M22F24: Linear Algebra with Applications

Instructor

Lily McBeath (lmcbeath@math.dartmouth.edu)
Office: Kemeny 214
Office Hours: MW 10:00 - 11:00 am, x-hour (see below)

Course Information

MWF 2:10 - 3:15 pm, x-hour Th 1:20 - 2:10 pm
Dates: 16 September 2024 - 19 November 2024
Location: Kemeny 108
Required text: Lay, D. C., Lay, S. R., & McDonald, J. (2016). Linear algebra and its applications (Fifth edition). (ISBN: 978-0321982384)

Course Description

Linear algebra is the study of vector spaces and the linear transformations between them. Examples of vector spaces that you may have seen before include the vector spaces of continuous functions, differential functions, and integrable functions, and the familiar operations of differentiation and integration from calculus can be thought of as linear transformations between such vector spaces. In this class, we will work mostly with the vector space $\mathbb{R}^n$ consisting of length-n vectors of real numbers. We will learn how to represent linear transformations with matrices and study different types of linear transformations. During the last weeks of classes we will concentrate on applications of linear algebra to problems in mathematics and other fields. For a more detailed description on the topics we will learn in this class, see the Course Summary on Canvas.

Linear algebra is very important for both pure and applied mathematics. This is one of the reasons that it is a prerequisite for almost all of your math major courses and other STEM subjects. The techniques of linear algebra are used in engineering, physics, natural sciences, computer science and economics. Since linear algebra is an important foundational course, we will focus not only on developing computational proficiency, but also on understanding definitions and theorems, and writing clear and organized mathematical arguments.

See the description in the ORC.

Course Goals

- Students will learn the main concepts and techniques in linear algebra.
- Students will learn some applications of linear algebra.
- Students will be prepared for more advanced courses in mathematics, computer science, physics and any other subjects that require linear algebra.

Grades, Assignments & Exams

The course grade will be computed as follows:

WeBWorK	15%
Homework	15%
Discussion Participation	5%
Midterm 1	20%
Midterm 2	20%
Final Exam	25%

Each of these components are explained below.

WeBWorK

The daily web-based problems can only be accessed by clicking the corresponding link in the Assignments section of Canvas. See also the WeBWorK homepage containing a FAQ and quick start guide.

It is *highly recommended* that you keep a notebook in which you write up your WeBWorK homework (including your work as well as the answers). Then when you are studying for exams, you will have a record of your work to refer to.

WeBWorK assigned from each class should be done by the next class. This preparation will be expected during the lecture. That being said, the formal deadline is set to be the day of the class after the next one. For instance, WeBWorK assigned on Fridays must be completed by 12 p.m. the following Wednesday. Similarly, WeBWorK assigned on Mondays is due by 12 p.m. on the upcoming Friday within the same week. So although you have the authority to grant yourself a short extension if necessary, at no penalty, you should not do so consistently if you want to keep pace with the course.

Homework

Written homework assignments will be assigned once a week and will be posted on Canvas. They will be collected every Wednesday via Gradescope.

No late homework will be accepted. *Please do not ask for extensions on the homework.* The lowest homework score will be dropped at the end of the class.

Homework is to be written neatly. Make sure not to write too close to the margins, otherwise when you scan it there might be missing information. Make sure that before you submit your homework you check to make sure that all information has been scanned and that it can be read. As an alternative to writing and scanning homework, you may type your homework using the typesetting tool LaTeX. The easiest way to get started is to use Overleaf.

Use complete sentences when writing explanations or justifications. If you can't read your solutions aloud as fluently as if you were reading a textbook, try using nouns and verbs in your write ups! If you do not follow these guidelines, your written homework will be returned to you ungraded.

Discussion Participation

Each week you will be asked to submit posts on the Discussions page. It will be initiated by a prompt. The idea is to have a weekly conversation generally inspired by something mathematical and usually related to our class. The point is that there is a lot of mathematics in the world and in particular, a lot of linear algebra going on the quantified digital work that we inhabit. This is sometimes exciting, sometimes unnerving, and most times, worth thinking about and talking about. Your posts can be in response to earlier posts, start new subjects, but whatever they are, they need to be thoughtful (posts that essentially just say "I agree" are not acceptable) and civil. One sentence responses also do not receive credit. To get full credit, you must write *both one post and one reply to another student* each week, otherwise you will not receive credit for that week. They are graded as 0 (didn't do it) or 1 (did it) and the total comprises your participation grade. The lowest two discussion scores will be dropped at the end of the class.

Exams

There will be two midterm exams and a cumulative final exam. The exam schedule is as follows:

Exam	Date & Time	Location
Midterm 1	10 October (7:00 pm)	Wilder 104
Midterm 2	31 October (7:00 pm)	Wilder 104
Final	22 November (3:00 pm)	Moore B03

The midterms will be in person, 2-hours in length and the final is a 3-hour exam scheduled by the registrar. More information will be provided by your instructor in the week before the midterm.

If you have a conflict with one of the midterm exams because of a religious observance, scheduled extracurricular activity such as a game or performance, scheduled laboratory for another course, or similar commitment, please see your instructor as soon as possible, and *at least one week in advance* so possible alternative arrangements can be pursued.

All students must take the final at the scheduled time, unless they are scheduled by the registrar to have two conflicting examinations or three examinations on a single calendar day. In particular, no final will be given early or late to accommodate student travel plans. If you make travel plans that later turn out to conflict with the scheduled exam, then it is your responsibility to either reschedule your travel plans or take a zero in the final.

Tutorials & Additional Support for your Learning

Our graduate teaching assistants Rohan Kapoor and Ben Shapiro will run tutorials Tuesday, Thursday, and Sunday from 7:00 - 9:00 pm in Kemeny 105, focusing on answering your questions as you work through understanding the concepts. You can get help with any questions you have regarding the course topics and homework assignments. Tutorials are open to all Math 22 students. You don't need an appointment.

The Academic Skills Center is open to the entire Dartmouth Community. Here are some common reasons why you might visit the ASC:

- You're getting B's but you want to get A's

- You don't feel comfortable talking in class
- You're attending class regularly but you feel like you're missing important points
- You feel like you're a slow reader
- You're having trouble completing tests in the allotted time
- You're spending hours studying for foreign language but still not "getting it"
- You feel like you don't have enough time to get everything done
- You're not sure how to take notes
- You want to sign up for a tutor or study group
- You're not sure if you should get tested for a learning disability

See also the Peer Tutoring Program.

Academic Honor Principle

Cooperation on daily and weekly homework is permitted (and encouraged), but you should write up the solution on your own. In other words, you might share your thoughts on a sheet of paper or blackboard to get started together, but then work on your own submission afterwards using only your understanding. For written homework, please acknowledge any cooperative work by listing your collaborators at the end of each assignment. If you did not talk with anyone please write "No Collaborators."

This still also holds true if you consult other textbooks for solutions or hints or utilize online resources, including generative AI (e.g. ChatGPT). If you use any of these additional resources, you must similarly make this explicit by acknowledgement: include all source code you wrote, the links to all pages used, and a complete transcript of your AI session.

Students may not give or receive assistance of any kind on an exam from any person except for the professor or someone explicitly designated by the professor to answer questions about the exam.

Please feel free to reach out to me with any questions you may have about this policy before submitting anything that has been substantially informed by something other than your own work.

Plagiarism, collusion, or other violations of the Academic Honor Principle, after consultation, will be referred to the Committee on Standards. If you have any questions as to whether some action would be acceptable under the Academic Honor Principle, please speak to me beforehand. For more information about standards of conduct, please see the Community Standards.

Student Accessibility Needs

Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services (SAS; Apply for Services webpage; 1-603-646-9900) and to request that an accommodation email be sent to me in advance of the need for an accommodation. Then, students should schedule a follow-up meeting with me to determine relevant details such as what role SAS or its Testing Center may play in accommodation implementation. This process works

best for everyone when completed as early in the quarter as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

Mental Health

The academic environment at Dartmouth is challenging, our terms are intensive, and classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including: the Counseling Center which allows you to book triage appointments online, the Student Wellness Center which offers wellness check-ins, and your Undergraduate Dean. The student-led Dartmouth Student Mental Health Union and their peer support program may be helpful if you would like to speak to a trained fellow student support listener. If you need immediate assistance, please contact the counselor on-call at (603) 646-9442 at any time. Please make me aware of anything that will hinder your success in this course.

Religious Observances

Dartmouth has a deep commitment to support students' religious observances and diverse faith practices. Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with me as soon as possible – before the end of the second week of the term at the latest – to discuss appropriate course adjustments.

Title IX

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community.

The Sexual Respect Website at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community.

Please note that I am obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see this resource sheet).

Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator or the Deputy Title IX Coordinator for the Guarini School. Their contact information can be found on the sexual respect website at: `https://sexual-respect.dartmouth.edu`.