.0 Warmup will not be graded	open, due 01/10/2020 at 11:59pm EST
<input type="checkbox"/> 1.1 Linear Systems	will open on 01/06/2020 at 12:00am EST
<input type="checkbox"/> 1.2 Row Reduction	will open on 01/06/2020 at 12:00am EST
<input type="checkbox"/> 1.3 Parametric Form	will open on 01/13/2020 at 12:00am EST
<input type="checkbox"/> 2.1-2.2 Vectors and vector equations	will open on 01/20/2020 at 12:00am EST
<input type="checkbox"/> 2.3 Matrix Equations	will open on 01/27/2020 at 12:00am EST
<input type="checkbox"/> 2.4 Solution Sets	will open on 01/27/2020 at 12:00am EST
<input type="checkbox"/> 2.5 Linear Independence	will open on 01/27/2020 at 12:00am EST
<input type="checkbox"/> 2.6 Subspaces	will open on 02/03/2020 at 12:00am EST

Course Info Edit

**Under Assignments In Canvas.
Warmup this week,
not for a grade**

Advice, etc.

Honor Code

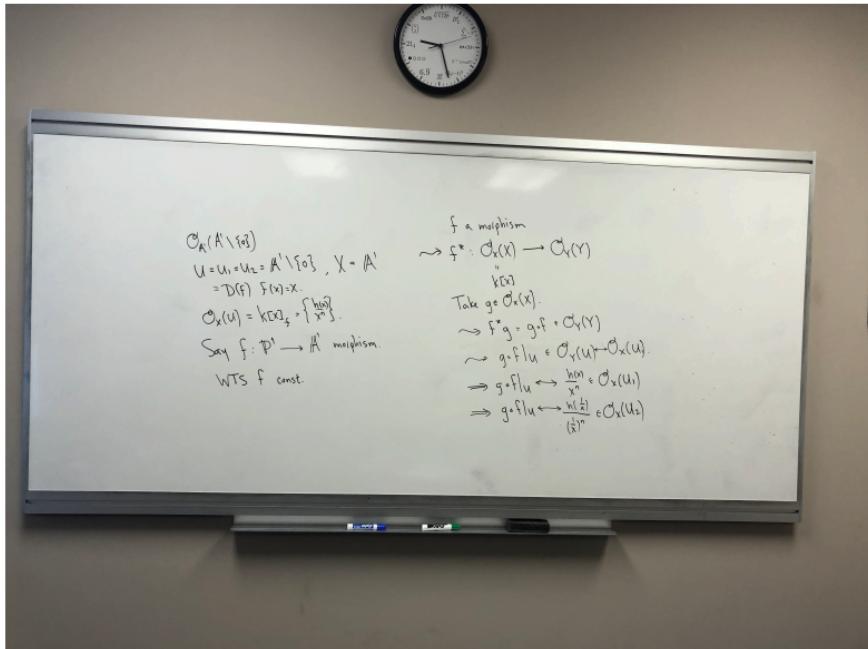
- You should abide by the GT honor code at all times.

This week only:
Thu 1-2
Skiles Cartyd

Also: PLUS

Office Hours

- Microsoft Teams and in person
- Times to be announced
- You should come!
- Ok if you don't have questions
- Also by apt.



General advice

- Talk through the material (again, office hours!)
- Be critical about whether you are understanding
- Get help as soon as you are not understanding
- Memorize important definitions as soon as they come up
- Practice

Advice on my web
site.

Growth mindset

There is a prevalent belief that you are either “good” or “bad” at math, and if you are “bad” at it, then you will always be bad at it no matter how hard you try. This is false. Mathematics is just like any other discipline or skill: you can improve more and more with practice (think of any hobby you got better at over time).

Linear algebra will be completely new to most of you. You are all starting from the ground floor this semester.

Statement of Inclusivity

I will strive to make this class accessible to people of all races, genders (including gender non-conforming individuals), sexual identities, and class backgrounds. While this is a priority for me, I do not claim to know how to best honor this commitment, and so I am very open to feedback from students when it comes to making the course more accessible and inclusive to all identities.

Also

If you need anything, please ask.

Some Things that Make Me Happy

- Have your camera on
- Pay attention
- Bring energy
- Ask questions
- Email / online etiquette
- Say hi

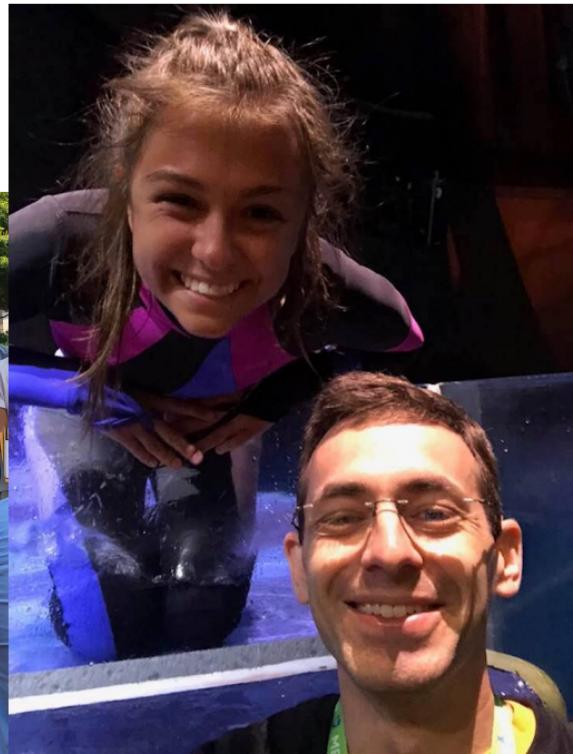
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Some Things that Make Me Happy

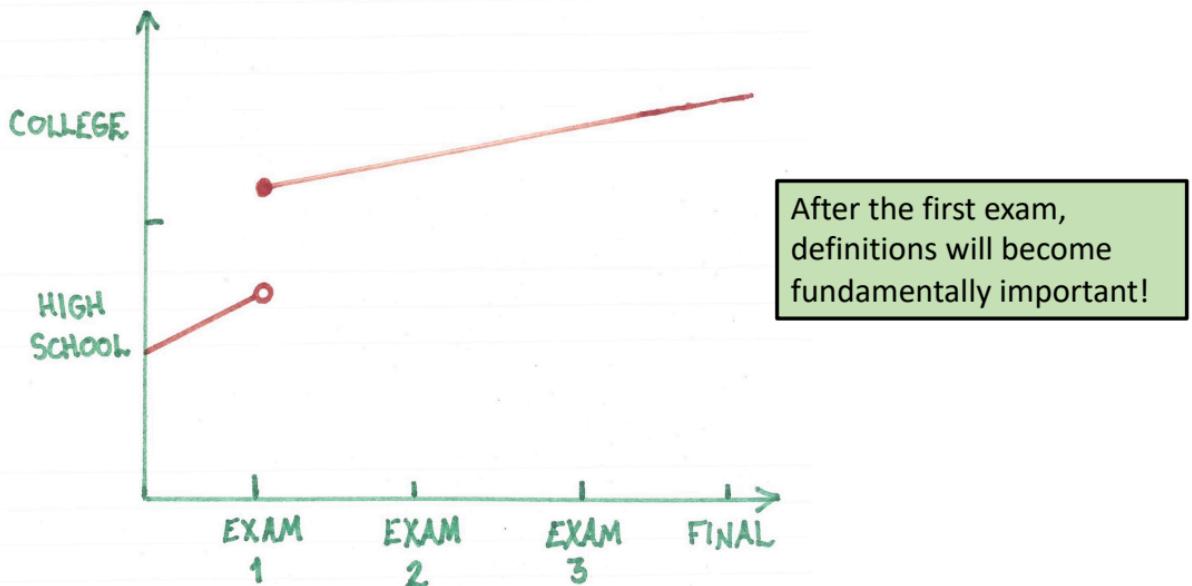
- Have your camera on
- Pay attention
- Bring energy
- Ask questions
- Email / online etiquette
- Say hi



Asking questions

- Please ask questions!
- Kudos if your answers are not correct
- Will answer as many questions as I can

Difficulty of the Course



Good luck!



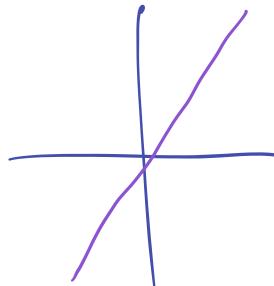
Math 1553: Introduction to Linear Algebra

Fall 2021, Georgia Tech

Dan Margalit

Linear Algebra.

What is Linear Algebra?



Linear

$$y = 2x$$

$$3x + 2y + 7 = 1$$

no exponents
no trig etc.

~~$$x^2 + \sin x + xy + e^x$$~~

Algebra

- from al-jebr (Arabic), meaning reunion of broken parts
- 9th century Abu Ja'far Muhammad ibn Muso al-Khwarizmi

Why a whole course?

Engineers need to solve *lots* of equations in *lots* of variables.

$$3x_1 + 4x_2 + 10x_3 + 19x_4 - 2x_5 - 3x_6 = 141$$

$$7x_1 + 2x_2 - 13x_3 - 7x_4 + 21x_5 + 8x_6 = 2567$$

$$-x_1 + 9x_2 + \frac{3}{2}x_3 + x_4 + 14x_5 + 27x_6 = 26$$

$$\frac{1}{2}x_1 + 4x_2 + 10x_3 + 11x_4 + 2x_5 + x_6 = -15$$

Often, it's enough to know some information about the set of solutions without having to solve the equations at all!

In real life, the difficult part is often in recognizing that a problem can be solved using linear algebra in the first place: need *conceptual* understanding.

Linear Algebra in Engineering

Almost every engineering problem, no matter how huge, can be reduced to linear algebra:

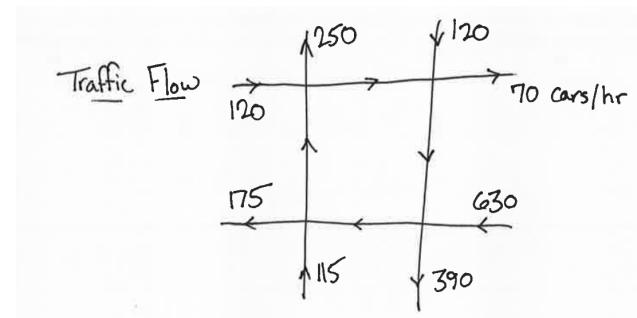
$$Ax = b \quad \text{or}$$

$$Ax = \lambda x \quad \text{or}$$

$$Ax \approx x$$

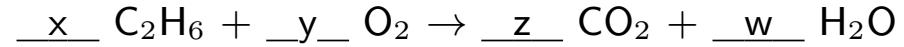
Applications of Linear Algebra

Civil Engineering: How much traffic lies in the four unlabeled segments?



Applications of Linear Algebra

Chemistry: Balancing reaction equations



Applications of Linear Algebra

Biology: In a population of rabbits...

- half of the new born rabbits survive their first year
- of those, half survive their second year
- the maximum life span is three years
- rabbits produce 0, 6, 8 rabbits in their first, second, and third years

~~= = =~~

If the numbers of first, second, and third year rabbits in 2021 are 10, 4, and 5, then what are they in 2022?

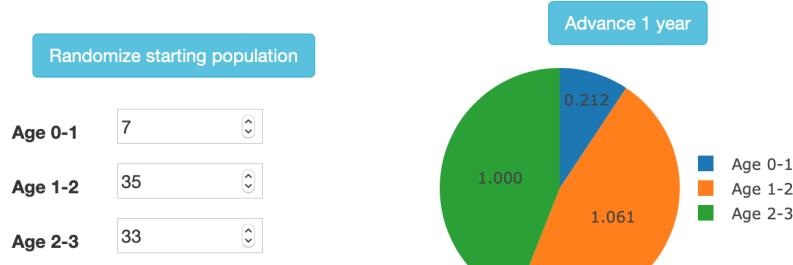
$$\begin{aligned} F_{2022} &= 6 \cdot 4 + 8 \cdot 5 = 64 \\ S_{2022} &= \frac{1}{2} \cdot 10 = 5 \\ T_{2022} &= \frac{1}{2} \cdot 4 = 2. \end{aligned}$$

If the numbers of first, second, and third year rabbits in year n are F_n , S_n , and T_n , what are the numbers in year $n+1$?

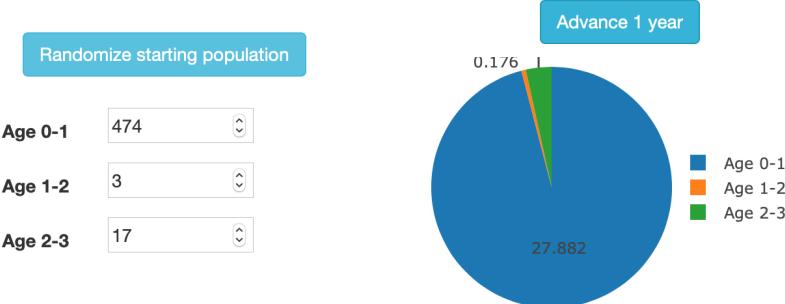
$$\begin{aligned} F_{n+1} &= 6 \cdot S_n + 8 \cdot T_n && \text{linear eqns} \\ S_{n+1} &= \frac{1}{2} F_n \\ T_{n+1} &= \frac{1}{2} S_n \end{aligned}$$

What happens in long term?

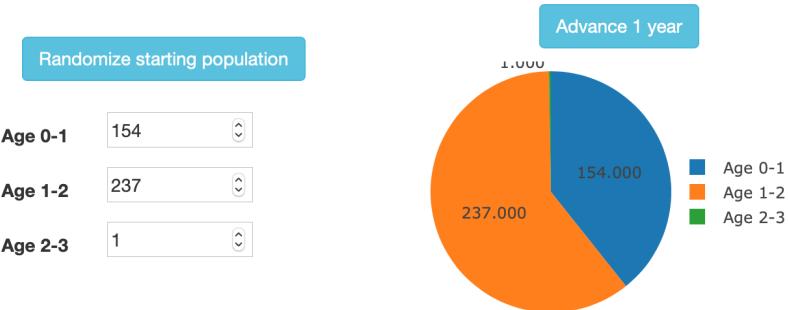
Rabbit populations



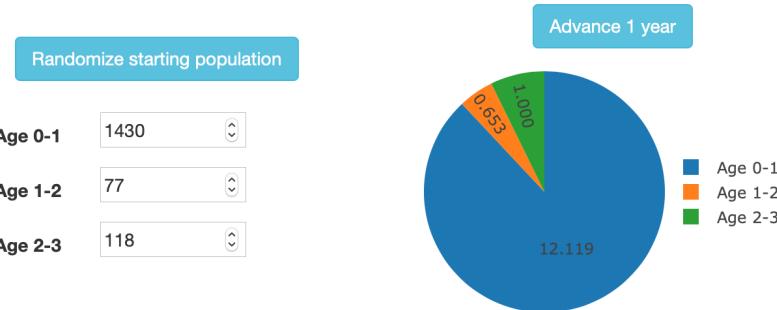
Rabbit populations



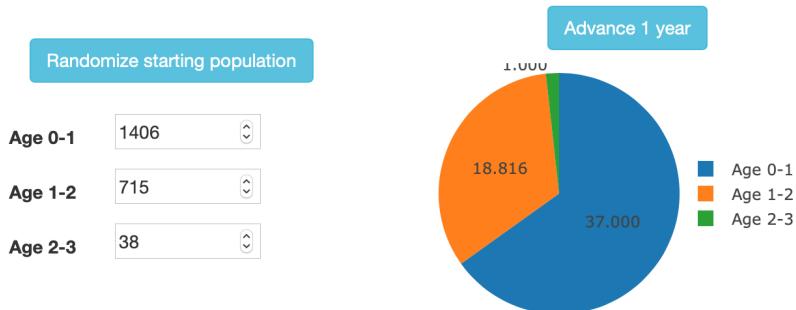
Rabbit populations



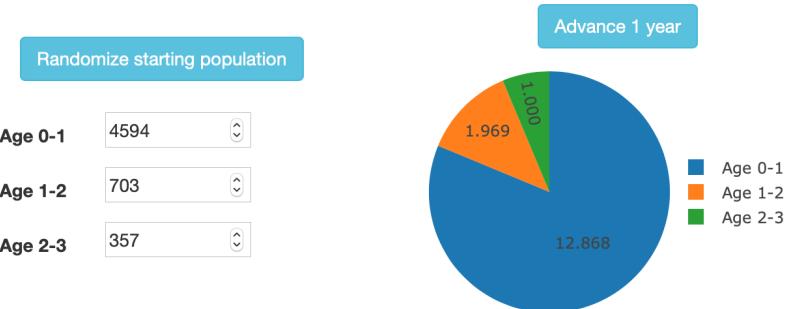
Rabbit populations



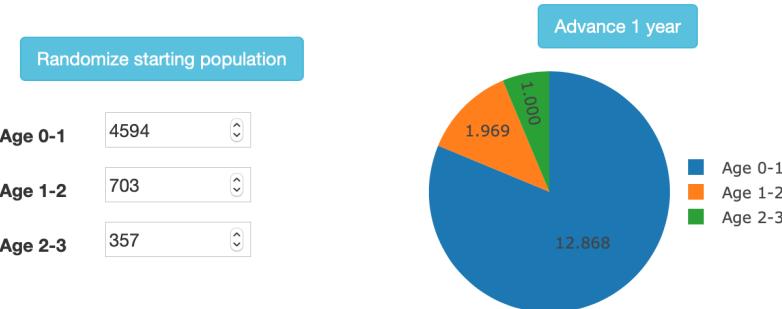
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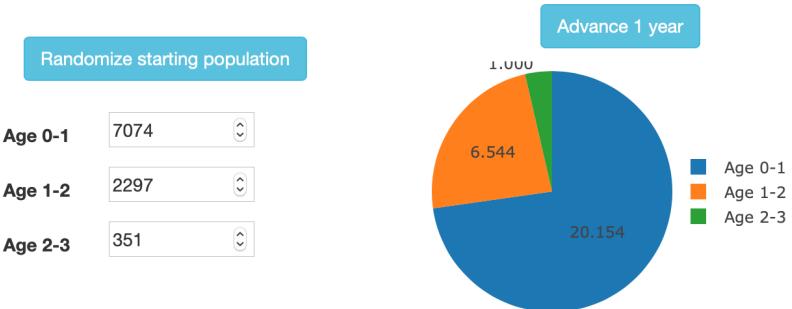
Rabbit populations



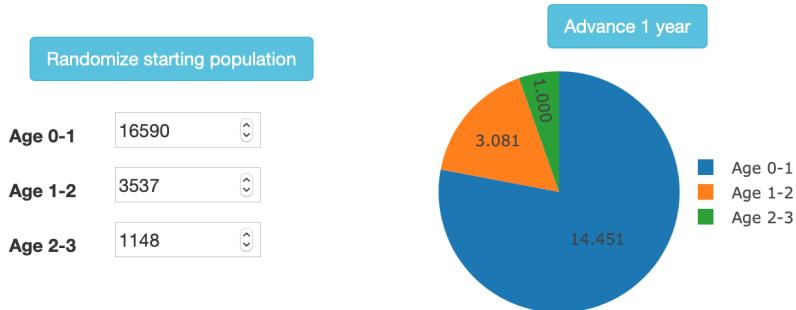
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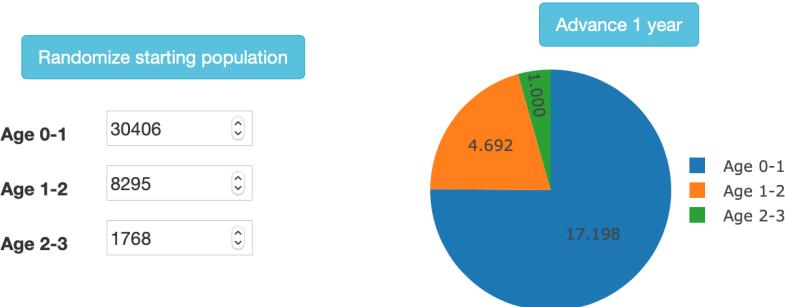
Rabbit populations



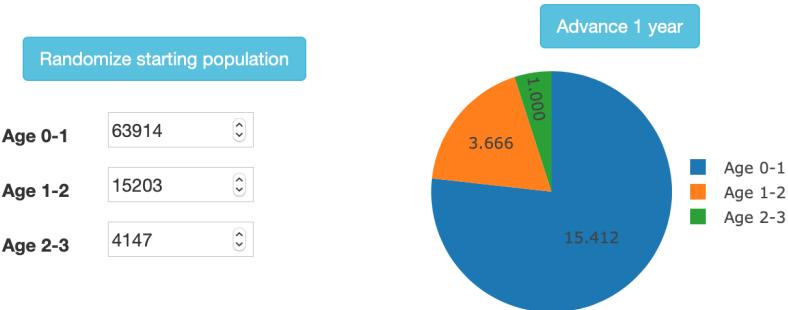
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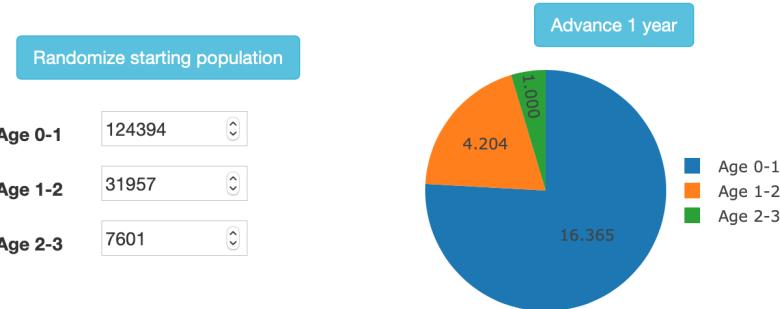
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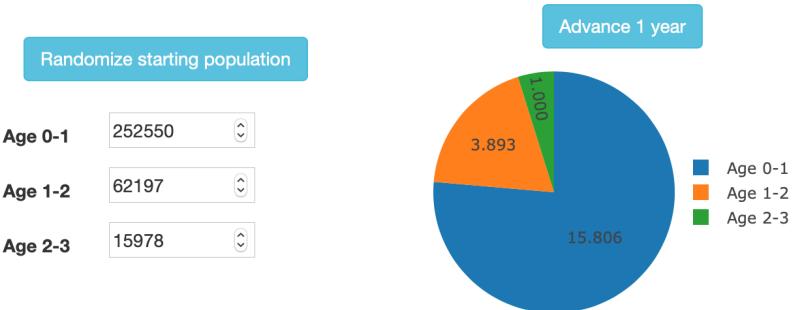
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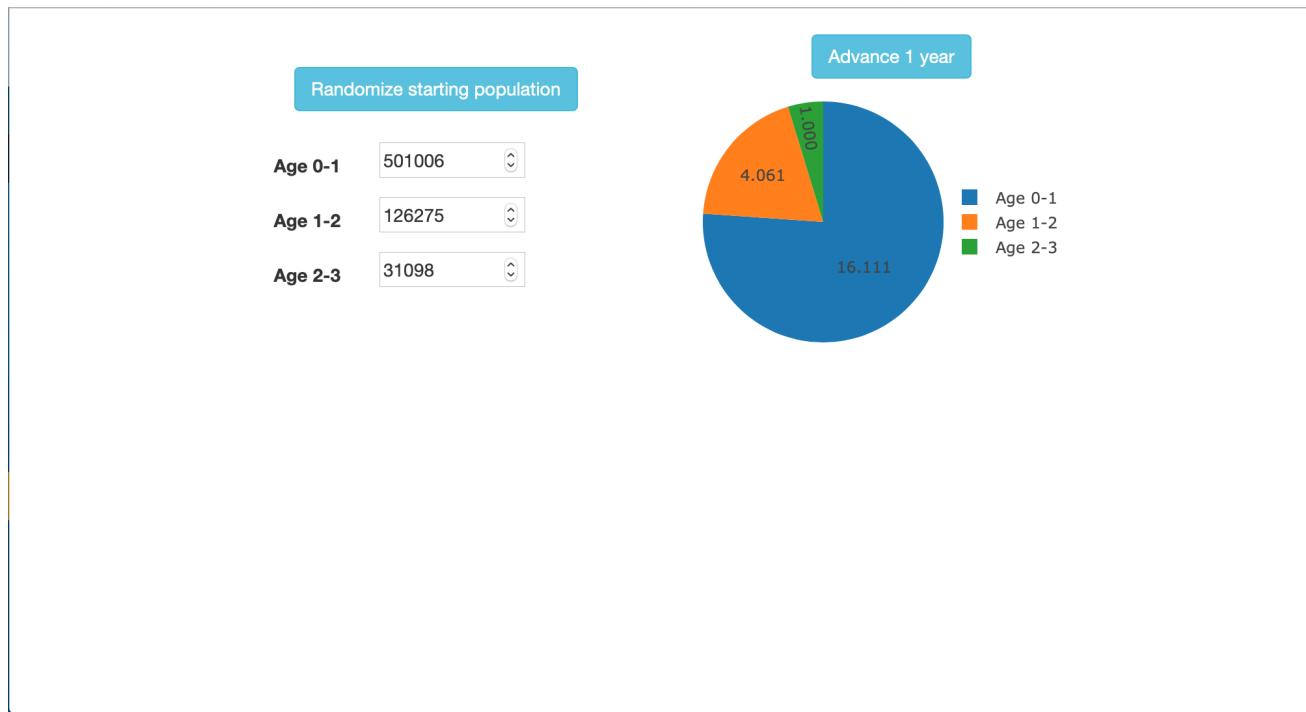
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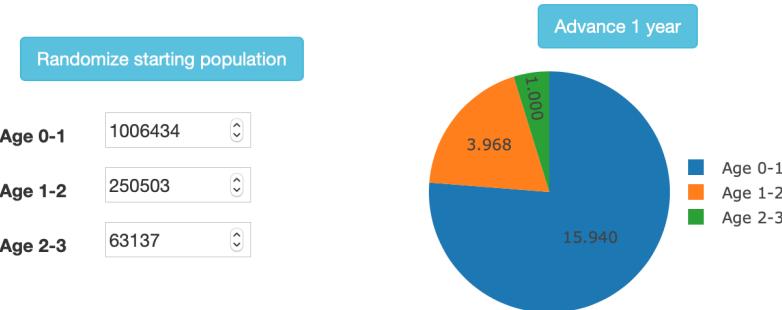
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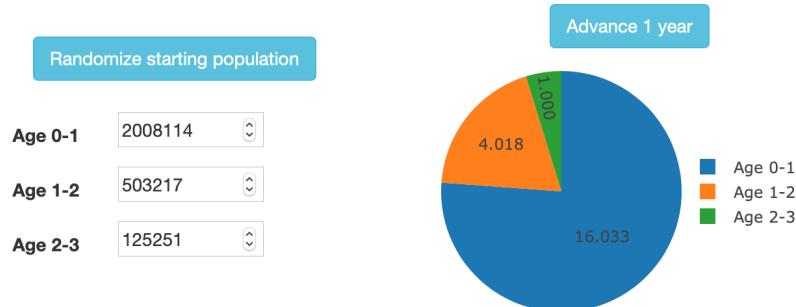
Rabbit populations



Rabbit populations



Rabbit populations



eigenvector.

▶ Demo

Applications of Linear Algebra

Geometry and Astronomy: Find the equation of a circle passing through 3 given points, say $(1,0)$, $(0,1)$, and $(1,1)$. The general form of a circle is $a(x^2 + y^2) + bx + cy + d = 0 \rightsquigarrow$ system of linear equations.

Very similar to: compute the orbit of a planet: $a(x^2 + y^2) + bx + cy + d = 0$

Applications of Linear Algebra

Google: “The 25 billion dollar eigenvector.” Each web page has some importance, which it shares via outgoing links to other pages \rightsquigarrow system of linear equations. Stay tuned!

Overview of the course

- Solve the matrix equation $Ax = b$

Overview of the course

- Solve the matrix equation $Ax = b$
 - ▶ Solve systems of linear equations using matrices and row reduction, and inverses

Overview of the course

- **Solve the matrix equation $Ax = b$**
 - ▶ Solve systems of linear equations using matrices and row reduction, and inverses
 - ▶ Solve systems of linear equations with varying parameters using parametric forms for solutions, the geometry of linear transformations, the characterizations of invertible matrices, and determinants
- **Solve the matrix equation $Ax = \lambda x$**

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- **Solve the matrix equation $Ax = \lambda x$**
 - ▶ Solve eigenvalue problems through the use of the characteristic polynomial

Overview of the course

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 - ▶ Solve systems of linear equations with varying parameters using parametric forms for solutions, the geometry of linear transformations, the characterizations of invertible matrices, and determinants
- **Solve the matrix equation $Ax = \lambda x$**
 - ▶ Solve eigenvalue problems through the use of the characteristic polynomial
 - ▶ Understand the dynamics of a linear transformation via the computation of eigenvalues, eigenvectors, and diagonalization
- **Almost solve the equation $Ax = b$**

Overview of the course

- **Solve the matrix equation $Ax = b$**
 - ▶ Solve systems of linear equations using matrices and row reduction, and inverses
 - ▶ Solve systems of linear equations with varying parameters using parametric forms for solutions, the geometry of linear transformations, the characterizations of invertible matrices, and determinants
- **Solve the matrix equation $Ax = \lambda x$**
 - ▶ Solve eigenvalue problems through the use of the characteristic polynomial
 - ▶ Understand the dynamics of a linear transformation via the computation of eigenvalues, eigenvectors, and diagonalization
- **Almost solve the equation $Ax = b$**
 - ▶ Find best-fit solutions to systems of linear equations that have no actual solution using least squares approximations