MATH 201: LINEAR ALGEBRA (SECTION F03)
COURSE INFORMATION & SYLLABUS

FALL 2021

Place:	Eliot 314
Time:	MWF 3:10–4:00 P.M.
Instructor:	David Perkinson (he/his) (davidp@reed.edu)
Course homepage:	https://people.reed.edu/~davidp/201/
Text:	Linear Algebra, by Jeff Hefferon.
Lecture notes:	See course homepage (link above).
Help:	For office hours, evening sessions, and tutoring, see our Moodle page.

Course description. This class covers the basic theory of finite-dimensional vector spaces over arbitrary fields. Topics include linear transformations, determinants, eigenvalues, eigenvectors, and diagonalization. Geometry of inner product spaces is examined in the setting of real and complex fields.

Learning outcomes. After taking this course, students will be able to:

» solve systems of linear equations;
» understand the concept of vector space, basis, dimension;
» express linear transformations as matrices and vice versa;
» compute determinants and understand their universal and geometric properties;
» find eigenvalues and eigenvectors of linear transformations, and understand their meaning;
» understand the geometry of inner product spaces;
» understand and produce proofs related to the above topics;
» solve open-ended problems related to the above topics;
» apply the above topics in relevant examples and applications; and
» communicate mathematical ideas verbally and in writing.

Distribution requirements. This course can be used towards your Group III, "Natural, Mathematical, and Psychological Science," requirement. It accomplishes the following goals for the group:

» Use and evaluate quantitative data or modeling, or use logical/mathematical reasoning to evaluate, test, or prove statements.
» Given a problem or question, formulate a hypothesis or conjecture, and design an experiment, collect data or use mathematical reasoning to test or validate it.

This course **does not** satisfy the "primary data collection and analysis" requirement.

Class attendance and participation. This is an in-person class. Therefore, when your health allows, you are expected to be present and engaged. At the same time, each community member has an individual responsibility to help prevent the spread of the coronavirus and other diseases. If you need to miss a class, or series of classes, due to illness, self-isolation, and/or quarantine, you are responsible for emailing me to let me know as soon as possible.

While in class, I expect you to actively engage in conversations by asking questions and participate in classroom discussions and activities. You are expected to **do the assigned reading in advance** of class, and that will help you to participate more effectively.

People have a tendency in math classes to think that their question is trivial or uninteresting. However, in fact, if you are confused about something—even if it feels like something that should be simple—count on at least half of your fellow students being confused on the same point. Asking that question is likely to come as a great relief to several of your classmates. Your questions will then encourage others to participate (and they are invaluable in helping me adjust the pace of the class).

Text. The fourth edition of *Linear Algebra* by Jim Hefferon is required for the course. A free PDF of the text is available here, and inexpensive physical copies are available at the Reed bookstore. Each lecture will be paired with a suggested reading. Lectures and readings are intended to be complementary, and you are expected to **engage with each reading ahead of the corresponding lecture**. Even skimming the reading before class will help all of us quite a lot.

Homework. Homework assignments will be posted on our course homepage and will be due via Gradescope.[1] Excellent solutions take many forms, but they all have the following characteristics:

» they use complete sentences, even when formulas or symbols are involved;
» they are written as explanations for other students in the course; in particular, they fully explain all of their reasoning and do not assume that the reader will fill in details;
» when graphical reasoning is called for, they include large, carefully drawn and labeled diagrams;
» they are neatly typeset using the LaTeX document preparation system. A guide to LaTeX resources is available on the course homepage.

The purpose of homework is for you to solidify your knowledge by putting it into practice. Some of the problems in the homework will be basic computations, and it might seem that you are not learning much from doing these. After all, you probably will never multiply matrices by hand in the future, in particular since there is software that can do that. It turns out that by thoughtfully doing these computations you can figure out trends that are deeply related to the theory that we are learning. In other words, these careful computations can be a means for better and deeper understanding. Most of the problems though will involve proofs. These will be challenging, and many of you will probably struggle with some of them. You should know that struggling is ok, it is how we learn.

I reserve the right to not accept late homework. If health or family matters might impede the timely completion of your homework, please contact me as early as possible.

Homework recommendations. Here are some strategies for efficiently learning from the homework assignments:

» start early, don't wait until the night before it's due to look at it;
» read all the problems, and identify the ones you can solve right away and the ones you can't;

[1] Gradescope is an online homework submission and evaluation platform. You are likely to already be enrolled in our Gradescope class. If not, you will be able to enroll using a link+code provided on our Moodle page.

» review your notes and the book carefully; even if you paid attention in lecture, you probably didn't get all the details (I recommend doing this *before* trying to attempt the problems);
» make an honest attempt to solve all the problems before seeking help;
» talk to others, you can really learn from each other (make sure you don't just get the solutions from someone else, and that you are learning and understanding from this process);
» if needed, go to my office hours, the evening sessions, tutoring sessions, or meet with an individual tutor.

Feedback. You will receive timely feedback on your homework via Gradescope, either from me or the course graders (other mathematics undergraduates). Most homework problems will be graded on a five-point scale (5 = perfect; 4 = minor mistake; 3 = major mistake, right idea; 2 = significant idea; 1 = attempted, 0 = none of the above). *The quality of your writing will be taken into account.* If your answer is incorrect, this will be reflected in the score, and there will also be a comment indicating where things went wrong with your solution. You are strongly encouraged to engage with this comment, understand your error, and try to come up with a correct solution. You are very welcome to post questions about old homework problems to the Slack channel (see below) and talk about them with me in office hours (see the Help section).

Collaboration. You are permitted and encouraged to work with your peers on homework problems. It is best practice to cite those with whom you worked, and you must write up solutions independently. **Duplicated solutions will not be accepted and constitute a violation of the Honor Principle.**

Tests. We will have two midterm exams and a final exam. Calculators, computers, phones, collaboration, books, and the Internet are prohibited during exams.

» Exam 1: distributed via email Monday, September 20; due via Gradescope Wednesday, September 22.
» Exam 2: distributed via email Monday, November 1; due via Gradescope Wednesday, November 3.
» Final exam: as scheduled by the Registrar, December 13–16. *Do not make travel plans that might conflict with the final exam.*

In-class presentations. During the last week of class, each of you will give a 5-minute presentation on an application of linear algebra to other areas (within or outside of mathematics). You will have to turn in a proposal for your presentation on Tuesday, November 23 (more information to come).

Grades: Your grade will be based on your performance on the homework, the midterms and final exam, the in-class presentation, and your participation.

Academic honesty: As noted above, for homework you should write your own solutions and disclose your collaborators. For exams, no collaboration is allowed. The internet is a great source of information about mathematics; you are welcome to search for information about the material of the course online, but you should not search for solutions to specific problems in the homework. You should not consult solutions to homework and exams from previous versions of this class. **Copying solutions from fellows students or from the Internet is an Honor Principle violation and will result in an academic misconduct report.**

Joint expectations. As members of a communal learning environment, we should all expect consideration, fairness, patience, and curiosity from each other. Our aim is to all learn more through cooperation and genuine listening and sharing, not to compete or show off. I expect diligence and academic and intellectual honesty from each of you. You should expect that I will do my best to focus the course on interesting, pertinent topics, and that I will provide feedback and guidance which will help you excel as a student.

Help. There are a number of resources you can access for help with this course's content. Everyone is welcome and encouraged to attend my **office hours**. They are an opportunity to clarify difficult material and also delve deeper into topics that interest you. Additionally, there will be two **evening problem sessions** for Math 201 each week. These will provide a structured, facilitated environment in which you can collaborate on homework and better understand the material. The math department also hosts general **drop-in tutoring** on most evenings preceding weekdays. Tutors will be available to clarify concepts and help you with homework problems. Specifics for all of the above can be found on our Moodle page. Finally, every Reed student is entitled to one hour of free **individual tutoring** per week. Use the tutoring app in IRIS to arrange to work with a student tutor.

Technology: The use of electronic devices (computers, cell phones, tablets, etc.) is not allowed in the classroom without my authorization. Browsing the internet, answering your email, and texting during class is rude—it disrupts learning. It distracts your classmates and your instructor. Talk to me if you have a specific reason for needing to use technology (for example, note-taking).

Slack. All three section of Math 201 will share a Slack channel. Use the Slack channel to ask questions (of me or the class), collaborate on problems, and share resources. The Slack channel is an extension of our classroom and joint expectations discussed above extend to this setting. You will receive an email invitation to join our Slack channel during the first week of classes.

Academic accommodations. If you have a documented disability requiring academic accommodation, please have Disability & Accessibility Resources (DAR) provide a letter during the first week of classes. We can then discuss your accommodations. I cannot provide accommodations after an assignment has been turned in or within 24 hours of an exam. If you believe you have an undocumented disability and that accommodations would ensure equal access to your Reed education, I would be happy to help you contact DAR.

Learning in the time of COVID:. We are all hoping that this semester will be as "normal" as possible, but it might not be. We still need to watch out for symptoms, and possibly isolate/quarantine. The following recommendations should guide your decision about coming to class:

» Self-isolation is the recommended course of action for anyone experiencing flu-like symptoms, whether due to possible coronavirus or to other illnesses. Please stay at home if you feel sick, and contact the Health and Counseling Center (HCC) or your healthcare provider to discuss. This is especially important if you think you may have an infectious disease.

» You should not attend class if you have tested positive for COVID-19 in the last 10 days, or if you have received notification or advice from the college or a health professional (including HCC staff) to quarantine or self-isolate.

» The CDC suggests that people with the any of the following symptoms may have COVID: fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, diarrhea. As always, please consult a medical professional (members of the HCC or otherwise) if you have any questions about your health or health safety.

» If you suspect or know you have been exposed to a case of COVID-19, contact the HCC right away to discuss your next steps.

For more information, visit the CDC's webpage on isolation and quarantine.

It is also possible that we may have bigger disruptions due to COVID. We will navigate the situation together, and I promise to maintain an open communication so that we all know what is going on. Potential changes that might happen depending on the situation include:

» Moving to a hybrid format, where some students are in the classroom and other students are remote.

» Moving to a fully remote version, with lectures being online.

» Changing the access to office hours to be fully remote.

» Instead of doing an in-class presentation, you will produce a 5-minute video.

A final remark: Learning and understanding mathematics requires engaging with the material several times. You might not get what is happening on the first try. Struggling with the material is normal, and maybe even expected. By actively participating in class, spending time working on the homework, reviewing the material, talking to classmates and talking to me, you will increase your understanding. Use the resources available!

Remember: *Math is hard, but we're going to get through this together!*

Weekly schedule

This is a rough version of the weekly schedule for topics covered in this class.

Week	Topics
1	Solving systems of linear equations, reduced echelon form, geometry of vectors in $\mathbb{R}^2$ and $\mathbb{R}^3$.
2	Vector spaces, subspaces, linear combinations, spans, linear independence.
3	Basis and dimension.
4	Row space and column space, linear transformations.
5	Range and null space, dimension theorem, matrices representing linear transformations.
6	Operations on linear transformations and operations on matrices.
7	Inverse of a matrix, elementary matrices, change of basis.
8	Determinants.
9	Eigenvalues and eigenvectors.
10	Eigenpaces, diagonalizability, Jordan canonical form, some applications to graph theory.
11	Inner products, Gram-Schmidt orthogonalization.
12	Orthogonal complement, orthogonal projection, least squares approximation, spectral theorem.
13	Student presentations.