Math 1553
Introduction to Linear Algebra

School of Mathematics
Georgia Institute of Technology

Math 1553

Web Sites

My Web Site

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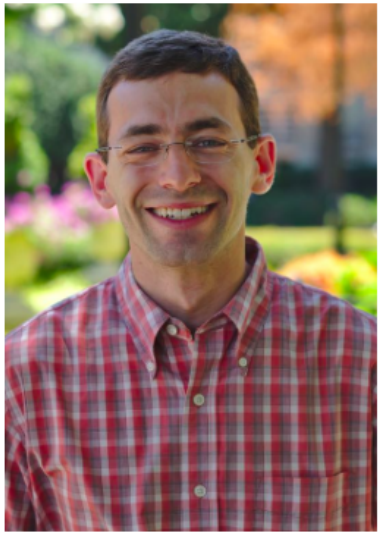
people.math.gatech.edu

Dan Margalit About Team Research Books 1553 Teaching REU

I am a Professor in the School of Mathematics at Georgia Institute of Technology. My research lies in the intersection of low-dimensional topology and geometric group theory. I mainly focus on mapping class groups of surfaces, that is, the symmetries of surfaces. I have published a number of articles and three books on these topics.

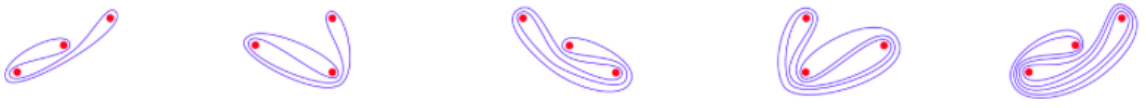


Some activities I am involved in:

- Topology Students Workshop
- Topology Students Resource
- Algebraic & Geometric Topology
- Geometry-Topology Seminar (mailing list)
- REU

Conferences and Special Sessions I am currently organizing:

- Tech Topology Conference
- Mathematical Congress of the Americas
- No Boundaries: Groups in Algebra, Geometry, and Topology



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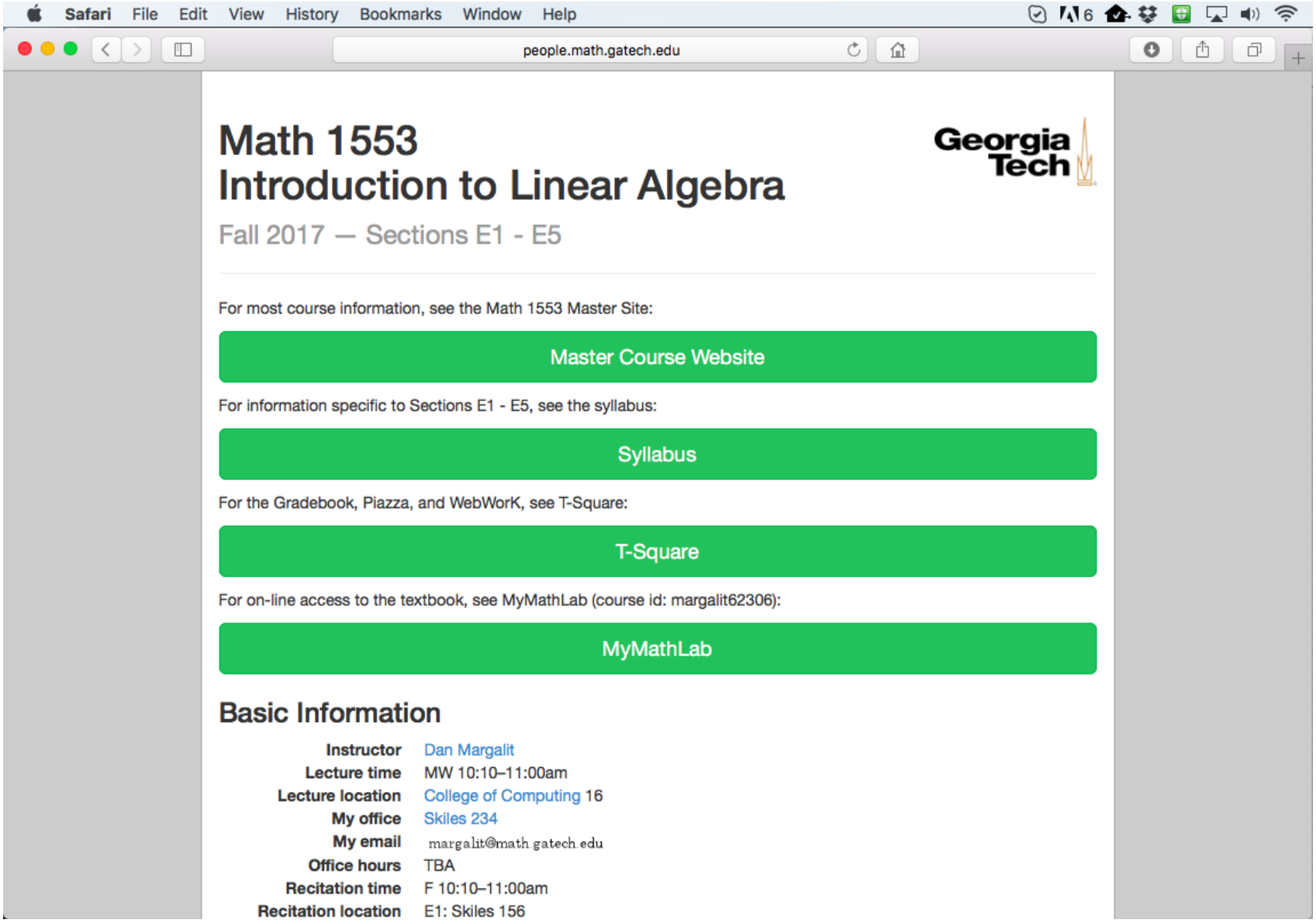
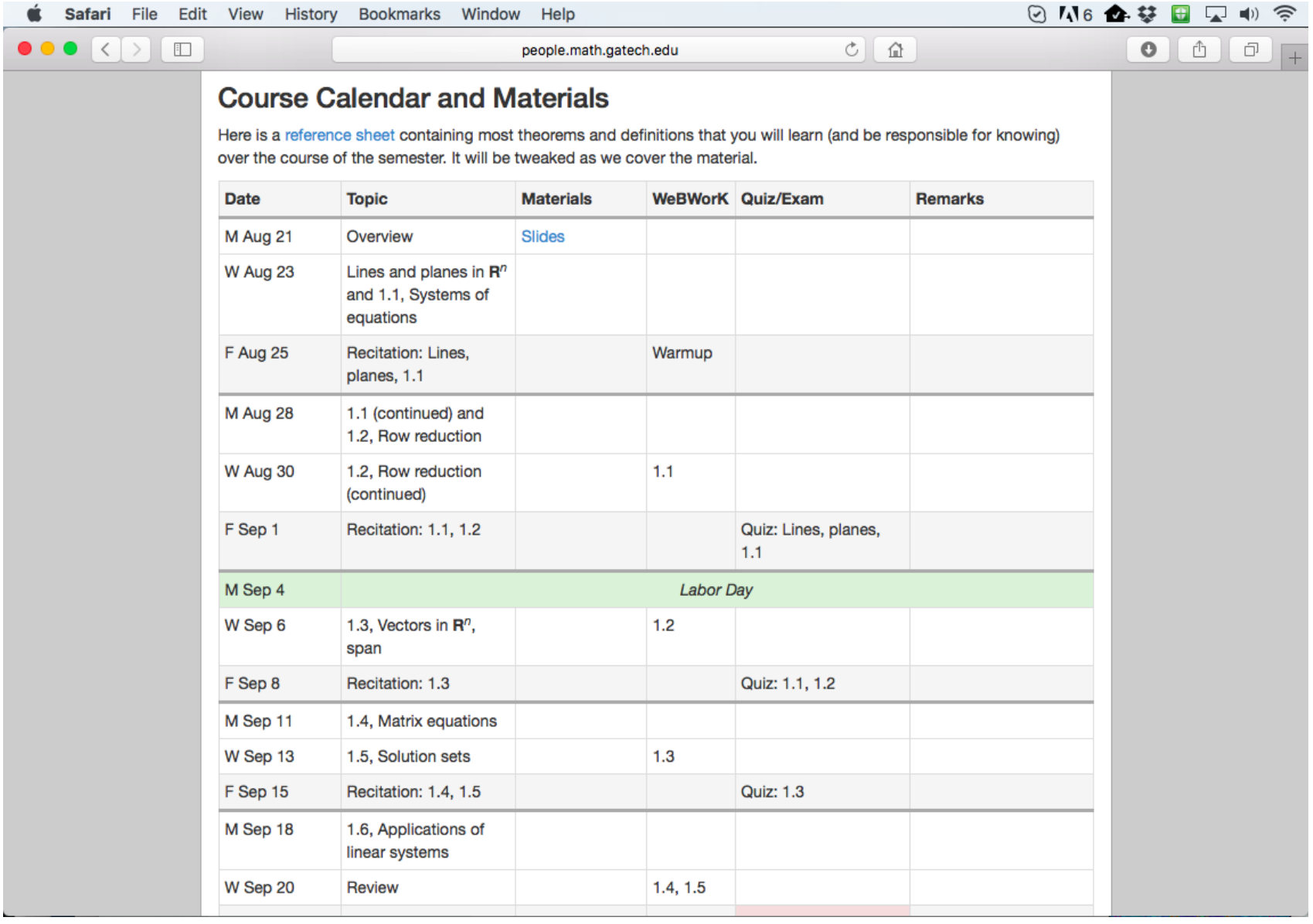
Math 1553 E1 - E5 Web Site



Math 1553 E1 - E5 Web Site



Course Calendar and Materials

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.

Date	Topic	Materials	WeBWorK	Quiz/Exam	Remarks
M Aug 21	Overview	Slides			
W Aug 23	Lines and planes in $\mathbf{R}^n$ and 1.1, Systems of equations				
F Aug 25	Recitation: Lines, planes, 1.1		Warmup		
M Aug 28	1.1 (continued) and 1.2, Row reduction				
W Aug 30	1.2, Row reduction (continued)		1.1		
F Sep 1	Recitation: 1.1, 1.2			Quiz: Lines, planes, 1.1	
M Sep 4	*Labor Day*				
W Sep 6	1.3, Vectors in $\mathbf{R}^n$, span		1.2		
F Sep 8	Recitation: 1.3			Quiz: 1.1, 1.2	
M Sep 11	1.4, Matrix equations				
W Sep 13	1.5, Solution sets		1.3		
F Sep 15	Recitation: 1.4, 1.5			Quiz: 1.3	
M Sep 18	1.6, Applications of linear systems				
W Sep 20	Review		1.4, 1.5		

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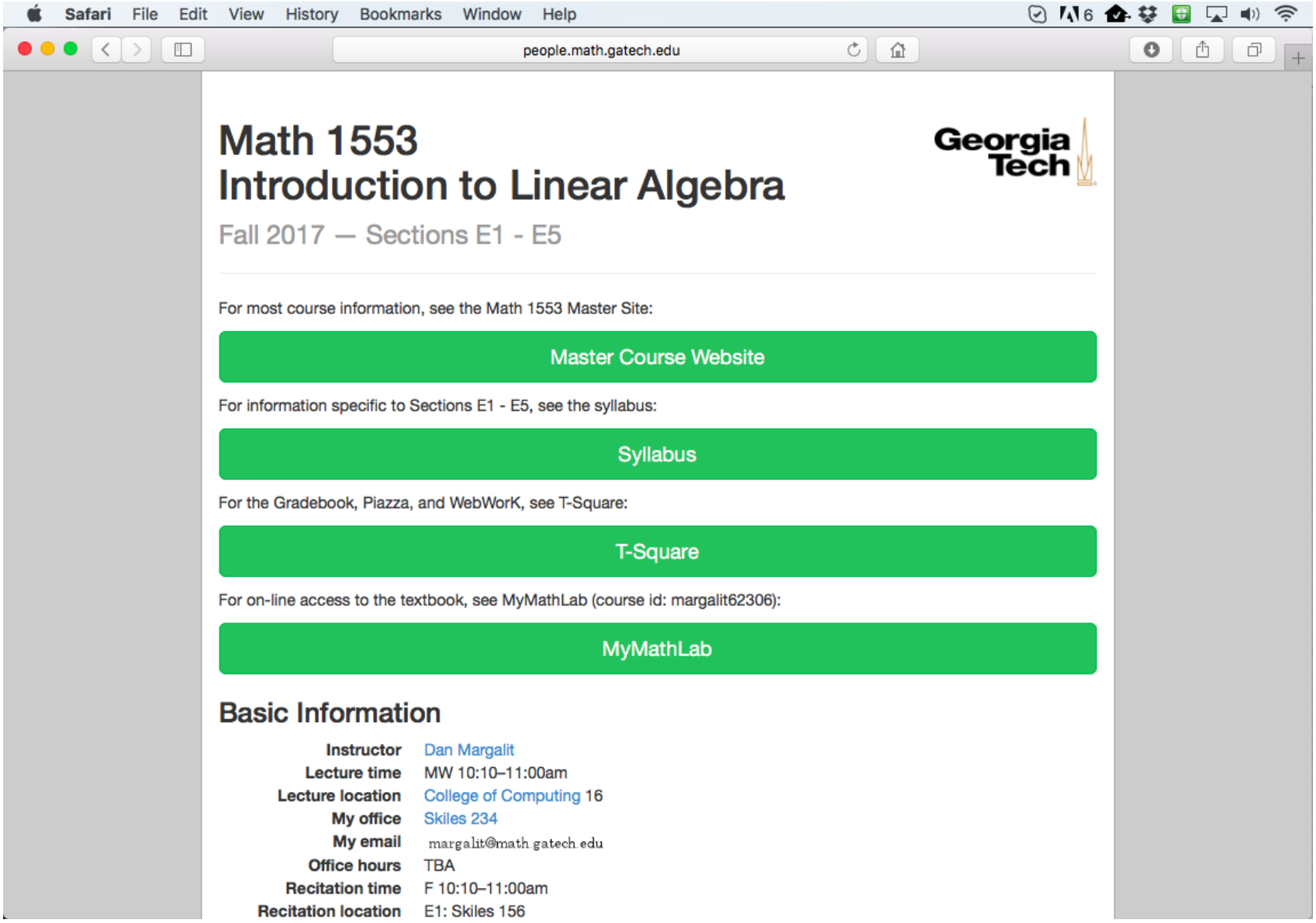
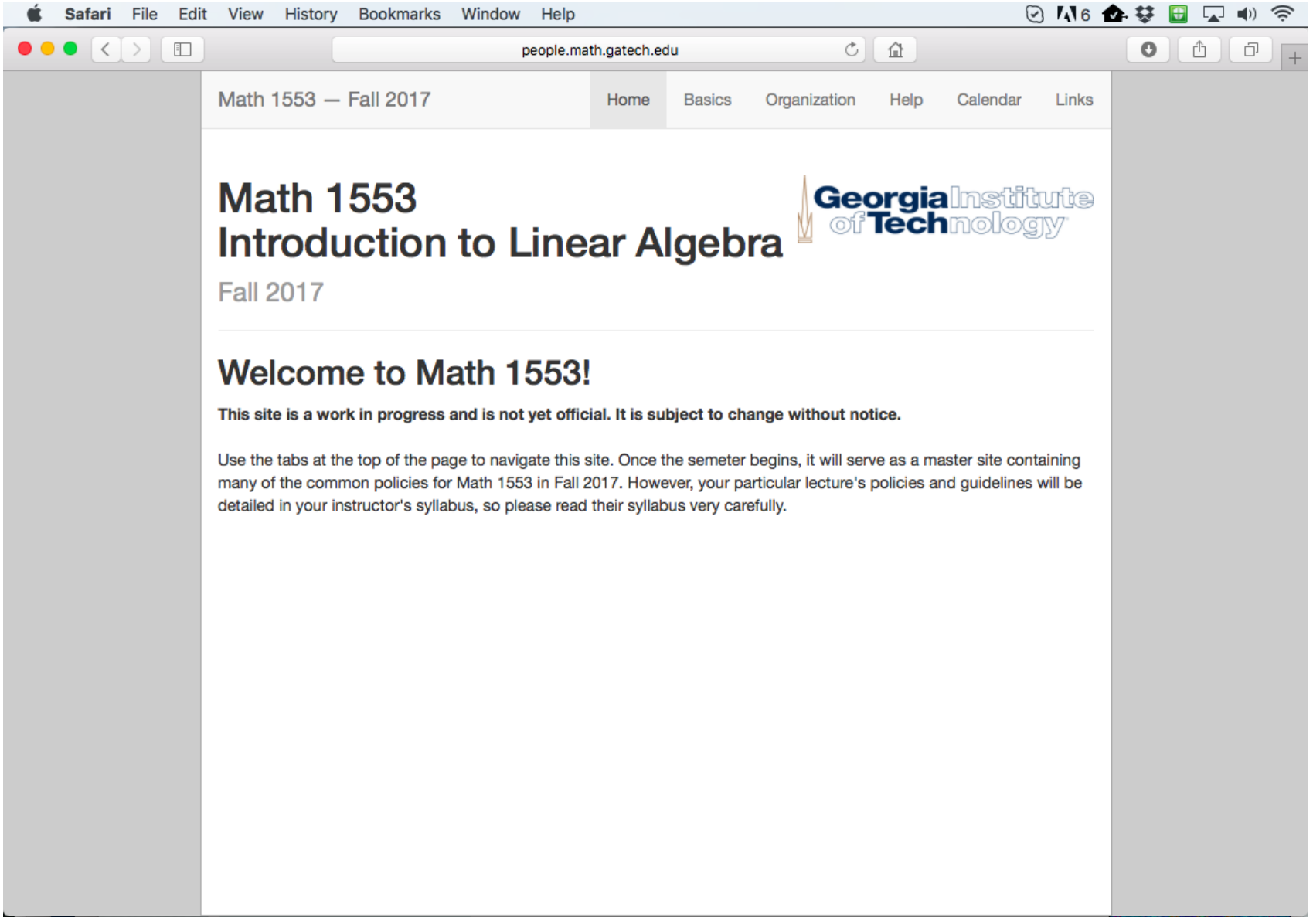
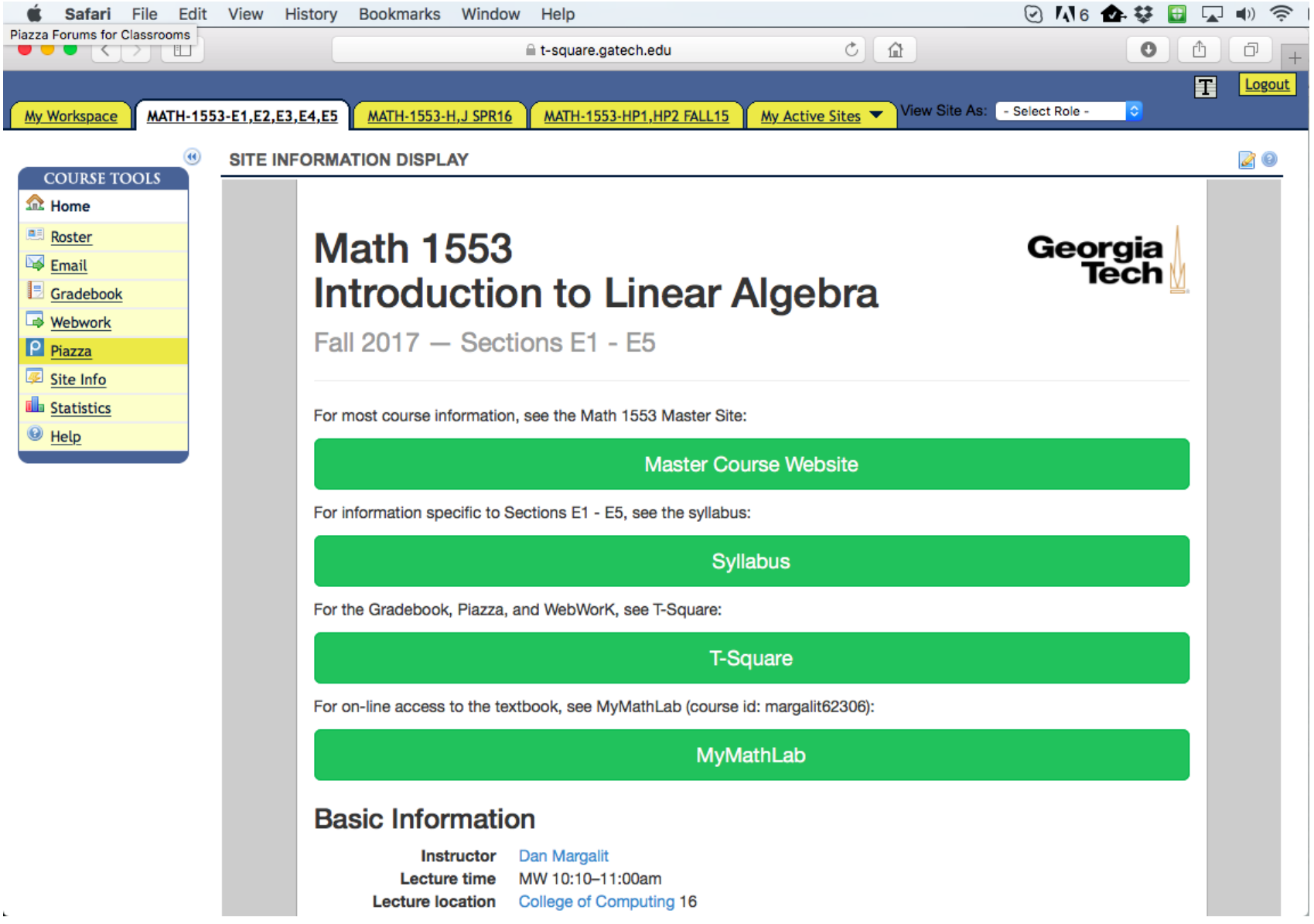


Math 1553 Master Web Site



T-Square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MATH-1553-HP1,HP2 FALL15
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Fall 2017 — Sections E1 - E5
For most course information, see the Math 1553 Master Site:
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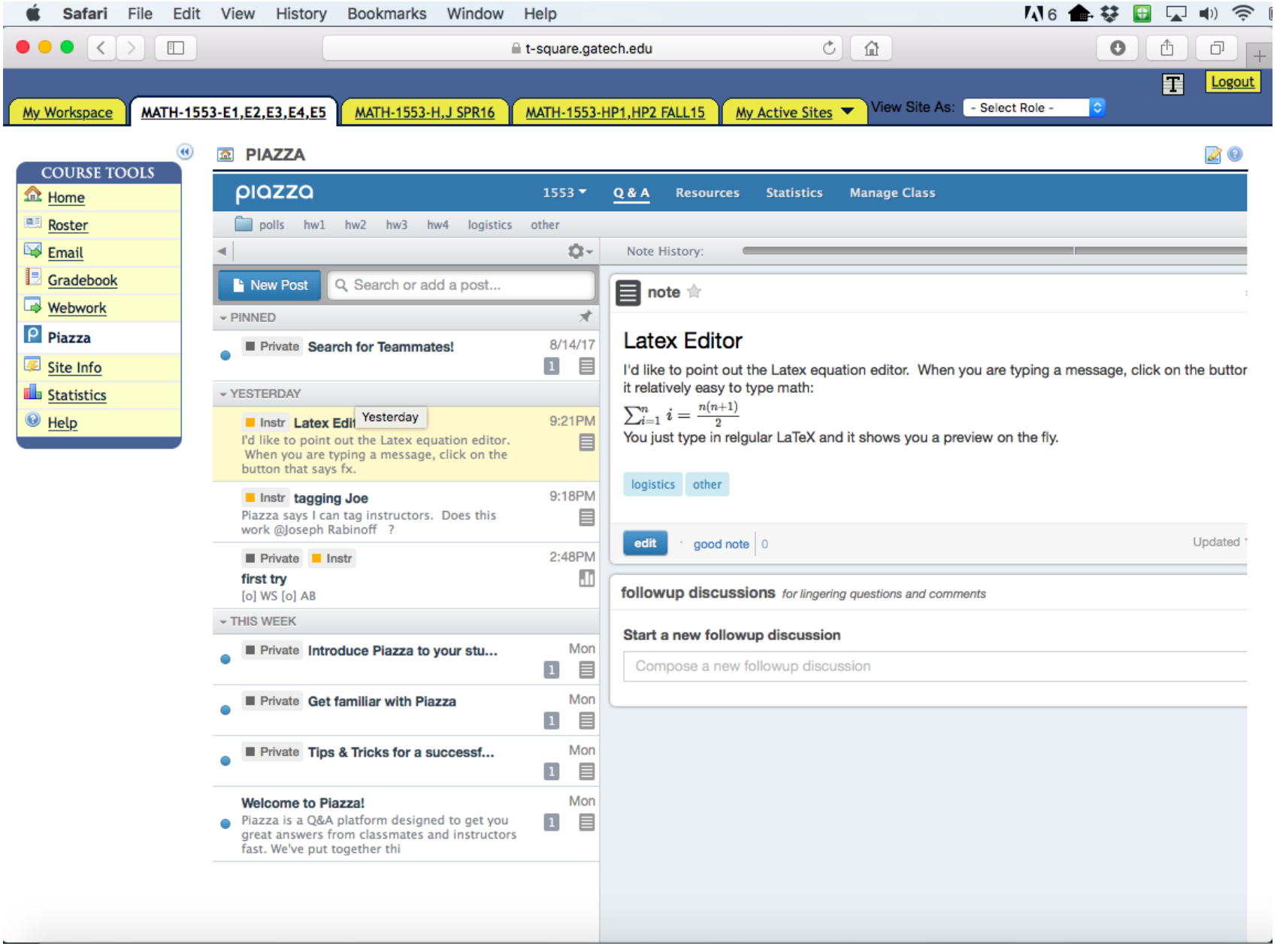
For information specific to Sections E1 - E5, see the syllabus:
Syllabus
For the Gradebook, Piazza, and WebWorK, see T-Square:
T-Square
For on-line access to the textbook, see MyMathLab (course id: margalit62306):
MyMathLab
Basic Information
Instructor Dan Margalit
Lecture time MW 10:10–11:00am
Lecture location College of Computing 16

Piazza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Private Tips & Tricks for a successf...
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Compose a new followup discussion

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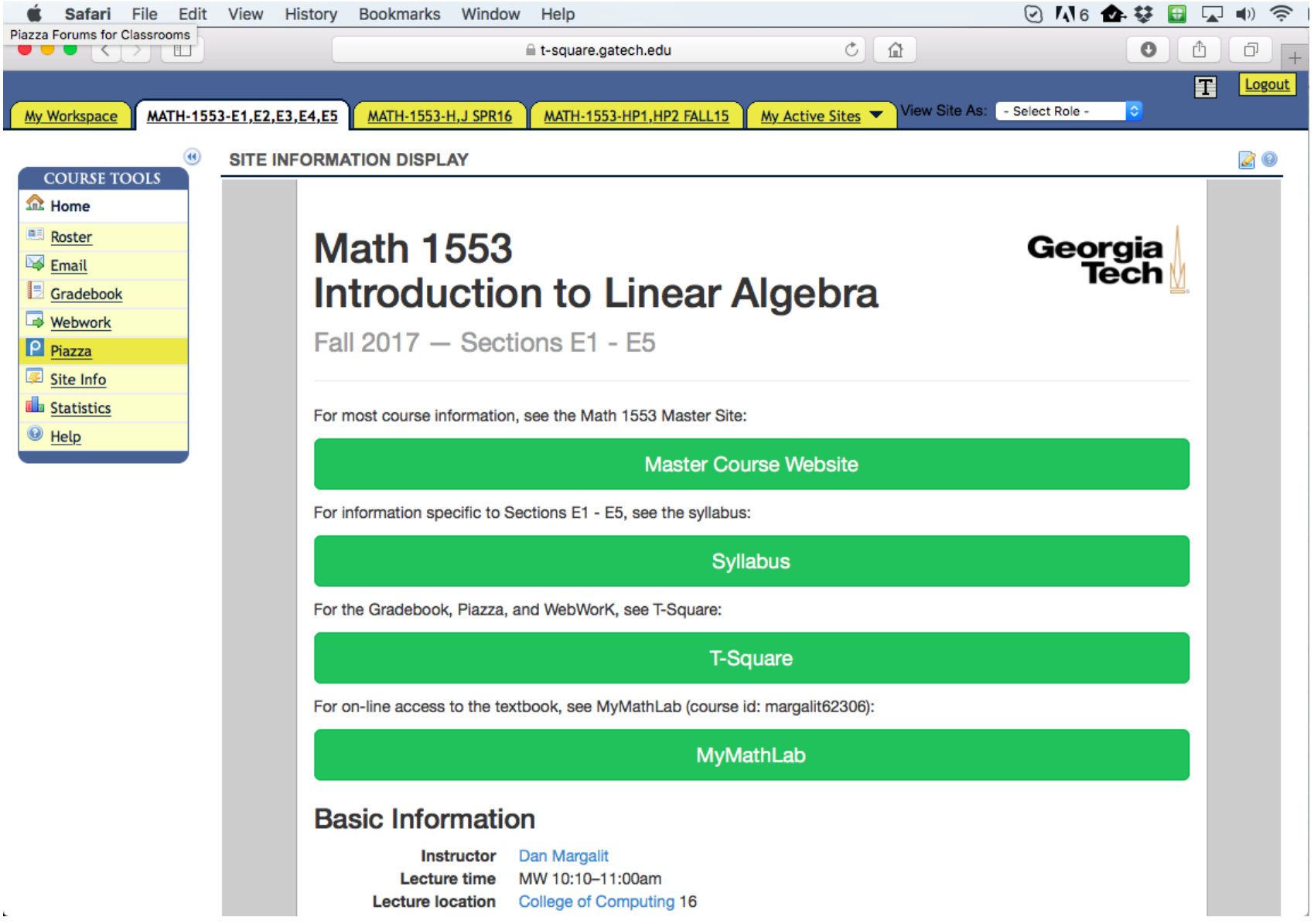
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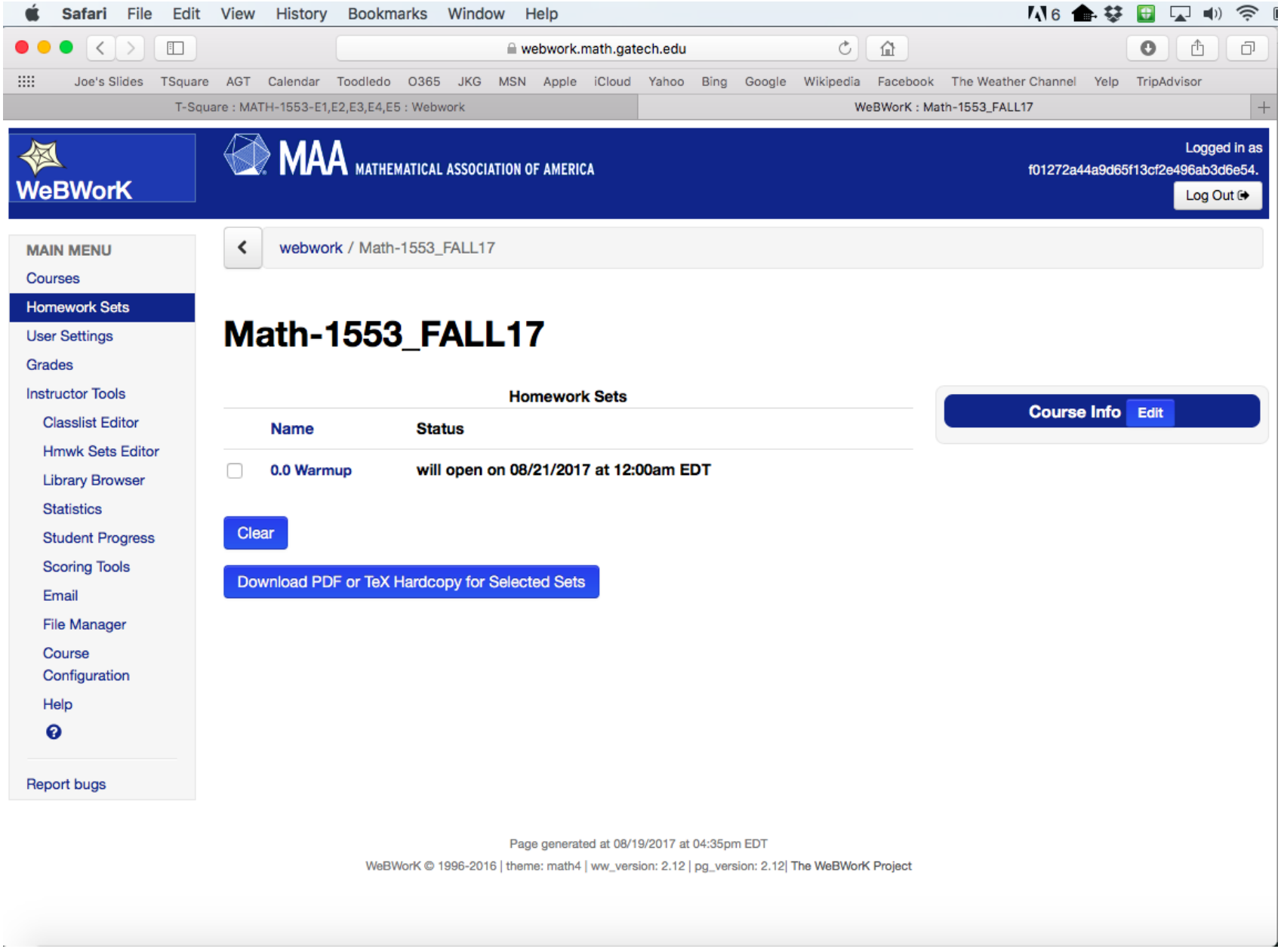
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Math 1553

About the Course

Evaluations

- Homework
  - due at 11:59 pm on Wednesdays
  - completed via WebWorK
  - two lowest dropped, no late hw
- Quiz
  - in Recitation on Fridays
  - covers material on the Homework
  - lowest dropped
- Three Midterms
  - Sep 22/Oct 20/Nov 17
  - Please tell me about Rosh Hashanah conflicts
- One common, cumulative Final
  - Dec 12
- One (small) Writing Project
- Participation
  - Clicker Polls
  - get the Piazza app for Wed

Not your High School Math Class

Your previous math courses probably focused on how to do computations:

- Compute the derivative of $\sin(\log x)\cos(e^x)$.

In this course:

- About half the material focuses on how to do linear algebra computations—that is still important.
- The other half is on *conceptual* understanding of linear algebra.

Advice, etc.

- Keep up with the definitions
- Come to office hours
- Sit in front, participate
- If you are having a problem, talk to me
- No devices in class unless instructed
- Be polite in your emails/posts

Introduction to Linear Algebra

Motivation and Overview

Linear. Algebra.

Linear

Algebra

- from al-jebr (Arabic), meaning reunion of broken parts
- 9^{th} 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

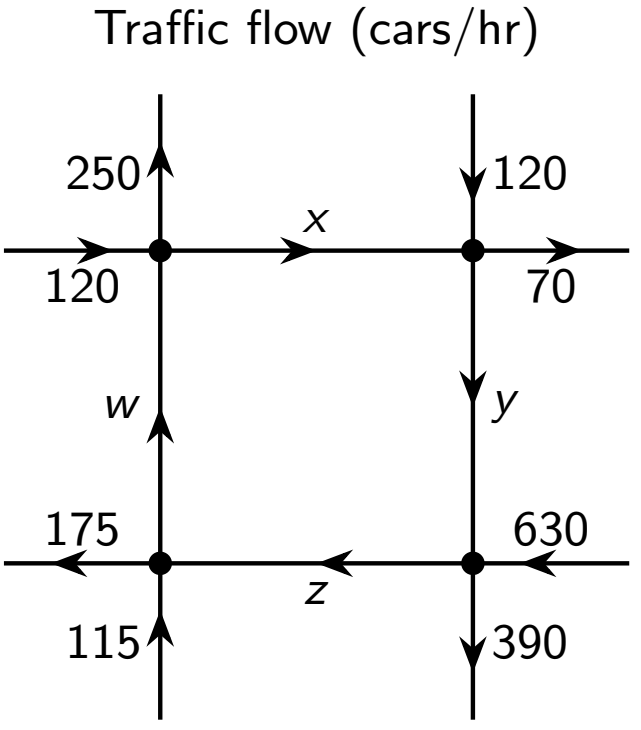
Many engineering problems, no matter how huge, can be reduced to linear algebra:

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

Applications of Linear Algebra

Civil Engineering: How much traffic flows through the four labeled segments?

⇝ system of linear equations:



Applications of Linear Algebra

Chemistry: Balancing reaction equations

$$___\ C_2H_6 + ___\ O_2 \rightarrow ___\ CO_2 + ___\ H_2O$$

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 2017 (in terms of the number of first, second, and third year rabbits), then what is the population in 2018? or 2117?

Applications of Linear Algebra

Geometry and Astronomy: Find the equation of a circle passing through 3 given points, say $(1, 0)$, $(0, 1)$, and $(1, 1)$.

Hint: The general form of a circle is $a(x^2 + y^2) + bx + cy + d = 0$.

Very similar to computing the orbit of a planet:

$$ax^2 + by^2 + cxy + dx + ey + f = 0$$

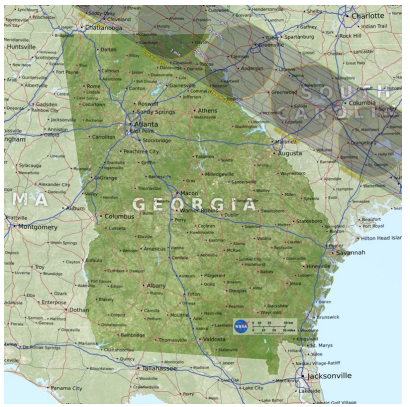
Applications of Linear Algebra

Google: "The 25 billion dollar eigenvector." Each web page has some importance, which it shares via outgoing links to other pages

Stay tuned!

Overview of the Course

- Solve the matrix equation $Ax = b$
  - Solve systems of linear equations using matrices, 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.