Math 224W: Linear Algebra

Professor Dykstra (Fall 2025)

- Office: CJ 122
- Office Hours: 2 - 4 on Mondays, Wednesdays, and Thursdays, and by appointment
- Homework will normally be due Mondays, Wednesdays, and Thursdays at 8 p.m.

Overview

Linear Algebra is a beautiful and mostly self-contained theory that has a wide range of exciting real-world applications. This semester we will focus almost exclusively on the underlying theory, but I encourage you to look into applications on your own or discuss them with me, and you will certainly see more if you go on to take courses in applied math. For example, Differential Equations is great to take directly after this course because it features some especially powerful applications.

One of my main goals for this course is to help you learn to write mathematical proofs. I will not expect you to have any prior proof writing experience, and I will aim to give you lots of feedback on your work, always being as detailed and *critical* as I can to help you improve. Please do not lose heart if some of the grades you earn on proof writing assignments are lower than you had hoped. Trust me: as long as you read the feedback I give you and strive to implement my feedback on future assignments, you *will* improve. Proof writing is a delicate and challenging art form that takes years of practice to truly master, so it is completely normal and understandable to struggle with it when you are first exposed to it. As with any artistic endeavor, to grow and develop as a proof writer, especially when you are first getting started, you need to approach your work with a mindset that is humble and open to criticism.

Textbook

Our textbook will be *Elementary Linear Algebra with Applications* by Bernard Kolman and David R. Hill (ninth edition). We will cover most of chapters 1, 2, 3, 4, 6, and 7.

To maximize your understanding of the material and fully develop your ability to read and write in the precise language of mathematics, you should read the textbook outside of class. This is especially important in a proof-based course like Linear Algebra. Indeed, one of the best ways to improve your own proof writing is to read proofs written by other people, and the proofs written by our textbook authors are excellent examples.

Lecture Notes

Each day I will write my personal lecture notes on my iPad and post them to Blackboard at the end of class. My notes will include basically everything I write on the board, and probably some extra details as well. In addition to the textbook, you would be wise to read my notes regularly.

My primary goal in making my notes available to you is to give you the option to take fewer notes of your own. Research shows that a student who attempts to transcribe a lecture word-for-word will typically end up with a lower level of comprehension than a student who jots down only the main ideas and summarizes key concepts in his or her own words. The former student is focusing too much on copying, while the latter student is actively processing the material in real time.

Since you will have my notes, you may prefer to not take your own notes. Or you may prefer to take some notes, with an eye toward synthesizing big-picture ideas as opposed to transcribing every detail. Or you may ultimately decide that you learn best by copying down every single word. Everyone learns differently, so just do whatever feels right to you.

Exams

There will be two midterm exams and a cumulative final exam, each with a 3-hour time limit. Midterm exams will be from 7 - 10 p.m.

- **Exam 1** will be Monday, October 6.
- **Exam 2** will be Monday, November 17.
- **The Final Exam** will be Tuesday, December 16 from 7:00 p.m. to 10:00 p.m. The date and time of the final exam is set by the registrar and cannot be rescheduled for individual students. Please make your winter travel plans accordingly.

Homework

There will be two types of homework assignments. The first are *computational assignments*, which will consist of relatively straightforward exercises to give you practice with the techniques we learn in class. The second type are *writing assignments*, where you will write proofs. Whereas the computational assignments will be graded by student graders, I will grade the writing assignments myself. Also, whereas you can use pencil and paper for the computations, your work on the writing assignments should be typed up using the math typesetting program LaTeX, which I will teach you how to use.

You will do the computational assignments individually. You will also do the first couple of writing assignments individually, but on writing assignments after that you will be divided into teams of two, and each team will turn in just one copy of their joint work. Assignments will usually be due on Mondays, Wednesdays, and Thursdays at 8:00 p.m. Your work on all assignments should be submitted through Gradescope.

Our student graders will be working hard to give you detailed feedback on your homework. To protect their time, I will not be asking them to grade homework turned in more than 24 hours late. For this reason, I will not grant extensions on homework assignments, even for reasonable excuses such as sickness or emergencies.

That said, to give you some flexibility it will always be possible to turn in homework up to 24 hours late for a very small deduction, as follows:

- If you submit your work after the normal 8 p.m. deadline but before 11:59 p.m. that night, there will be a 2% deduction.
- If you submit your work after 11:59 p.m. that night but before the late deadline of 8 p.m. the next day, there will be a 5% deduction.
- No work submitted after the late deadline will be accepted.

You never need to ask my permission to use the late deadline, and I would actually prefer if you didn't. I have intentionally made the deductions *extremely tiny* to avoid having to constantly respond to emails asking for homework extensions. The deductions will never be waived, even for "valid" excuses.

Our graders may deduct points if they find it difficult to read your work, so be sure to clearly label the start of each new problem and ensure that each solution is well-organized and easy to read. Before you submit your work through Gradescope, double-check to make sure that the scan you are submitting is rotated properly and isn't blurry or difficult to read. And of course, be sure your handwriting as neat and tidy as you can make it!

I encourage you to collaborate with your classmates on homework, and of course I'm always happy to help too. But final write-ups of the problems must be your own work. Simply copying someone else's work violates the honor code. To ensure that you properly credit other people's ideas, at the top of every assignment you turn in, you should list any students you worked with and any outside sources you used. Please be specific, for example:

- "Jack showed me how to do problem 3."
- "I collaborated with Jane to come up with my solution to problem 3."
- "I collaborated with Jane on all problems on this assignment."
- "I copied the answer to problem 3 from ChatGPT."
- "I picked the lock on your office, stole your solutions, scanned them and printed out a copy, put my name (and this note) on top, and am now submitting them to you for a grade. I left a $100 bill on your desk as hush money. Hope that's okay, and have a great weekend!"

I know it can sometimes be difficult to know which kinds of collaboration or outside sources are allowed. But please rest assured: as long as you fully document the nature of the

collaboration or outside source, you will not get into trouble. Even if you do something that clearly crosses the line (see the last two examples above), as long as you explain what you did at the top of your assignment, then the worst that could happen would be that I might want to talk with you privately to clarify what is or is not allowed going forward. The only way you would get into trouble would be if you did not properly document the outside sources you used to come up with your answers. Just remember to always list these sources at the top of your homework so that you properly credit them. As you will discover if you go on to pursue a career in mathematics, properly documenting your sources is *essential* to conducting legitimate mathematical research.

Honor Code

I take the honor code very seriously and will report any suspicion of academic dishonesty directly to the dean of students. In addition to keeping your own nose clean, you should report instances of suspected cheating that you personally witness, either to your professor or to the dean of students.

Technology

You may use technology such as calculators and computer software as much as you wish on homework. However, on exams you will only be allowed to use pencil and paper, so it is in your best interest to use technology sparingly on homework.

Attendance and Participation

There are 5 points possible for attendance and participation. You can earn 4 points by simply coming to class every day and consistently putting in solid effort both in and out of class. To earn 4.5 points, you need to demonstrate above average participation during class and leadership in collaborations with your classmates. Scores of 5 will rarely if ever be given and will be reserved for students who through their attendance and participation make profound contributions that are indispensable to the intellectual development of the class as a whole. At the end of the semester, any student who earns a 5 will receive a hand-written note from me to thank them for their outstanding contributions.

Disabilities

If you have a documented disability and need academic adjustments or accommodations, please let me know as soon as possible. You should also contact Allen Harrison (Phone: 4021) in the Dean of Students Office, who coordinates services for students with disabilities.

Grades

At the end of the semester, I will compute your semester average as follows:

- Attendance and participation: 5%
- Quiz covering this syllabus: 1%
- Computational assignments: 5%
- Writing assignments: 14%
- Midterm exams: 25% each
- Final exam: 25%

I will convert your semester average into a letter grade using standard cutoffs (for example, 70 = C–, 73 = C, 77 = C+). However, in making the final decision about which letter grade you deserve, I reserve the right to also take into account my holistic assessment of your work.