

Math 312: Linear Algebra

Summer 2017, Session II

Instructor	Marcus Michelen
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Course Website	https://www.math.upenn.edu/~marcusmi/312Sum2017.html and Canvas
Lectures	MTWR 10AM – 12:10PM in DRL 4C6
Office Hours	MW 12:10 – 1 in DRL 3C11
Extra Help	Math help is available MTWR 9AM – 1PM in DRL 4C8

Course Overview: Linear algebra begins with solving an old problem: how can I find a solution to a system of linear equations? A key insight is that the techniques used to solve linear systems apply to a much broader class of problems. This course will cover the techniques used to solve linear equations, build off these techniques to deal with more complex problems, and discuss real-world applications such as Google’s PageRank algorithm, principal component analysis, and the use of the singular value decomposition in robotics.

Prerequisites: You are expected to be comfortable with integrating and differentiating functions as well as the basic concepts of multivariate geometry, e.g. vectors vs. scalars, equations defining lines and planes, parameterized paths and so on. We will review matrix operations such as addition and multiplication but it is assumed that you have seen these before.

Material: We’ll cover the following concepts (and hopefully some others too):

- Solving linear systems
- Gauss-Jordan elimination
- Vector Spaces and Subspaces
- Dimension
- The Rank-Nullity Theorem
- Linear Transformations
- Determinants
- Eigenvectors and Eigenvalues
- Diagonalization
- Orthonormal Bases
- Gram-Schmidt Process
- Inner Product Spaces
- Least-Squares Approximation
- The Singular Value Decomposition
- Fourier Series
- Markov Chains
- Google’s PageRank Algorithm
- Principal Component Analysis

Text: We’ll be using *Introduction to Linear Algebra*, 5th edition, Gilbert Strang, Wellesley Cambridge Press.

Grade Components: There will be Homework, Quizzes, a Midterm and a Final. Each of these four components is work 25% of the final grade.

Homework: There will be 10 homework assignments which will mostly consist of problems from Strang. This is a course that is very techniques driven, and regular practice like

homeworks is a necessary part of learning the material. Homework will be accepted late at a penalty of 10% per day but not more than a week late.

Quizzes: There will be five 15-minute quizzes (approximately one per week) that will take place at the start of class on the dates indicated below. The quizzes will strongly resemble a portion of the previous week's homework problems. Let me know ahead of time if you will be absent for one or more of the quizzes.

Exams: There will be a one-hour midterm administered during normal class time. The last day of the class will be devote to the final exam and will not be explicitly cumulative. Again, let me know ahead of time if you will be absent for the midterm or final.

Collaboration and Academic Integrity: I encourage you to work together to study and to do homework. However, in order to ensure that each student has an understanding of the material, I ask that any work that is handed in is written up individually. This means that you may (and should!) work with fellow students to figure out how to solve a problem, and then write the solution on your own using only your understanding of the material. For reasons both of learning and academic integrity, copying solutions is not permitted.

Getting Help: This is a fast-paced course, and some of the material will be of a different flavor than many of you are used to. If you're confused about anything or have any questions, don't hesitate to take advantage of the many resources available to you:

- **Me!** Ask questions in class; no question is too basic. Come to my office hours with any other questions you have. If you can't make it to my scheduled office hours we can make an appointment.
- **Math Help** is available Monday through Thursday 9AM to 1PM in DRL 4C8. No appointment is necessary. This is a great place to work together on homework, with extra assistance available if need be.
- **The Tutoring Center** www.vpul.upenn.edu/tutoring/
- **Math Department Approved Private Tutors**
www.math.upenn.edu/ugrad/tutors.html
- **Weingarten Learning Resource Center** www.vpul.upenn.edu/lcr/lr

Extra Resources: There many excellent supplementary resources available for free online:

- **MIT Open Courseware** Professor Gilbert Strang—author of the text for this course—has lectures for an entire course taught from this book available online. He has many resources available: videos and transcripts of lectures and recitations, problem sets with solutions, and exams. It's all available at ocw.mit.edu in courses 18.06 and 18.06 SC.

- **Khan Academy** This is a great resource for learning a lot of different math techniques; the videos here are more techniques oriented than theory oriented, and some of our more advanced topics aren't covered, but Khan Academy is still a great resource for large parts of this class. www.khanacademy.org/math/linear-algebra
- **Wikibooks** The Linear Algebra textbook on Wikibooks is fairly comprehensive and includes a large collection of examples and practice problems with in-depth solutions. en.wikibooks.org/wiki/Linear_Algebra

Disabilities: Any student who requires special accomodation should contact the Office of Student Disabilities Services (SDS) at the Weingarten Learning Resources Center. For more information, see www.vpul.upenn.edu/lrc/sds

Tentative Schedule:

MONDAY	TUESDAY	WEDNESDAY	THURSDAY
June 26th	27th	28th	29th Introductions 1.1 - 1.3
July 3rd 2.1 - 2.3	4th Independence Day	5th 2.4 - 2.5	6th Quiz 1 2.6 - 2.7
10th 3.1 - 3.2	11th 3.3 - 3.4	12th 3.5	13th Quiz 2 4.1 - 4.2
17th Midterm 4.3 - 4.4	18th 5.1 - 5.2	19th 5.3 - 6.1	20th Quiz 3 8.1 - 8.2
24th 6.2, 8.3, 6.4	25th 6.5, 7.1	26th Quiz 4 7.2 - 7.4	27th 9.1 - 9.2
31st 9.2	Aug 1st Quiz 5 Applications	2nd Review	3rd Final