Math 1553

Section M (M01-M04)

Georgia Tech Fall 2020

Dan Margalit

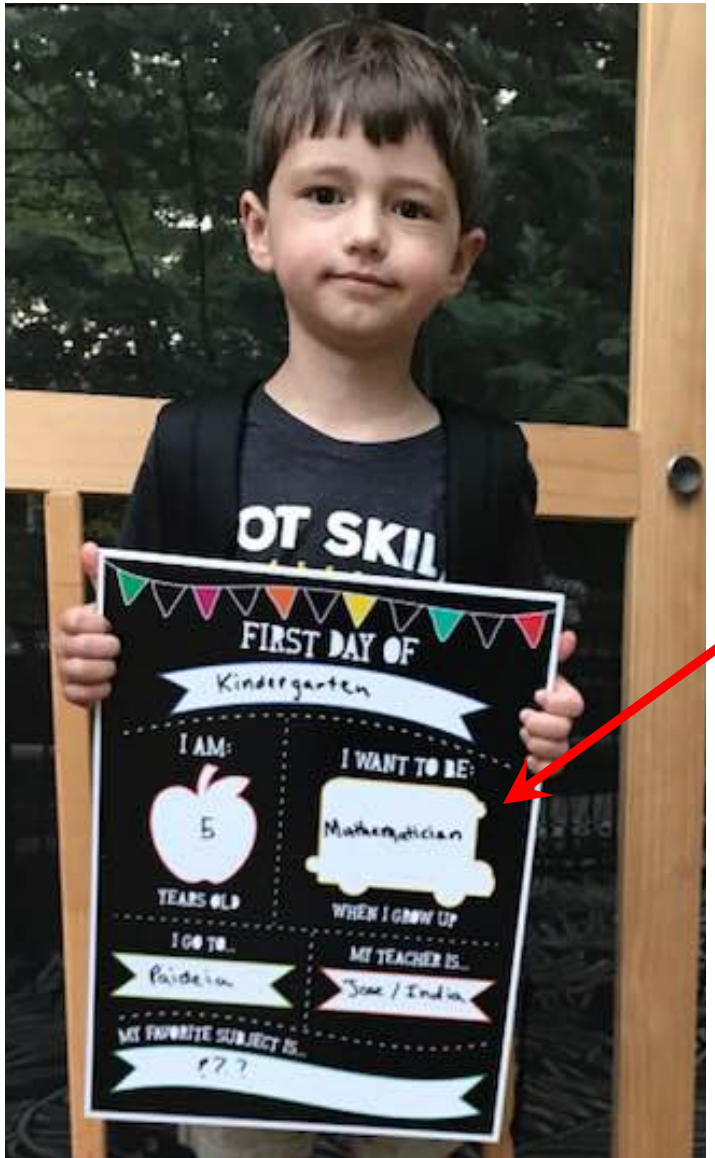
Me

About Me

DOB 03/06/1976
Sex M
Eyes HAZ
Hgt 5’-10”
Wgt 150 lb
Donor ❤️

More About Me

More About Me



Winning

More About Me

I like…

More About Me

I like…

- Cake

More About Me

I like…

- Cake
  - Chocolate

More About Me

I like…

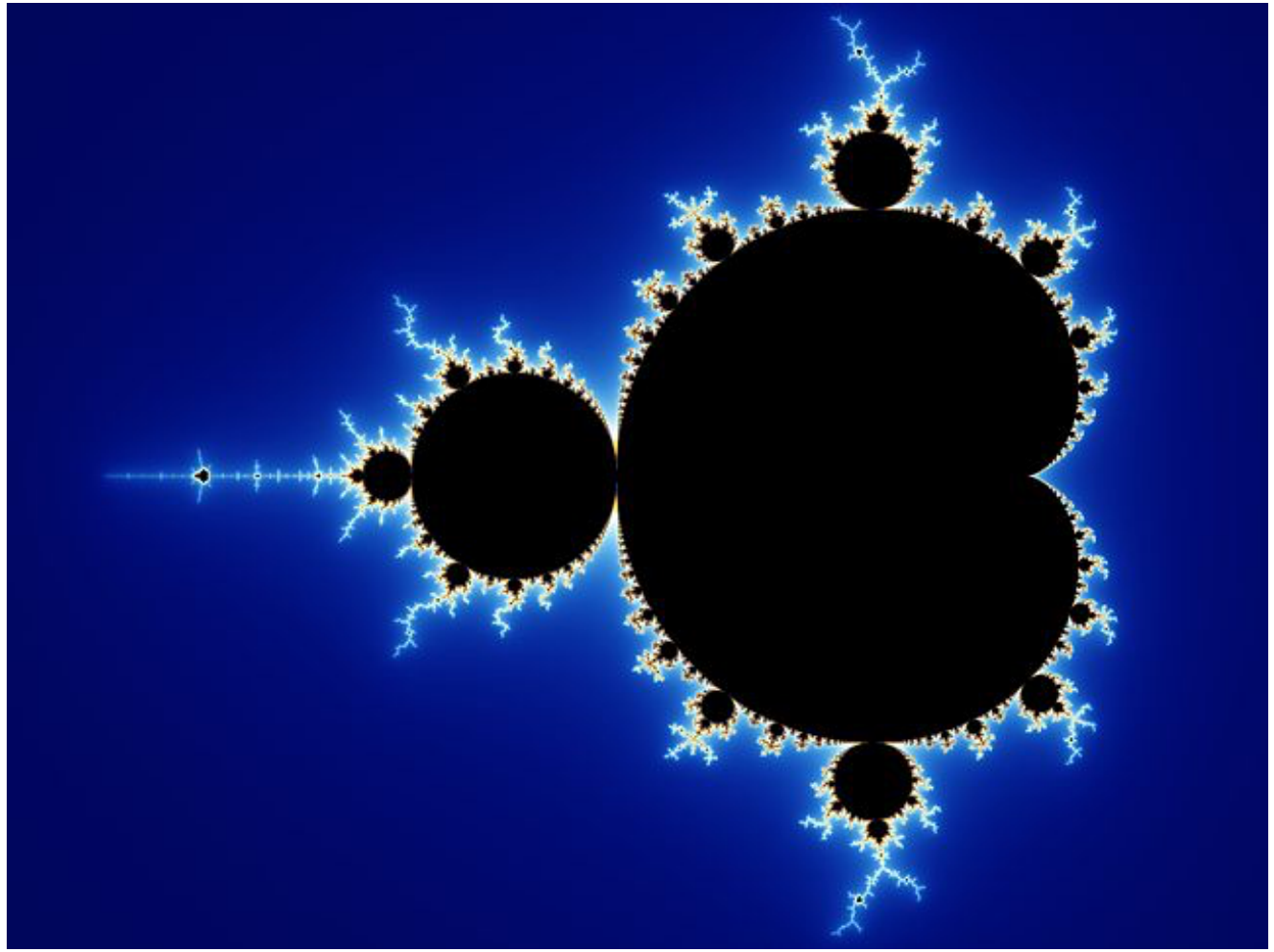
- Cake
  - Chocolate
  - Double Chocolate

More About Me

I like…

- Cake
  - Chocolate
  - Double Chocolate
  - Death by Chocolate

Even More About Me



The class

This class will be online.

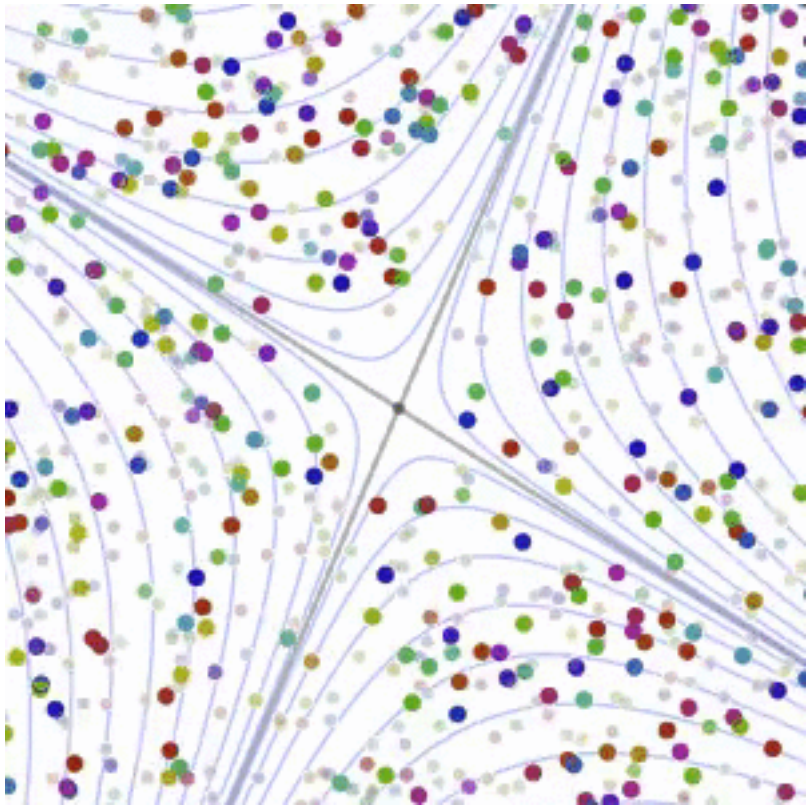
This class will be online.

And it will be

AWESOME

Textbook

Textbook



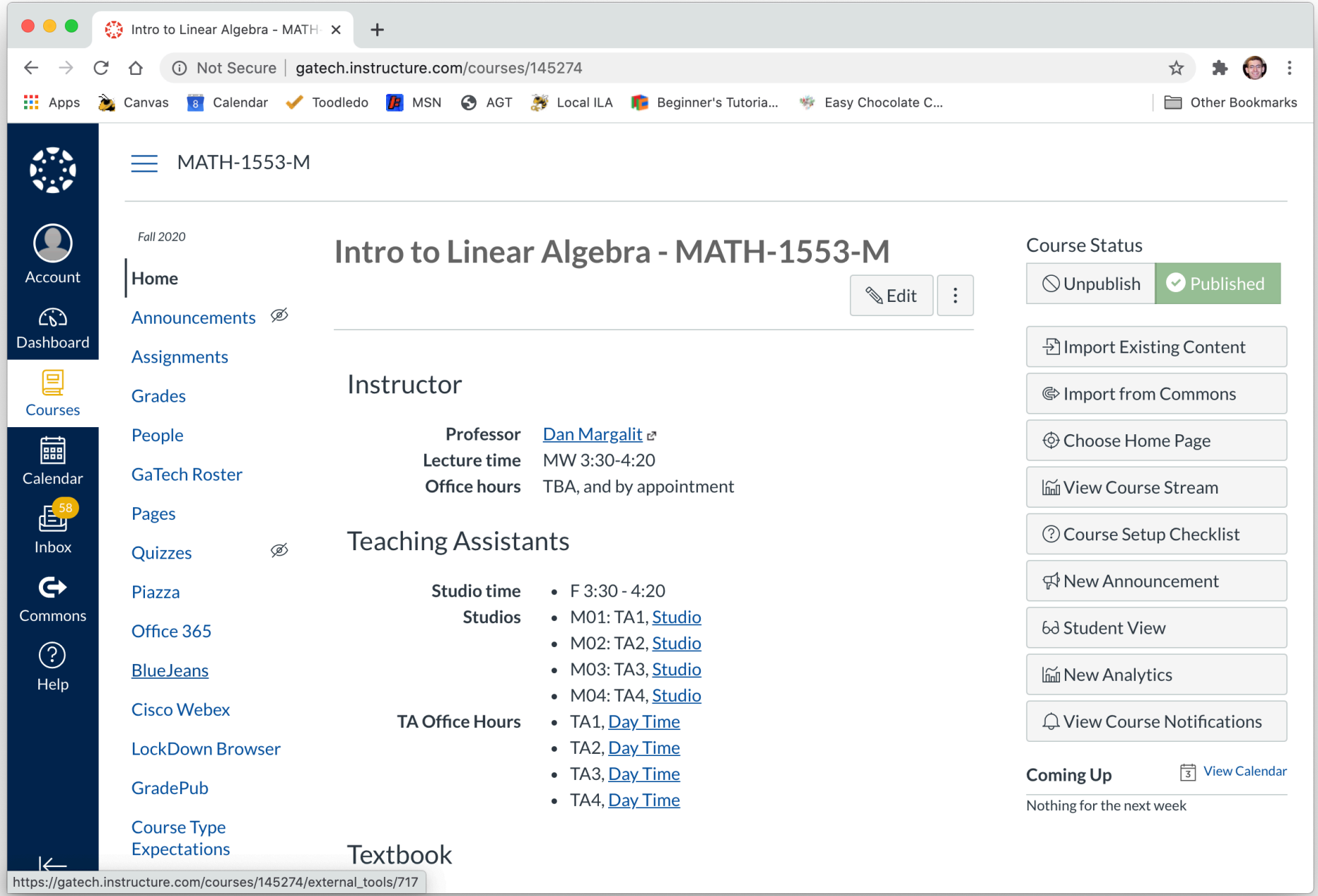
Interactive Linear Algebra

Dan Margalit & Joe Rabinoff

The textbook is free and online.

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

Canvas


Intro to Linear Algebra - MATH-
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Apps
Canvas
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MSN
AGT
Local ILA
Beginner's Tutoria...
Easy Chocolate C...
Other Bookmarks
MATH-1553-M
Account
Dashboard
Courses
Calendar
Inbox
58
Commons
Help
Fall 2020
Home
Announcements
Assignments
Grades
People
GaTech Roster
Pages
Quizzes
Piazza
Office 365
BlueJeans
Cisco Webex
LockDown Browser
GradePub
Course Type Expectations
Intro to Linear Algebra - MATH-1553-M
Edit
Instructor
Professor Dan Margalit
Lecture time MW 3:30-4:20
Office hours TBA, and by appointment
Teaching Assistants
Studio time F 3:30 - 4:20
Studios M01: TA1, Studio
M02: TA2, Studio
M03: TA3, Studio
M04: TA4, Studio
TA Office Hours TA1, Day Time
TA2, Day Time
TA3, Day Time
TA4, Day Time
Textbook
Course Status
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Published
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Import from Commons
Choose Home Page
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Course Setup Checklist
New Announcement
Student View
New Analytics
View Course Notifications
Coming Up
View Calendar
Nothing for the next week
https://gatech.instructure.com/courses/145274/external_tools/717

Intro to Linear Algebra - MATH

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Apps Canvas Calendar Toodledo MSN AGT Local ILA Beginner's Tutoria... Easy Chocolate C... Other Bookmarks

Account
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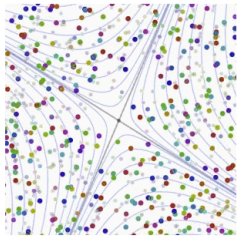
Help

Expectations
Discussions
Files
Syllabus
Outcomes
Rubrics
Modules
Conferences
Collaborations
Settings

Textbook

The textbook for the course is *Interactive Linear Algebra*, by Dan Margalit and Joe Rabinoff. Click on the icon below.



Syllabus

Here is the common syllabus for Math 1553 in Fall 2020.

Teams

Here is our Microsoft Teams page .

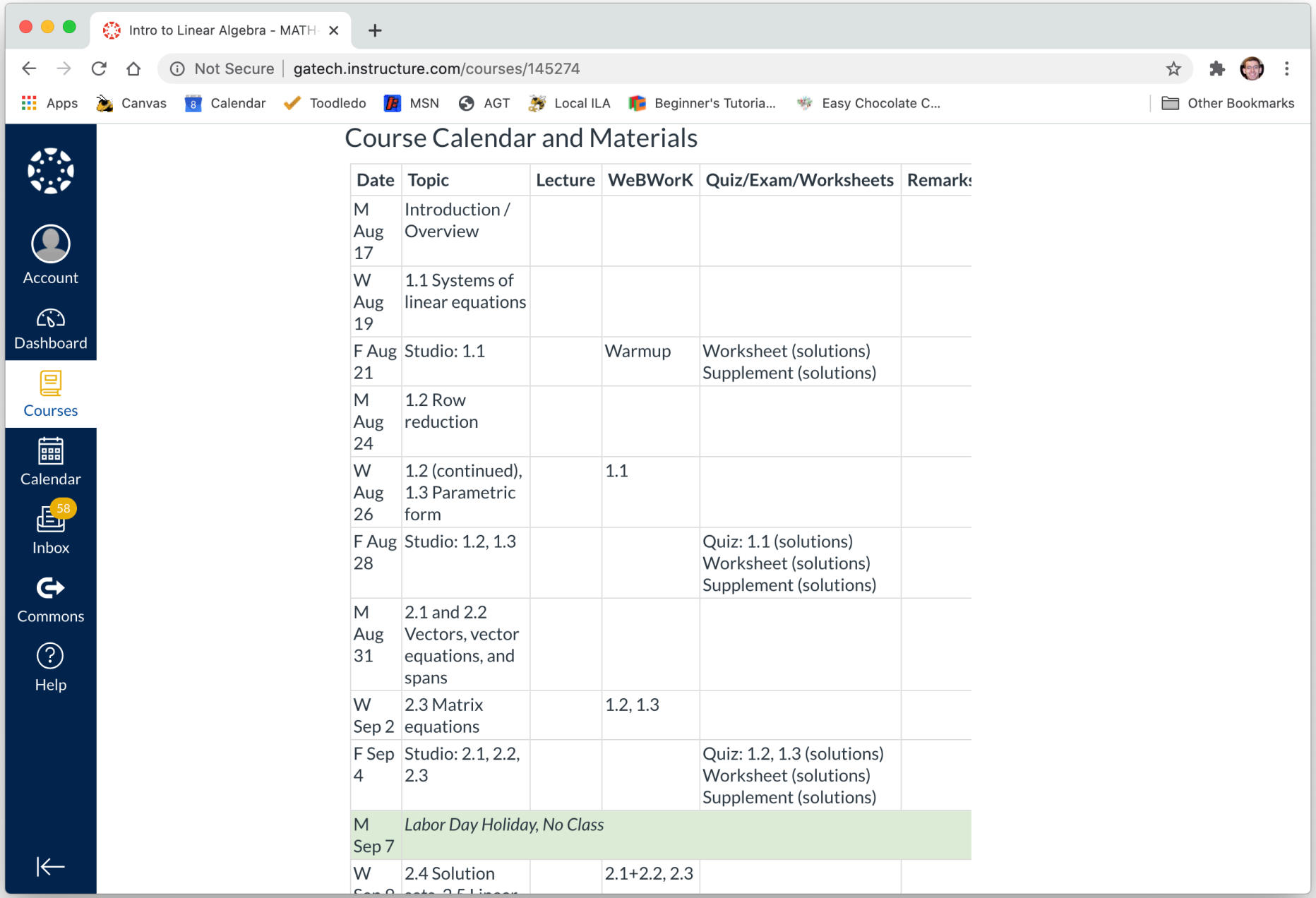
Other resources

Here is a reference sheet containing most theorems and definitions that you will learn (and be responsible for knowing) over the course of the semester. It will be tweaked as we cover the material.

Here is the interactive row reducer .

There are some games related to the course here .

You can play Lights Out here . If you want to know what this has to do with linear algebra, ask me!



Course Calendar and Materials

Date	Topic	Lecture	WeBWorK	Quiz/Exam/Worksheets	Remarks
M Aug 17	Introduction / Overview				
W Aug 19	1.1 Systems of linear equations				
F Aug 21	Studio: 1.1		Warmup	Worksheet (solutions) Supplement (solutions)	
M Aug 24	1.2 Row reduction				
W Aug 26	1.2 (continued), 1.3 Parametric form		1.1		
F Aug 28	Studio: 1.2, 1.3			Quiz: 1.1 (solutions) Worksheet (solutions) Supplement (solutions)	
M Aug 31	2.1 and 2.2 Vectors, vector equations, and spans				
W Sep 2	2.3 Matrix equations		1.2, 1.3		
F Sep 4	Studio: 2.1, 2.2, 2.3			Quiz: 1.2, 1.3 (solutions) Worksheet (solutions) Supplement (solutions)	
M Sep 7	*Labor Day Holiday, No Class*				
W	2.4 Solution		2.1+2.2, 2.3		

Teams

Microsoft Teams

On Microsoft Teams, you can find the lectures, and class discussion. Please familiarize yourself with both features.

Your first assignment

Mathematical Autobiography

The first assignment is to post a mathematical autobiography on Teams, due Fri.

Include:

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

Assessment

Grades!

Grades

Category	Percentage
Homework	20% (2 drops)
Quizzes	30% (1 drop)
Midterms	30%
Final Exam	20%

If 85% of Section M does the CIOS at the end of the semester, one more quiz is dropped. Also, there is an optional writing assignment that can replace another quiz.

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

Exams

Exam	Date
Midterm 1	Sep 18 @ 8 am – 8 pm
Midterm 2	Oct 16 @ 8 am – 8 pm
Midterm 3	Nov 20 @ 8 am – 8 pm
Final Exam	Dec 4 @ 9 am – 9 pm

Notify me ASAP if you have a conflict.

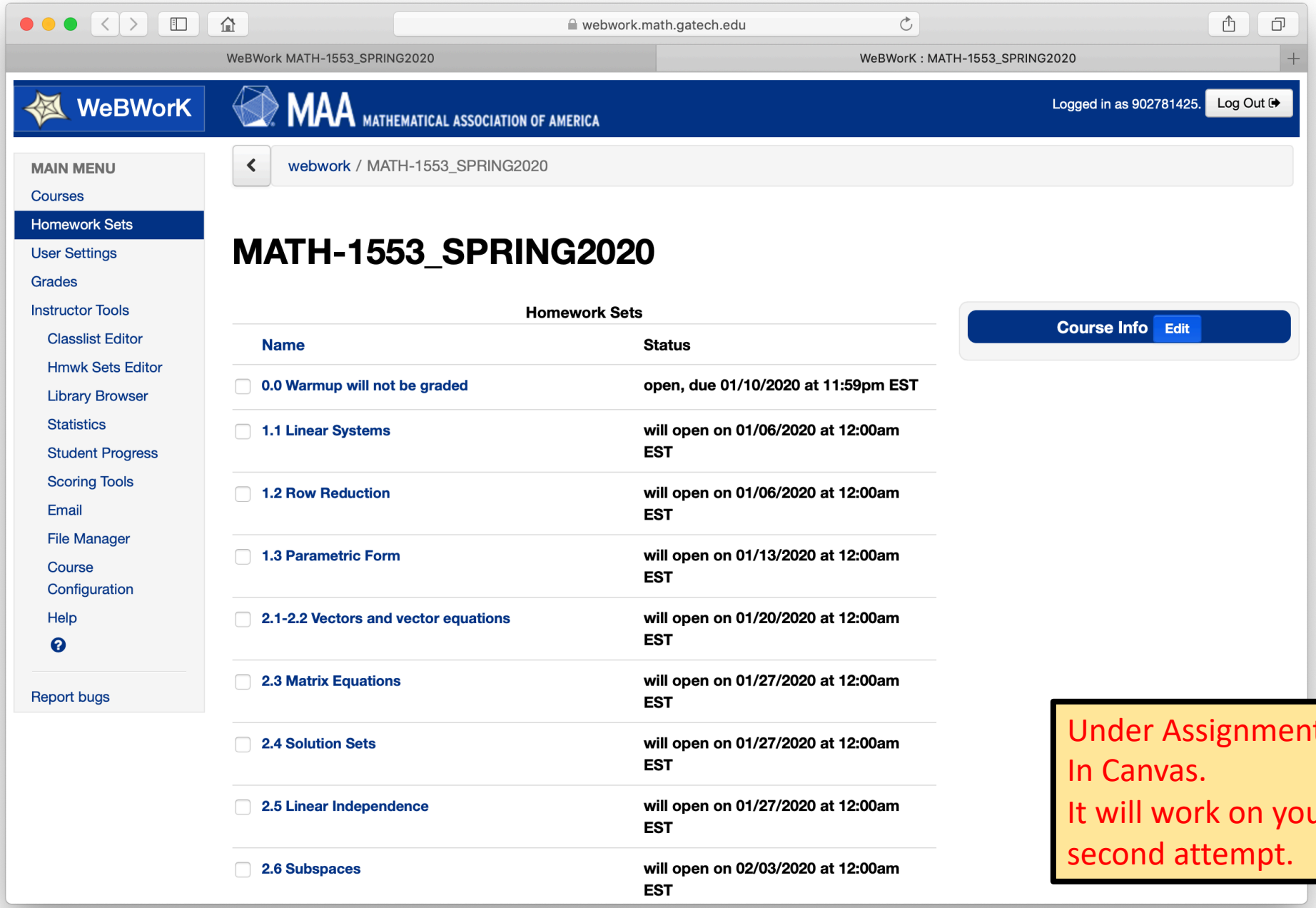
Quizzes

- There are 10 quizzes, on Fridays.
- Lowest quiz grade dropped (possibly two 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
- Generally due on Wed at 11:59 pm
- Normally as many tries as you want, but there are a handful of problems with a limited number of tries. The problem will say.
- One you get told your answer is correct, you are done with that problem.
- Two lowest scores dropped


webwork.math.gatech.edu
WeBWork MATH-1553_SPRING2020
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MAA MATHEMATICAL ASSOCIATION OF AMERICA
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Log Out
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
0.0 Warmup will not be graded
open, due 01/10/2020 at 11:59pm EST
1.1 Linear Systems
will open on 01/06/2020 at 12:00am EST
1.2 Row Reduction
will open on 01/06/2020 at 12:00am EST
1.3 Parametric Form
will open on 01/13/2020 at 12:00am EST
2.1-2.2 Vectors and vector equations
will open on 01/20/2020 at 12:00am EST
2.3 Matrix Equations
will open on 01/27/2020 at 12:00am EST
2.4 Solution Sets
will open on 01/27/2020 at 12:00am EST
2.5 Linear Independence
will open on 01/27/2020 at 12:00am EST
2.6 Subspaces
will open on 02/03/2020 at 12:00am EST
Course Info
Edit
Under Assignments
In Canvas.
It will work on your
second attempt.

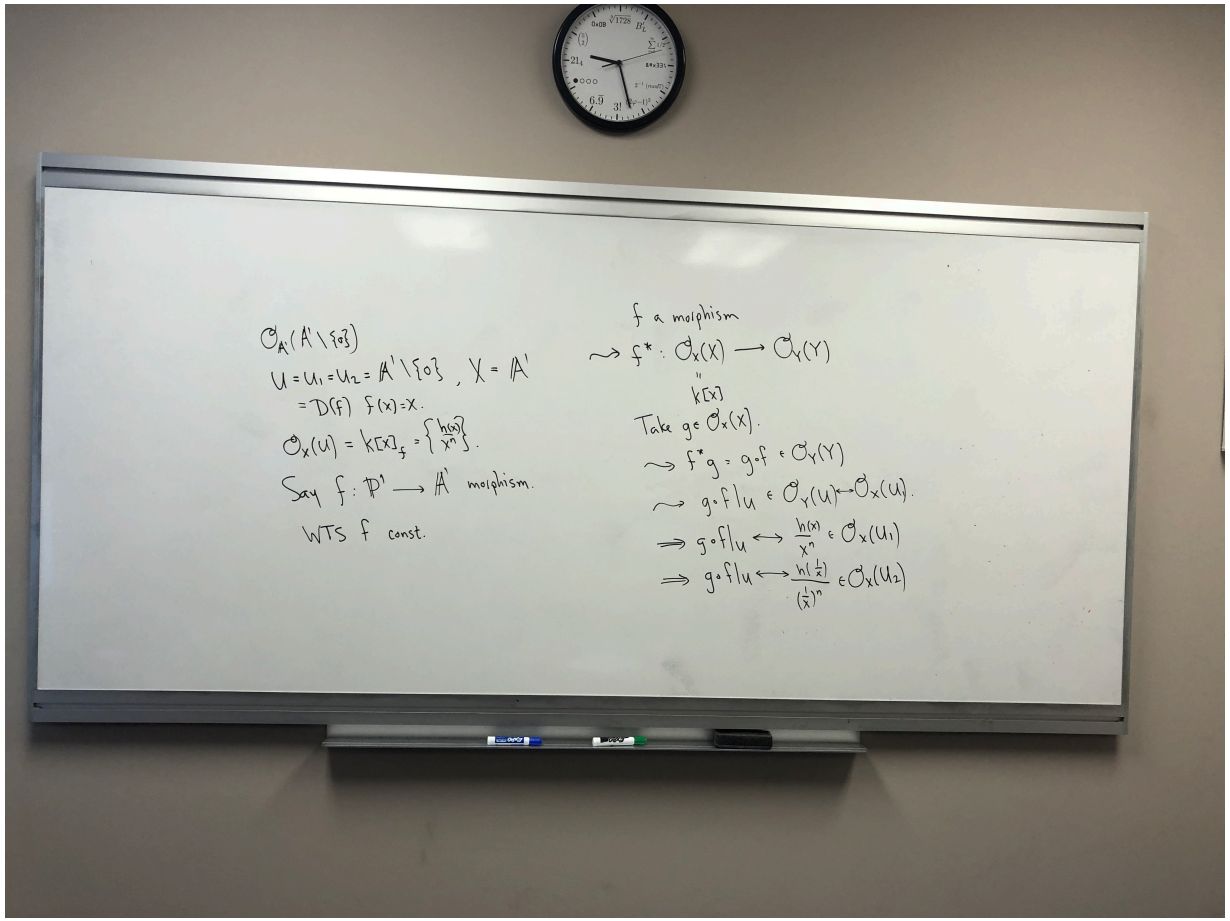
Optional Writing Assignment

- Find application of linear algebra to some field of study outside of mathematics.
- Write a 1-2 page summary in your own words (500-1000 words, but don’t use a word counter)
- Cite all references used
- Can be completed any time.
- You must explain any linear algebra that we have not yet covered in class
- Post on Teams in the Writing Assignment channel
- Replaces your lowest quiz grade

Advice, etc.

Office Hours

- Microsoft Teams
- Times to be announced
- You should come!
- Ok if you don’t have questions



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.

Honor Code

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

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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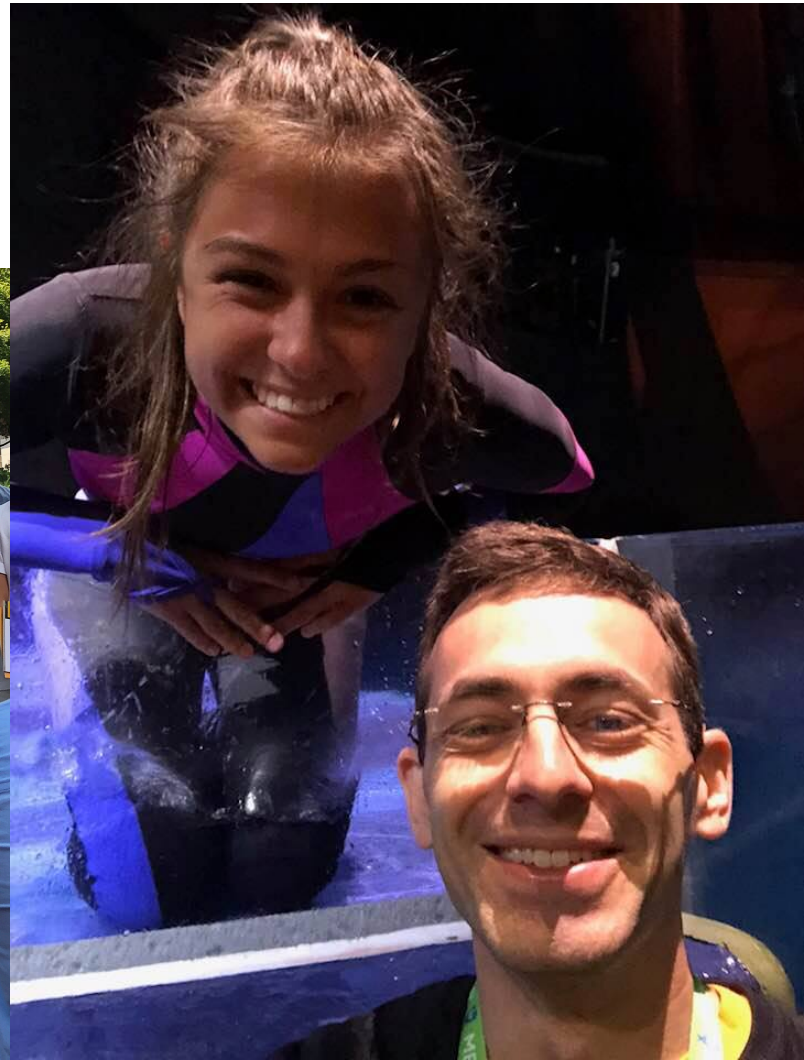


Asking questions

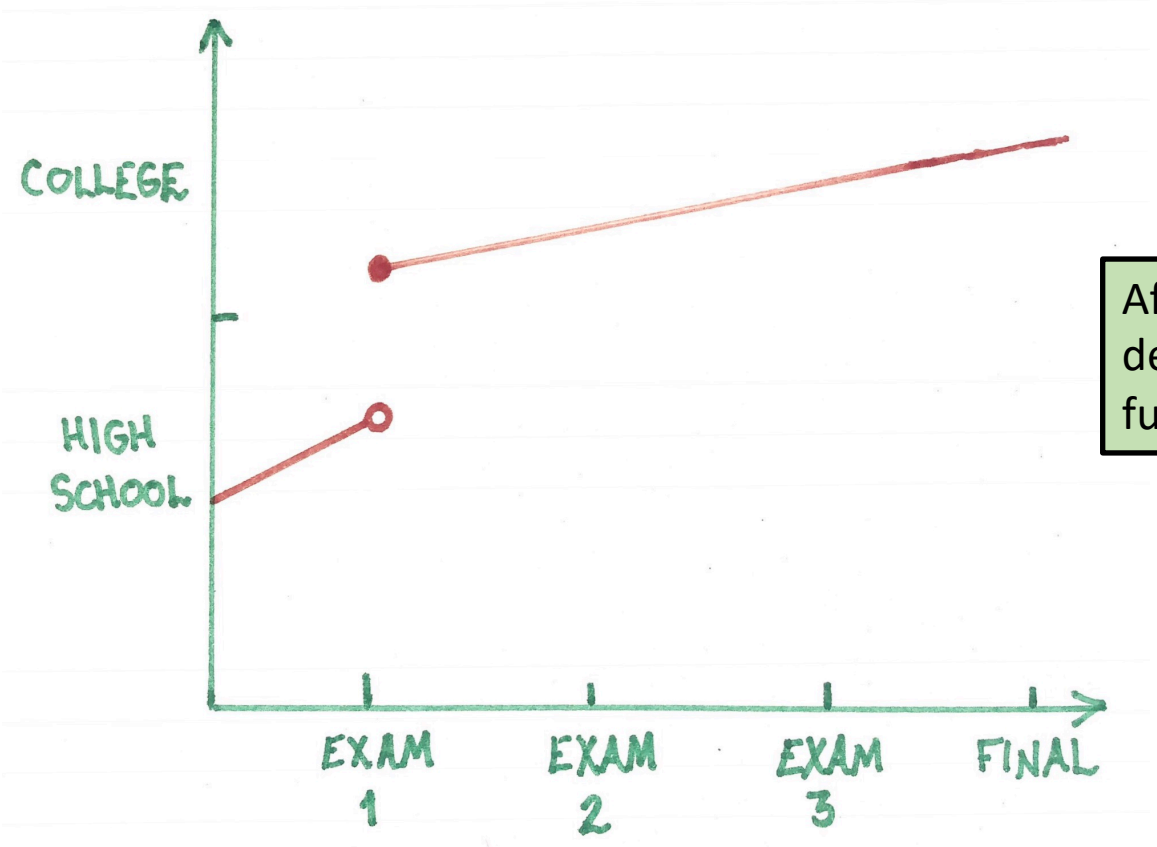
- Please ask questions!
- Ok if your answers are not correct
- Will answer as many questions as I can

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.

Difficulty of the Course



After the first exam, definitions will become fundamentally important!

In-person meeting

November 13, during Studio time. Details to be announced.

Good luck!

Math 1553: Introduction to Linear Algebra

Fall 2020, Georgia Tech

Dan Margalit

Linear. Algebra.

What is Linear Algebra?

Linear

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.

$$\begin{aligned}
3x_1 + 4x_2 + 10x_3 + 19x_4 - 2x_5 - 3x_6 &= 141 \\
7x_1 + 2x_2 - 13x_3 - 7x_4 + 21x_5 + 8x_6 &= 2567 \\
-x_1 + 9x_2 + \tfrac{3}{2}x_3 + x_4 + 14x_5 + 27x_6 &= 26 \\
\tfrac{1}{2}x_1 + 4x_2 + 10x_3 + 11x_4 + 2x_5 + x_6 &= -15
\end{aligned}$$

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:

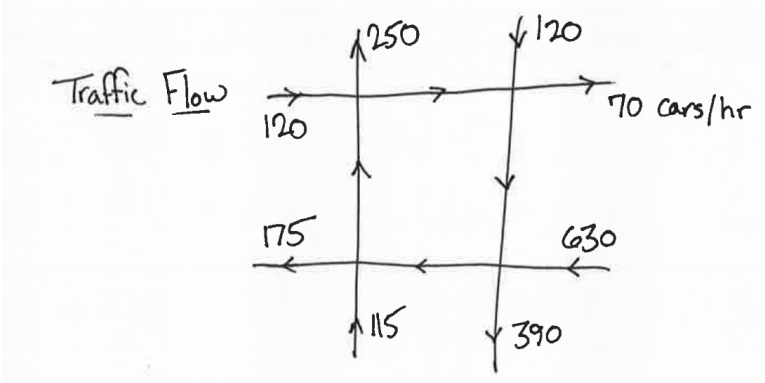
$$Ax = b \qquad \text{or}$$

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

$$Ax \approx x$$

Applications of Linear Algebra

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



Applications of Linear Algebra

Chemistry: Balancing reaction equations

$$\_\text{x}\_\ C_2H_6 + \_\text{y}\_\ O_2 \rightarrow \_\text{z}\_\ CO_2 + \_\text{w}\_\ H_2O$$

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 I know the population in 2016 (in terms of the number of first, second, and third year rabbits), then what is the population in 2017?

Say the numbers of first, second, and third year rabbits in year n are:

$$F_n, S_n, T_n$$

Demo

Rabbit populations

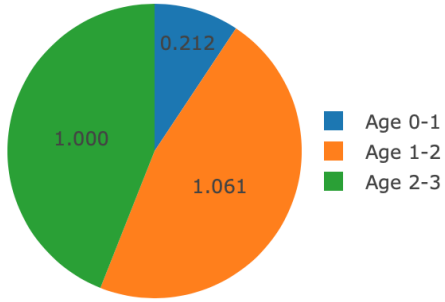
Randomize starting population

Age 0-1 7

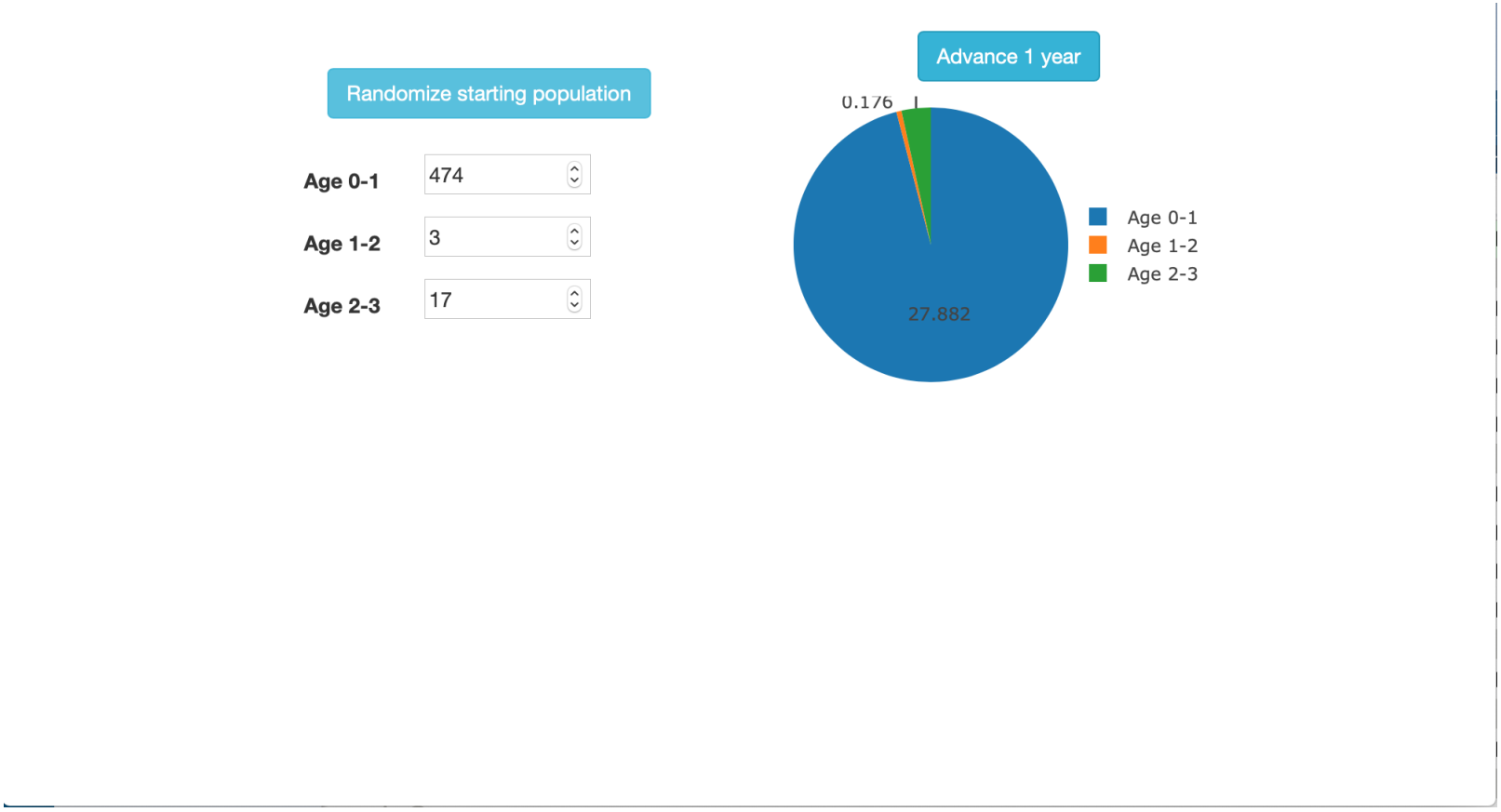
Age 1-2 35

Age 2-3 33

Advance 1 year



Rabbit populations

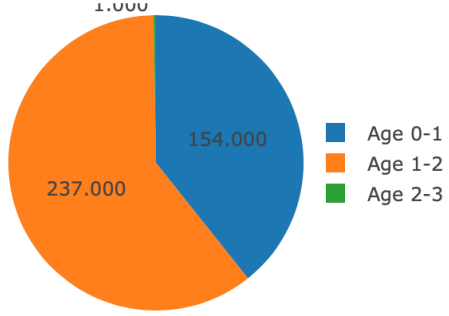


Rabbit populations

Randomize starting population

Advance 1 year

Age 0-1	154
Age 1-2	237
Age 2-3	1

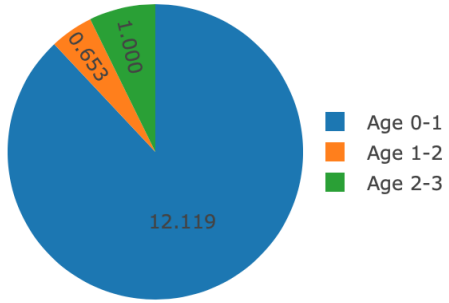


Rabbit populations

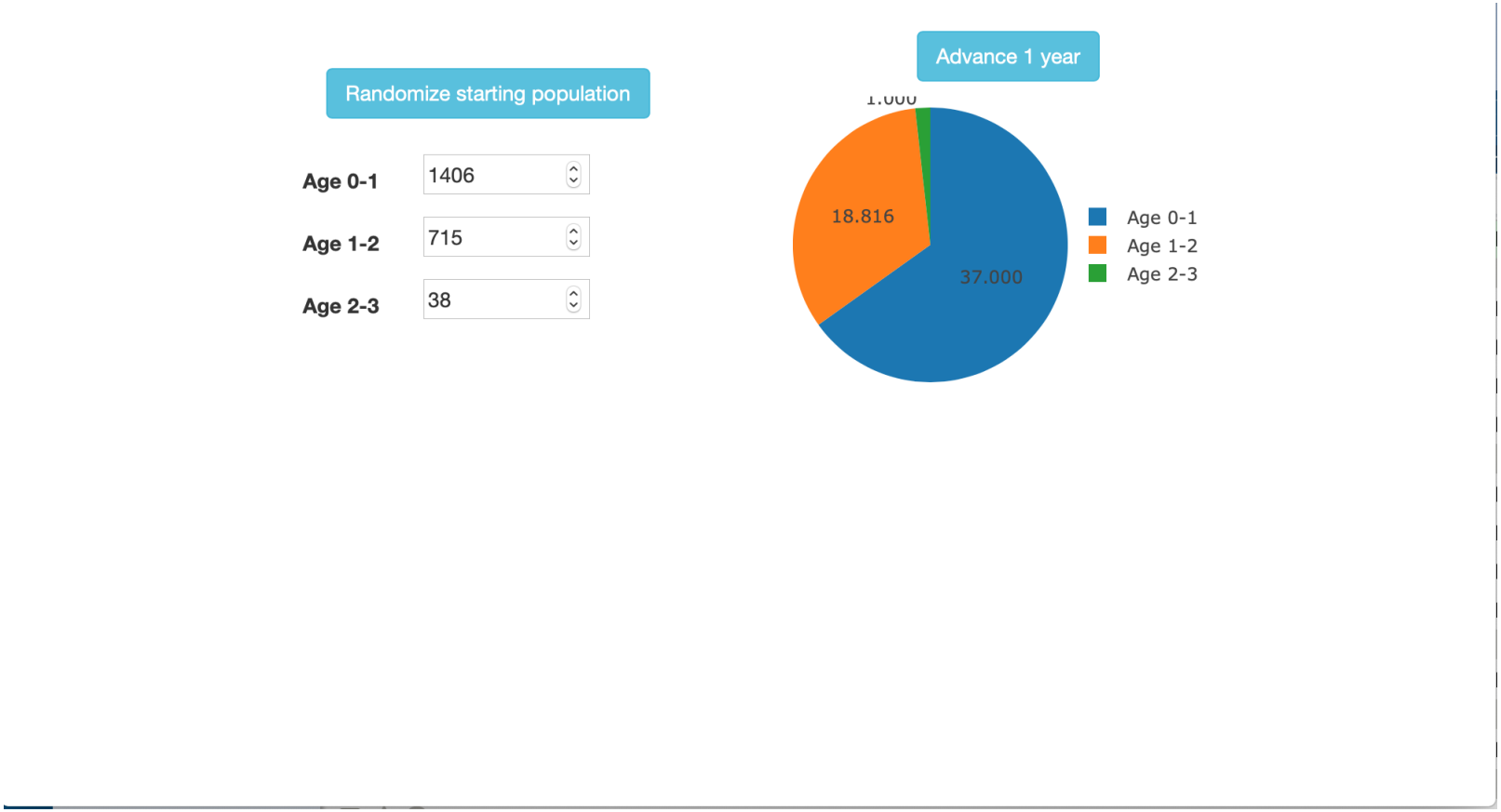
Randomize starting population

Advance 1 year

Age 0-1	1430
Age 1-2	77
Age 2-3	118



Rabbit populations

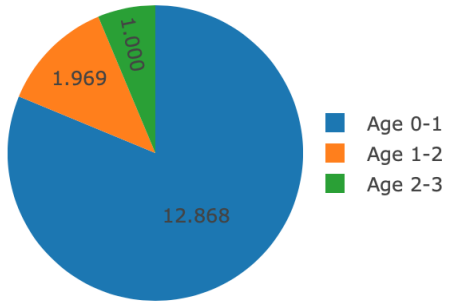


Rabbit populations

Randomize starting population

Advance 1 year

Age 0-1	4594
Age 1-2	703
Age 2-3	357



Rabbit populations

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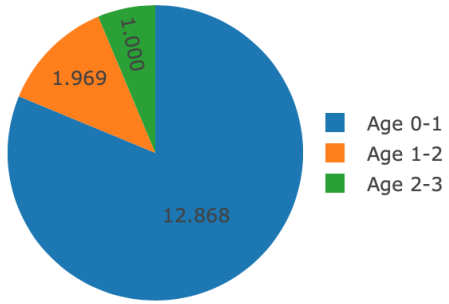
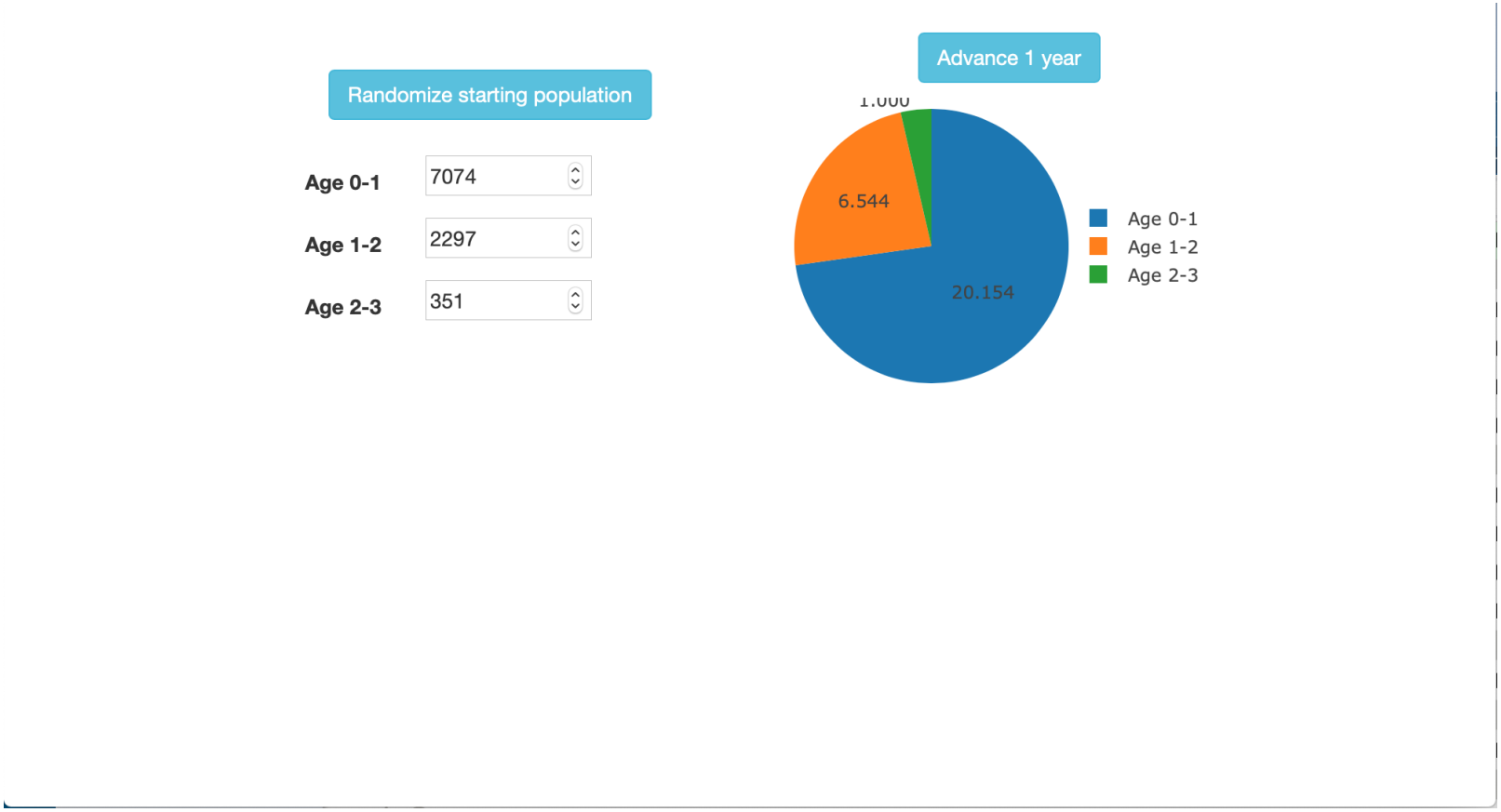
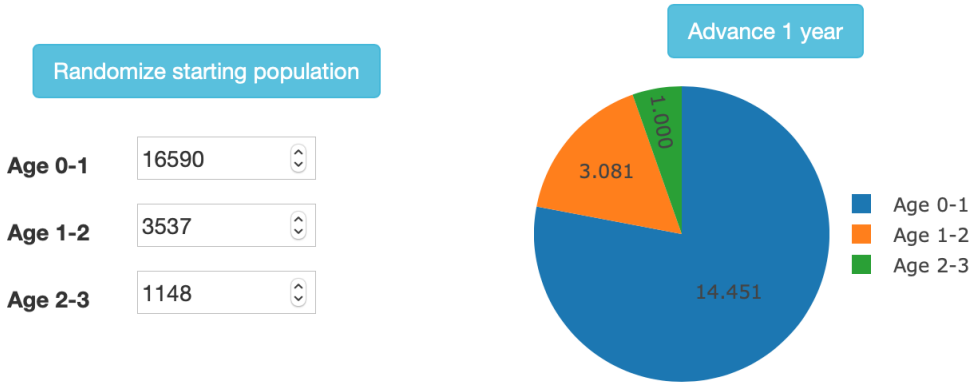


Rabbit populations



Rabbit populations

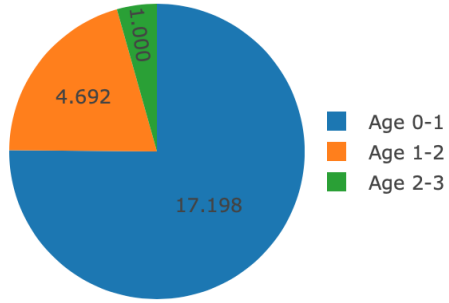


Rabbit populations

Randomize starting population

Advance 1 year

Age 0-1	30406
Age 1-2	8295
Age 2-3	1768

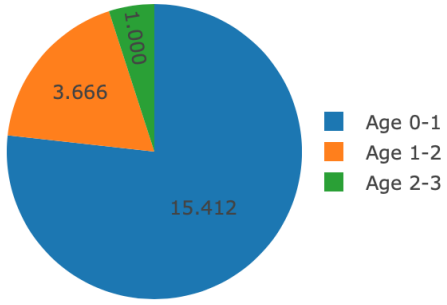


Rabbit populations

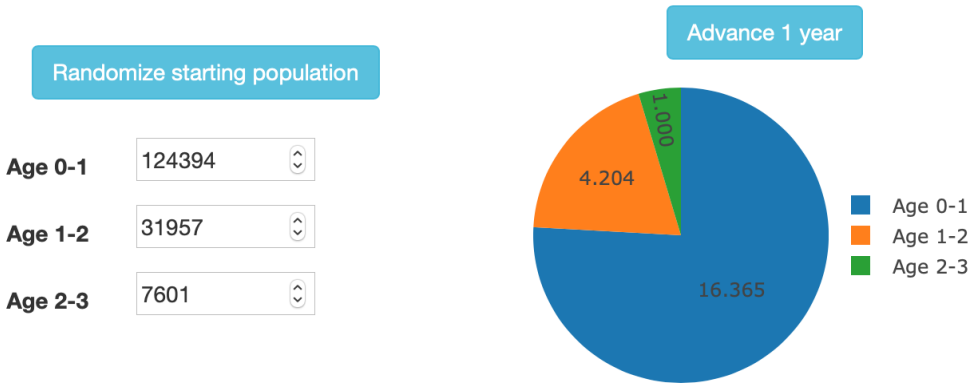
Randomize starting population

Advance 1 year

Age 0-1	63914
Age 1-2	15203
Age 2-3	4147



Rabbit populations

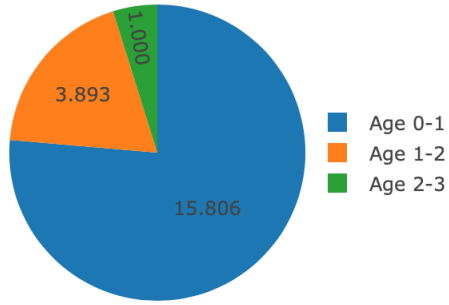


Rabbit populations

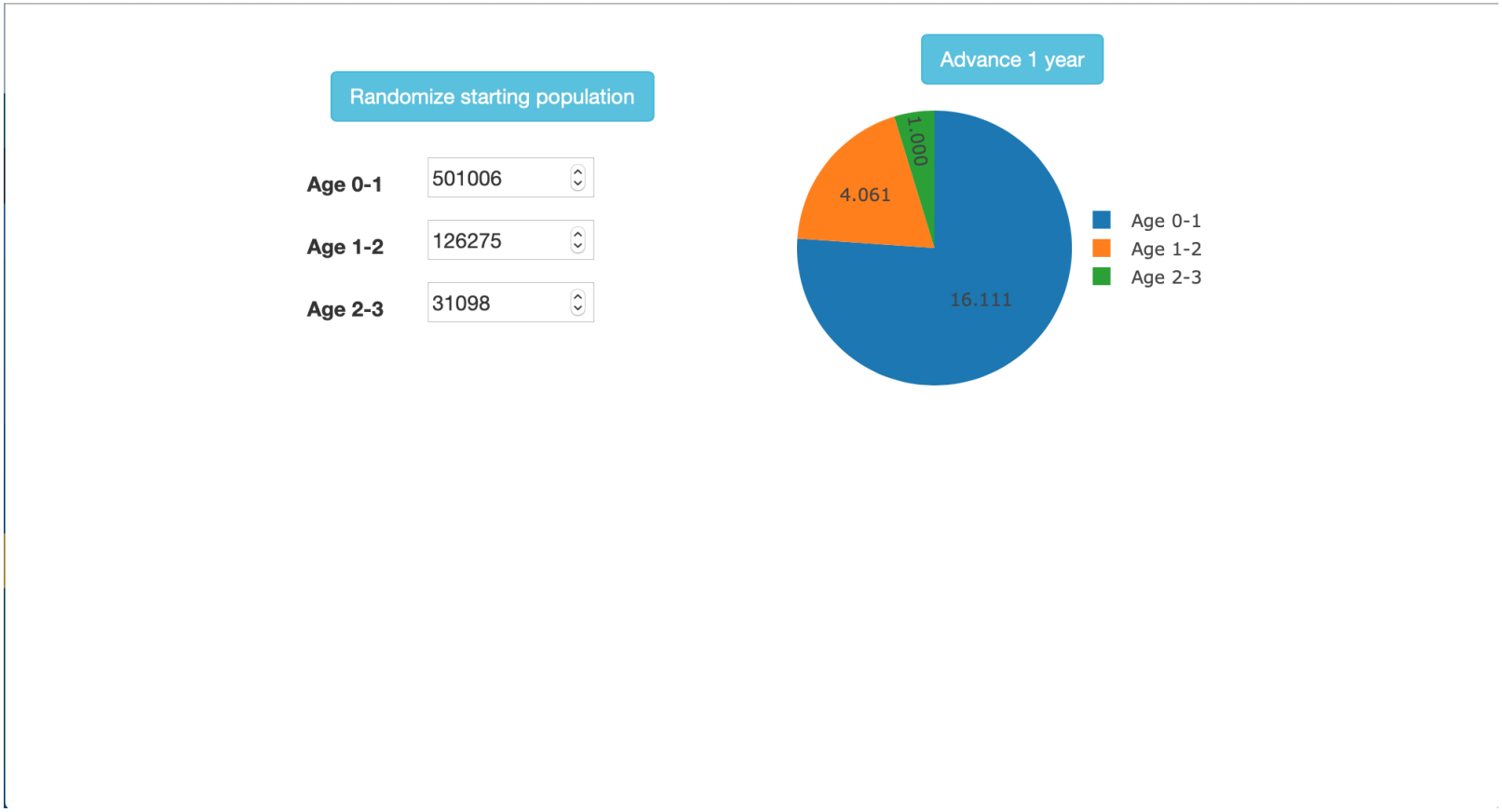
Randomize starting population

Age 0-1	252550
Age 1-2	62197
Age 2-3	15978

Advance 1 year



Rabbit populations

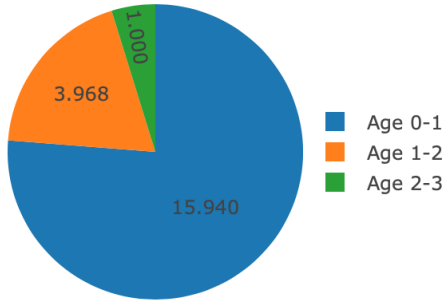


Rabbit populations

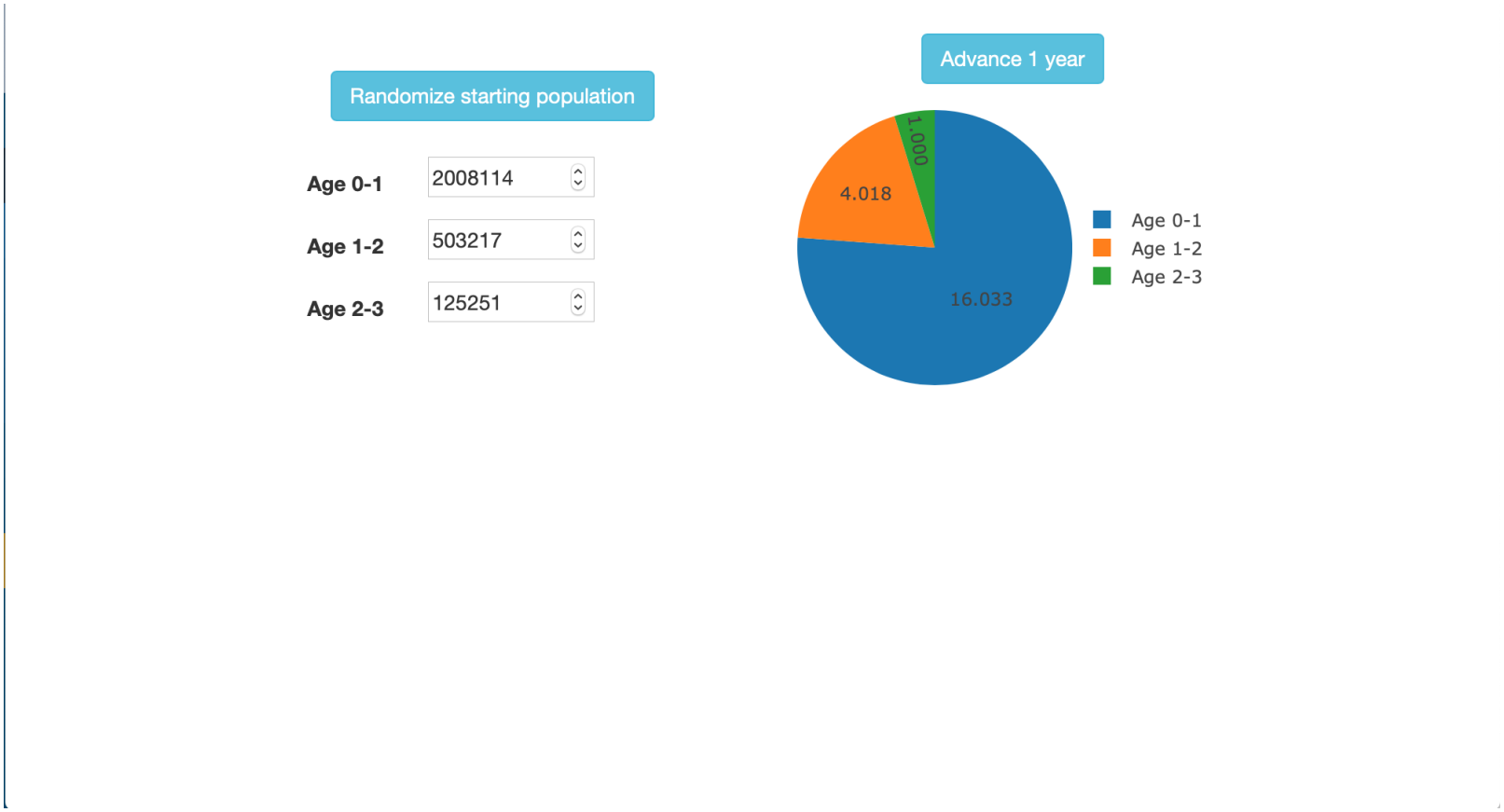
Randomize starting population

Age 0-1	1006434
Age 1-2	250503
Age 2-3	63137

Advance 1 year



Rabbit populations



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 $Ax = \lambda x$

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

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 $Ax = b$

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