Math 3406 Syllabus
A Second Course on Linear Algebra, 3 Credits
TTh, 1:30-2:45, Skiles 270

Instructor

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Office Hours: M10:30-12, W1-2:30, or by appointment

1 General Information

Course Description

Linear algebra is the branch of mathematics which studies vector spaces and linear mappings between them. Linearity places very strong constraints on a mapping. For instance, if \( f : \mathbb{R}^n \to \mathbb{R}^n \) is linear, then \( f \) is completely determined by evaluating it on \( n \) points. This second course will further your understanding of the ideas and methods of linear algebra, which you will learn by understanding them geometrically, justifying them algebraically, and using them to solve problems in various disciplines. You will be required to both understand all key concepts and compute with them.

Although we live in a nonlinear world, linear algebra remains an essential subject with applications throughout mathematics and its applications. There are several reasons for this, including, that in a large number of cases, useful insights about non-linear transformations can be obtained from their linear approximations. You have seen this line of thinking in calculus, where arbitrary smooth functions are studied via their derivatives - their best linear approximations. Luckily, as you will see during the course, we have a useful and beautiful theory which provides many tools to solve linear problems. The course is centered around solving four equations: \( Ax = b \) (roughly the first half of the course), \( A'Ax = A'b, Ax = \lambda x \), and \( du/dt = Au \).

Gilbert Strang argues that applications of linear algebra touch many more students than calculus. These days, much of "big data" arrives in matrix form and machine learning tools utilize linear algebra. In your first linear algebra course at GT, you may have seen applications to Google’s PageRank algorithm and Markov chains. Applications in this course will depend somewhat on student interests, but may include principal component analysis, image compression, quantum computing, solving linear ODEs and difference equations, Fourier series and transforms, graph theory, demography, etc.
Pre- and/or Co-Requisites

MATH 1553 or MATH 1554 or MATH 1564 or MATH 1502 or MATH 1512 or MATH 1522 or MATH 1X53.

Learning Objectives

1. How to analyze and solve a linear system of equations, and if it can’t be solved, find the best approximate solution (least squares and pseudo-inverses)

2. Important characteristics of matrices, such as its four fundamental subspaces, rank, determinant, eigenvalues and eigenvectors

3. How to factorize matrices in useful ways, such as A=LU, A=QR, diagonalization, Jordan form, triangular form, singular value decomposition, and polar decomposition

4. Important concepts of vector spaces such as independence, basis, dimensions, orthogonality, etc. as well as sums, products, and tensor products of vector spaces

5. Properties of special matrices, such as symmetric, triangular, positive definite, Hermitian, unitary, nilpotent, and normal matrices

6. Introduction to Matlab for linear algebra

7. Applications of linear algebra in the sciences and engineering

8. Practice clear, concise communication of mathematical ideas.

2 Course Requirements and Grading

Bi-weekly problem sets (20%), 2 exams (40%), final exam (40%)
Your lowest two homework grades will be dropped.
Your final exam grade may replace an exam grade.

Your final grade will be assigned as a letter grade according to the following scale: A 90-100%, B 80-89%, C 70-79%, D 60-69%, F 0-59%

Exam 1: 10/4
3 Course Materials

Course Text

Linear Algebra with Applications, 4th ed, Gilbert Strang, North American edition (Some international editions have different ordering of exercises). I plan to cover chapters 1-6, A1, and A2.

Course Website

people.math.gatech.edu/~weiss/math-3406-f18.html

Key subpages
people.math.gatech.edu/~weiss/math-3406-f18-homework.html
people.math.gatech.edu/~weiss/math-3506-f18-exams.html
people.math.gatech.edu/~weiss/math-3406-f18-lecture-schedule.html
people.math.gatech.edu/~weiss/math-3406-f18-links.html

Please note that I do not use Canvas or T-Square.

Homework

The only way to learn the material well (and thus receive a good grade) is by solving many problems, and struggling to solve the more challenging ones. Unfortunately, there is no shortcut.

Please read all the relevant sections in the textbook.

Homework problems will be assigned bi-weekly and will consist of odd number textbook problems, even number textbook problems, and non-textbook problems. Please only submit even numbered textbook problems and all non-textbook problems for grading. Please hand the problems to me before the class begins. You may discuss these problems with other students, but you must independently write up and submit your own solutions. Copying any part of a solution from a book, solutions guide, or website is cheating! Students are expected to abide by the Georgia Tech Academic Honor Code.

Late homeworks will not be excepted, but you may drop your two lowest homework grades. Emailed homeworks will only be accepted with prior agreement of the Instructor - else they will not be accepted.

To receive credit for a solution, you must clearly indicate how you obtained your solution. You will receive no credit without an explanation. Please keep
your written answers brief; be clear and to the point. The grader will deduct points for rambling and for incorrect or irrelevant statements. Please do not show arithmetic and most algebra calculations. Your solutions should look like the solutions of examples in the text. If you are asked to show or prove a general result, you will receive no points for numerically verifying the result or proving it for $2 \times 2$ matrices. However, counterexamples can certainly be $2 \times 2$ matrices.

In order to grade as many problems as possible, your submitted problem sets should be printed very neatly in large “font” and stapled. Please do not cross out. Write on only one side of each page, in a single column, and do not use paper that has been torn out of spiral bound notebooks. You may typeset your solutions, but this is not required.

Please either print or submit a screen shot of your code and solution of computer problems.

4 Course Expectations and Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech’s Academic Honor Code, please visit catalog.gatech.edu/policies/honor-code/. Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, please see me at the beginning of the semester (I will try to help!) and also contact the Office of Disability Services at (404) 894-2563 or disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter.

Attendance and/or Participation

It is essential that you come to class on time and ready to work. It is very disruptive when students walk into class late. I strongly recommend class attendance and participation and I will use this activity in determining borderline grades.
Collaboration and Group Work

You may discuss homework problems with other students, but you must independently write up and submit your own solutions. Copying any part of a solution from a book, solutions guide, or website is cheating!

Extensions, Late Assignments, and Re-Scheduled/Missed Exams

Late homework assignments will not be accepted without an official excuse from the Dean of Students or other university official. However, you may drop your two lowest homework grades. Emailed homeworks will only be accepted with prior agreement of the Instructor and received before the end of class when they are due.

In case that you are unable to take an exam, you need to provide me with an official university excused absence or obtain my written permission before the scheduled exam.

Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See catalog.gatech.edu/rules/22/ for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Student Use of Mobile Devices in the Classroom

You may use laptops or tablets in this class to take notes. Place your phone on mute before class begins. If you must, you may use your cell phone silently during class as long as it is hidden from view. Also, please do not video any parts of lectures.
Resources for Campus Students

In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

Academic support

- Center for Academic Success success.gatech.edu
- Center for Academic Success 1-to-1 tutoring success.gatech.edu/1-1-tutoring
- Center for Academic Success Peer-Led Undergraduate Study (PLUS) success.gatech.edu/tutoring/plus
- Center for Academic Success Academic coaching success.gatech.edu/coaching
- Residence Life’s Learning Assistance Program (including drop-in tutoring for many 1000 level courses) housing.gatech.edu/learning-assistance-program
- OMED: Educational Services (including group study sessions and tutoring programs) omed.gatech.edu/programs/academic-support
- Communication Center (individualized help with writing and multimedia projects) communicationcenter.gatech.edu
- Academic advisors for your major advising.gatech.edu/

Personal Support

- The Office of the Dean of Students: studentlife.gatech.edu/content/services; 404-894-6367; Smithgall Student Services Building 2nd floor
- Counseling Center: http://counseling.gatech.edu; 404-894-2575; Smithgall Student Services Building 2nd floor. Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources. Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at 404-894-2204.
- Students’ Temporary Assistance and Resources (STAR): studentlife.gatech.edu/content/need-help (can assist with interview clothing, food, and housing needs)
• Stamps Health Services: https://health.gatech.edu; 404-894-1420 (Primary care, pharmacy, women’s health, psychiatry, immunization and allergy, health promotion, and nutrition)

• OMED: Educational Services: omed.gatech.edu

• Women’s Resource Center: womenscenter.gatech.edu; 404-385-0230

• LGBTQIA Resource Center: gbtqia.gatech.edu/; 404-385-2679

• Veteran’s Resource Center: veterans.gatech.edu/; 404-385-2067

• Georgia Tech Police: 404-894-2500

Personal Support

As a member of the Georgia Tech community, I am committed to creating a learning environment in which all of my students feel safe and included. Because we are individuals with varying needs, I am reliant on your feedback to achieve this goal. To that end, I invite you to enter into dialogue with me about the things I can stop, start, and continue doing to make my classroom an environment in which every student feels valued and can engage actively in our learning community.