Math 2184-10: Linear Algebra

Fall 2020

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Office hours:	TBD	Office hours:	TBD

Lecture:	TR 12:45 pm - 2:00 pm US Eastern time
Recitations:	R 8–8:50am (§30), 9:35–10:25am (§31), or 11:10am–noon (§32) US Eastern time
Course Web Page:	https://jaydaigle.net/linear/
	All lectures and recitations will be available through Blackboard:
	https://blackboard.gwu.edu

Textbook

The official textbook for Math 2184 is *Linear Algebra and its Applications*, Fifth Edition, by Lay, Lay, and McDonald (ISBN-13: 978-0321982384). I will be loosely following this book, and it will be very useful to have, but I will not be assigning problems out of it.

Another perfectly fine book is *A First Course in Linear Algebra* by Rob Beezer. It is available for free online at http://linear.ups.edu/download.html.

Course content

This is a standard first course in linear algebra. The main topics are: linear equations; matrix algebra and equations; subspaces and bases; vector spaces; eigenvalues and eigenvectors; determinants; orthogonality and least squares. This corresponds to Chapters 1–7 of Lay, Lay, and McDonald.

Prerequisites

Students must have passed Calculus 1, possibly by passing one of Math 1221, Math 1231, or Math 1252. Students will be expected to be able to perform algebraic calculations comfortably and compute very basic derivatives and integrals. A familiarity with exponential derivatives will be helpful but not necessary.

Technological requirements; recordings

Lectures and recitations will be **delivered synchronously through Blackboard, and recorded**. There will be periods of small-group interaction in lecture and recitation; you will get much more out of the class if you are able to participate in these groups using a computer microphone and camera. Please contact the instructor *immediately* if you believe you will have a technical obstruction to participation. Please contact Student Support or Disability Support Services if you have questions or need assistance in accessing electronic course materials.

Under no circumstances may you post or share recordings of lecture or recitation (to YouTube, etc.) without the explicit permission of the instructor and everyone else who appears in the recording. Students who impermissibly share any electronic course materials are subject to discipline under the Student Code of Conduct. Please contact the instructor if you have questions regarding what constitutes permissible or impermissible use of electronic course materials and/or recorded class sessions.

I have set up a Discord server at https://discord.gg/HD3dvYC 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)
- Academic Commons (including peer tutoring): `https://academiccommons.gwu.edu/`

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.

Learning outcomes

By the end of the course, students will acquire the following skills and knowledge:

- Students will be able to find echelon forms of matrices, find a basis for the column space, row space and null space of that matrix, and determine if that matrix is invertible.
- Students will be able to determine if a set of vectors is linearly independent.
- Students will be able to calculate the eigenvalues and eigenvectors of matrices.
- Students will be able to diagonalize a matrix and use the diagonalization techniques to solve problems in other areas of mathematics

Lecture schedule

The list below gives a tentative outline of what is planned and when. (Please don't take it too literally.)

Sep 01	Linear Equations and Row Reduction	1.1-2	Oct 20	Midterm	
Sep 03	Vector and matrix equations	1.3-4	Oct 22	Eigenvectors and Eigenvalues	5.1,4
Sep 08	Solutions and independence of linear systems	1.5,1.7	Oct 27	Determinants	3.1-2
Sep 10	Linear Transformations	1.8-9	Oct 29	Characteristic Polynomials	5.2
Sep 15	Applications and Matrix Operations	1.6-2.1	Nov 03	Diagonalization	5.3
Sep 17	Matrix Inverses	2.2-2.3	Nov 05	Complex Eigenvalues	5.5
Sep 22	Matrix Factorizations and Leontief model	2.5-6	Nov 10	Markov Chains	4.9,5.6
Sep 24	Subspaces	2.8	Nov 12	Inner Products and Orthogonality	6.1
Sep 29	Dimension and Rank	2.9	Nov 17	Orthogonal Sets and Projections	6.2-3
Oct 01	Vector Spaces and Subspaces	4.1	Nov 19	Orthonormal Bases and Gram-Schmidt	6.4
Oct 06	Null spaces and Columspaces	4.2	Nov 24	Least-Squares Problems	6.5
Oct 08	Bases and Coordinate Systems	4.3-4	Dec 01	Symmetric Matrices	7.1
Oct 13	Dimension and Rank	4.5-6	Dec 03	Singular Value Decomposition	7.4
Oct 15	Isomorphism and Change of Basis	4.7	Dec 10	Principal Component Analysis	7.5

Communication

I use male pronouns. You can call me "Professor Daigle", "Dr. Daigle", or just "Jay". I will, however, be sad if you call me "Mr. Daigle". The TA uses female pronouns; you can call her "HJ". If you have never e-mailed a college professor before, this blog post provides a short, helpful guide to best practices: `http://tinyurl.com/h5w5nyo`.

We will endeavor to treat each of you with respect, and we ask that you do the same towards us and each other.

Expected amount of work

There are just over 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 1231, and this may be more than 5 hours per week.

Course Structure

This semester will probably be difficult for all of us. I will endeavor to make things as painless as I can manage. Please let me know if you are facing difficulties and I can do anything to help—or if you just need to talk.

I would like to focus our time together in lectures and recitations on actual interactions with each other. In the spring I found that online lectures tended to be very one-sided, so I will try to minimize the use of direct lecture.

For each class, I will assign some reading and some videos to watch before class. Some of these readings and videos will be produced by me; others will be from the textbook or from other (free) online content sources. Please familiarize yourself with at least some of them.

I intend to focus most of our lecture time on working problems. You should expect to work on problems in small groups with each other, and then discuss them with the entire class. I hope this will give you all a chance to meet and interact with your fellow students, which is an important part of the college experience. Attendance will not be monitored or enforced, but will be extremely helpful to progressing in your understanding of linear algebra.

There will be regular homework assignments, weekly quizzes, and a midterm and a comprehensive final exam.

WeBWork Homework

For each topic I will assign some homework through the MAA's WeBWork online homework system. This system is free to students. This will give you an opportunity to practice basic skills you will need to succeed in the course.

You will have an unlimited number of attempts to get credit for each WeBWork problem. However, most problems will rerandomize numbers after three failed attempts, so you can't just guess wildly and hope you eventually get it right. 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.

Each assignment will have a due date; work submitted after that date without prior arrangement will be worth partial credit.

Mastery Quizzes

The quiz grading will follow an approach called "mastery" grading, which is a little complicated but which I think will benefit all of you, and hopefully alleviate a little of the inevitable stress of this semester.

In this course I have identified 20 primary concepts I would like you to master. Each week we will introduce one or two of these concepts, and I will give a quiz with one problem for each concept. Each problem will receive a grade of either "apprentice" (A), "journeyman" (J), or "master" (M), based on the overall quality of your work. Minor arithmetic errors will not deny you a M grade, but no amount of "partial credit" will demonstrate mastery.

If you receive a M grade on a topic, you will get full credit and don't need to do any further work on that topic. However, if you receive an A or a J, you will have further opportunities to attempt to demonstrate mastery of that topic. The best grade you receive on a topic will be the one I use in my gradebook, so if you attempt a topic seven times and receive scores of A, A, A, A, J, J, M, you will get full credit for displaying mastery, just as if you had received an M on your first attempt.

You may reattempt mastery of a topic by:

- Attempting a similar problem on a future quiz; or
- Making an appointment with the instructor to work through a similar problem and display mastery.

You may try each of these one per week.

This approach has a few major advantages: It allows you to focus your work on the topics you need to improve on; it gives you room to improve and have that improvement reflected in your grade; it reduces the stress of each quiz because a poor performance can be completely made up for later. This approach also encourages you to actually master the fundamental skills and ideas of linear algebra.

The major disadvantage of mastery grading is that it is different and complicated. I will try to make it as clear as possible, but if you have any confusion about how things work or what your grade looks like at any given time, please let me know and I'd be happy to clarify.

Midterm and Final

There will be a midterm on roughly October 20, and a comprehensive final exam. I will distribute a practice test with solutions before each test so you will know what format to expect going in. If you have mastered the rest of the course material, both tests should be fairly straightforward.

Computation of final grades

- WeBWork Homework: 30%
- Mastery Quizzes: 45%
- Midterm: 10%
- Final Exam: 15%

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%.

Attendance and engagement in class and recitation, while not formally part of the computation, may be used as deciding factors in borderline cases. 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.