Math 2185: A Comprehensive Introduction to Linear Algebra

Fall 2023

Lectures:	TR 11:10 AM – 12:25 PM	MPA 302	
Textbook:	Linear Algebra, Fifth Edition	by Friedberg, Insel, and Spence	
Course Webpage:	`https://jaydaigle.net/linear/`		
Discord:	`https://discord.gg/G2keASj4m`		
Instructor:	Jay Daigle	**Email:**	`jaydaigle@gwu.edu`
Office:	Phillips 720E		
Office hours:	MW 2:00–4:00		
Often in Office:	TR 2:00–3:00		

Textbook

The official textbook for Math 2185 is Linear Algebra, 5th edition by Stephen H. Friedberg, Arnold J. Insel, and Lawrence E. Spence. Access to this book will not strictly be required but it will be a useful reference throughout the course. As of the time I'm writing this, there appear to be cheap paperback copies on Amazon.

There are other excellent references you may find helpful. Linear Algebra Done Right (Amazon) by Sheldon Axler is a great text for the more conceptual aspects of the course, although it is weak at the more concrete computational aspects. There is an abridged version freely available. A similar, freely available book is Linear Algebra Done Wrong by Sergei Treil.

For a more geometric and computational perspective, you may find the online source Interactive Linear Algebra very helpful. It has many manipulable graphics that can help you develop geometric and algebraic intuition.

Course content

This is our rigorous, proof-based linear algebra course, intended for math majors and students in other majors (e.g., computer science, data science, economics, or statistics) who want a deeper conceptual understanding than is offered in Math 2184. Math majors, prospective math majors, and students who intend to take Math 3125 should be encouraged to take this course. The theory of vector spaces is developed from the axioms and linear algebra is studied over arbitrary fields (with an emphasis on $\mathbb{R}$ and $\mathbb{C}$ in examples). This allows students to work with important vector spaces in addition to $\mathbb{R}^n$. Linear transformations also take a more central role than matrices, with matrices serving as a computational tool in the finite-dimensional case.

Complete proofs of most results are presented, and students are expected to develop a mastery of proving results in linear algebra. As Math 2971 is a corequisite (or prerequisite), it is appropriate to include brief discussions of proof techniques when relevant. In addition to conceptual understanding, the course also emphasizes both the computational and geometric aspects of linear algebra.

This course is part of a two-course sequence, along with Math 3125 (Linear Algebra II), which further develops the theory of linear algebra, but also covers applications to statistics, computer science, and physics. The comprehensive introduction to linear algebra given in Math 2185 prepares students to fully understand the mathematics behind these applications.

Prerequisites

This course requires Single-Variable Calculus I (Usually in the form of Math 1231 or Math 1221), and has Introduction to Mathematical Reasoning (Math 2971) as a corequisite. Because this course has an emphasis

on proof-writing and formal arguments, the skills from Math 2971 will be extremely important.

Technological requirements; recordings

I have set up a Discord server at `https://discord.gg/TPfSJq43` to facilitate low-key discussions of class material. This is totally optional, but you can go there to talk about the class with each other or with me; I'll be keeping an eye on it most of the time and it's usually the easiest and fastest way to get in touch with me.

Important resources

The following resources are available to help you succeed in Math 1231.

- Lecture and recitation
- Faculty and TA office hours (scheduled or by appointment)
- The Academic Commons at `https://academiccommons.gwu.edu/` offers peer tutoring, but they may not be well set-up to support this course.

In addition, the University's Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. For additional information, see `https://counselingcenter.gwu.edu/` or call 202-994-5300.

Lecture schedule

The rough schedule for the course will be something like

- Appendix, **Fields and Complex Numbers:** August 24
- Chapter 1, **Vector Spaces:** August 29, 31; September 5, 7, 12, 14, 19
- Chapter 2, **Linear Transformations and Matrices:** September 12, 16 ,28; October 3,5, **17**
- **Midterm:** October 10.
- **Fall Break:** October 12
- Chapter 3, **Gaussian Elimination and Systems of Linear Equations:** October 19, 24, 26, 31
- Chapter 5, **Eigenvalues, Eigenvectors, and Diagonalization**, and Chapter 4, **Determinants:** November 2, 7, 9, 14, 16, **28**
- **Thanksgiving Break:** November 21, 23
- Chapter 6, **Inner Product Spaces and Orthogonality:** November 30; December 5, 7.

Expected amount of work

There are just under 3 hours of class time each week. In addition, we expect a typical students to spend a minimum of 5 hours each week on independent work (primarily, homework assignments). Of course, you should spend as much time as you need to succeed in 2185, and this may be more than 5 hours per week.

Course Structure

Attendance will not be monitored or enforced, but will be extremely helpful to progressing in your understanding of calculus. There will be weekly problem sets, a midterm, and a final exam, along with some supplemental work through the online WeBWorK homework system and a chance to revise some of your proofs for clearer writing.

WeBWorK Online Homework System

For some more computational topics I will assign homework through the WeBWorK online homework system. This system is free to students. Although this course has a conceptual focus, there are important computational skills you will need to master, and WeBWorK gives you a chance to practice these.

You will have an unlimited number of attempts to get credit for each problem. If you find yourself struggling with a particular problem or type of problem, *please* discuss it with me, your TA, or one of the other academic resources suggested above. The purpose of this system is to give you an opportunity to *practice*; if you get the points without understanding, it's not fulfilling its purpose.

Each assignment will have a due date, generally a week after it is opened. However, you should attempt to complete these assignments well before the official due date, so that you are prepared to learn the more advanced material we are covering in class. You will have a grace period of one week after the due date during which you can submit your work for 90% credit. Consequently I will not give extensions except in extremely unusual circumstances.

Problem Sets

There will be a problem set due Thursday of each week, and returned to you in class the following Tuesday. These problem sets are the most important part of the class, and they are where you will do the most of your learning.

You may, and in fact should, collaborate with other students in the class, but all the work you submit should be your own, in your own words.

Starred Redo Problems

One problem on each week's homework will be starred. You may *not* discuss this problem with classmates before your first submission, though you should of course feel free to discuss it with me as much as you like. You must submit the starred problem on a *separate, detached sheet of paper* each week.

I will be exceptionally picky grading the starred problems, and in particular I will grade clarity of writing. After receiving my feedback, you may resubmit the problem the following week with corrections and edits made, and the new grade will supplant the previous grade. You may discuss these edits with your classmates, but the work you submit must be your own writing.

If you go a full week without submitting a problem or getting an extension from me, your grade will be locked in. This mostly means you can't put them off and then redo all of them in the last week of the term. (This is a terrible idea and never works).

Midterm and Final

There will be midterm on October 10, and a comprehensive final exam as scheduled by the registrar. I will update you when the registrar announces the final exam schedule. You will *not* be excused from the final if you schedule travel during finals week; if you must buy your plane ticket before the registrar announces final exam, please make sure it departs after May 16.

Computation of final grades

- WeBWork Homework: 10%
- Problem Sets: 30%
- Redo problems: 10%
- Midterm: 20%
- Final Exam: 30%

Minimum scores for each letter grade are as follows: A, 94%; A−, 90%; B+, 87%; B, 84%; B−, 80%; C+, 77%; C, 74%; C−, 70%; D+, 67%; D, 64%; D−, 60%.

No extra credit will be available under any circumstances.

Academic integrity Code

Students are responsible for the honesty and integrity of their own academic work. In particular, it is unacceptable to present the work or ideas of others as if they were your own. The course staff take this *extremely seriously*, and you should as well. The best way to avoid problems is to clearly indicate on your work what sources/individuals/etc. you consulted. Failure to abide by rules for individual assignments is subject to sanction, including possibly failure of the class. If you have any questions, please do not hesitate to contact the instructor. The complete university code is at `https://studentconduct.gwu.edu/code-academic-integrity`

Religious holidays and other excused absences

If you will be unable to complete or submit an assignment, notify your TA or instructor *in advance* to discuss your options. Unexcused missing work will be assigned a score of 0. In accordance with University policy, students should notify faculty *during the first week of the semester* of their intention to be absent from class on their day(s) of religious observance. For details and policy, see "Religious Holidays" at `https://provost.gwu.edu/policies-procedures-and-guidelines`

Students with disabilities

Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information, see `https://disabilitysupport.gwu.edu/`

Safety and Security

1. In an emergency: call GWPD 202-994-6111 or 911
2. For situation-specific actions: review the Emergency Response Handbook at `safety.gwu.edu/emergency-response-handbook`
3. In an active violence situation: Get Out, Hide Out, or Take Out. See `go.gwu.edu/shooterpret`
4. Stay informed: `safety.gwu.edu/stay-informed`

Final disclaimer

The course staff reserves the right to change course policies in light of unforseen events; in this case, announcements will be posted to Blackboard explaining the change.