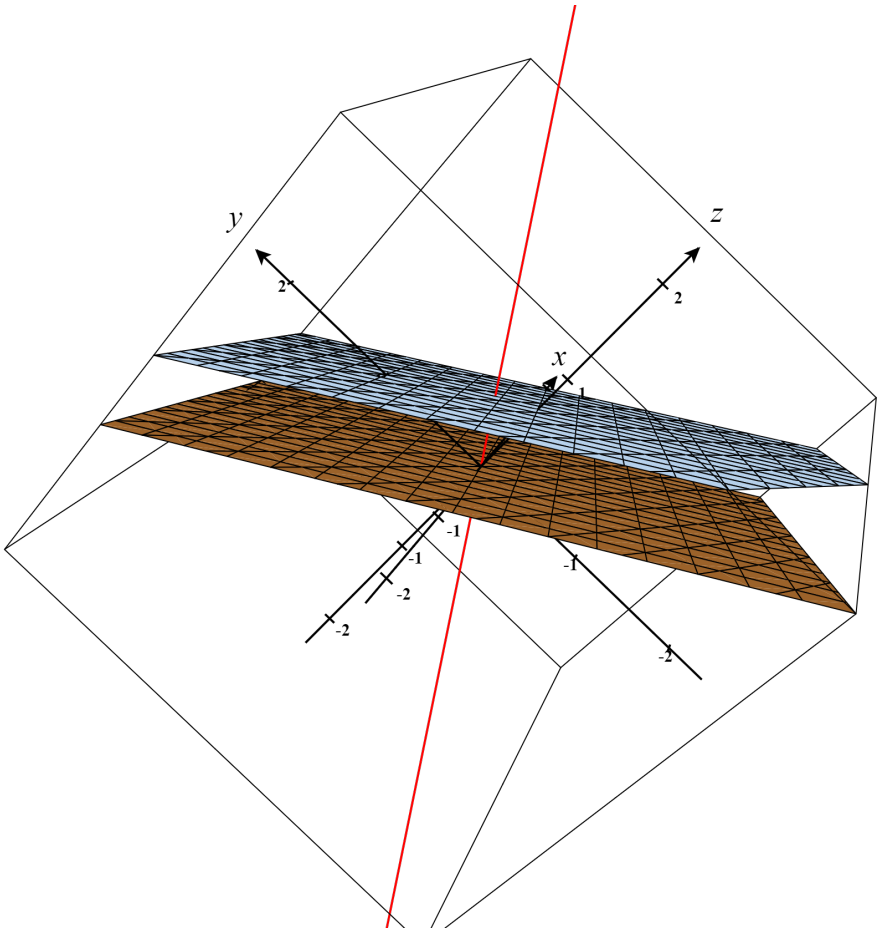
21-241 Matrices and Linear Transformations **Fall 2022**
Syllabus **Monday, August 29**

Welcome to Matrices and Linear Transformations! In this syllabus you will find basic information you need to navigate the course, a description of what we will be studying this semester, and advice intended to help you succeed in the course and make the class time enjoyable and productive. Please read this document carefully and save it as a reference. Don't worry if some of the mathematical terminology is new to you, we will be starting from scratch and will define all new concepts as they arise.



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1 Basic Information

Instructor

Instructor	David Offner
Email	`doffner@andrew` (Please use Piazza for non-personal messages)
Office Hours	MTWRF 2:30–3:30pm and by appointment, WEH 6219

Teaching assistants

TA (andrewID)	Recitation (day, time, location)
Gabriella Howse (ghowse)	G (R, 4:40–5:30pm, WEH 5409)
Pedro Marun (pmarun)	H (R, 1:25–2:15pm, PH A18A)
Jonathan Chiu (jchiu3)	I (R, 5:45–6:35pm, WEH 4625)
Alexandra Knox (akknox)	K (R, 12:20–1:10pm, PH A18A)
Felipe Mautner (fmautner)	L (R, 5:45–6:35pm, WEH 5403)
Tanay Bennur (tbennur)	M (R, 4:40–5:30pm, PH A18A)

Lecture times

Lecture 3	MWF 9:05–9:55, POS A35
Lecture 4	MWF 10:10-11:00, POS A35

Course materials

Course Website	`canvas.cmu.edu/courses/30188`
Required Textbook	*Introduction to Linear Algebra*, 5th edition, by Gilbert Strang
Corequisite	15-151 or 21-128

Course websites and communication: Course materials will be archived and resources will be linked at the course **Canvas** site. We will use **Piazza** for online out-of-class discussion and announcements. Rather than emailing questions to the teaching staff, you are encouraged to ask and answer questions there. We will use **Gradescope** for turning in and grading homework, quizzes, and exams. Both Piazza and Gradescope are linked from our Canvas site, and the Piazza site can be viewed directly at `piazza.com/cmu/fall2022/21241`.

Recitation: You are required to attend your scheduled recitation section, on Thursday. Recitations are instructional sessions with a more personal and interactive format than lecture where the TAs will lead discussions and introduce problems designed to help you build on what you learn in lecture.

Homework: There will be graded homework assignments, typically due at 8pm each Friday. As your lowest homework grade is dropped, late assignments will not be accepted. You are encouraged to collaborate on your homework with peers and discuss with myself and the TAs. However **you must independently write your own solutions, and you may not look at or copy anyone else's solutions.** Since typesetting with LaTeX is a worthwhile skill to learn, beginning with Homework 2, any homework typeset using LaTeX will receive one bonus point.

Quizzes: There will be brief online quizzes following each lecture, due before the following lecture. As the purpose of these is to help you keep up with the course, no late submissions will be accepted. You can drop 5 of these quizzes.

Midterms and final exam: We will have two in-class tests, scheduled for Friday, October 7 and Friday November 18. Absences will only be excused with a documented, university-approved excuse provided in advance. We will have a final exam scheduled by the registrar, and you should not leave campus before the final exam.

Project: There will be a final project where you will apply the linear algebra we have learned to a

computer science application of your choosing. Project topics will be chosen in November and the project will be due Friday, December 9.

Grading Concerns: Any questions regarding the grading of any assignment or test must be submitted as a regrade request through Gradescope **within 48 hours** of the grade being published.

Grades: Your grade will be calculated using a weighted average of your homework, two tests, quizzes, and final exam. It will be calculated using the more favorable of the following two formulas.

Formula 1		**Formula 2**	
Lower test score:	15%	Two tests:	25% each
Higher test score:	25%	Final:	30%
Final:	40%	HW (drop 1):	10%
HW (drop 1):	10%	Quizzes (drop 5):	5%
Quizzes (drop 5):	5%	Project:	5%
Project:	5%		

Grade cutoffs will be no higher than D: 60, C: 70, B: 80, A: 90.

Help: In addition to the course staff, this course is supported by the Carnegie Mellon Student Academic Success Center (`cmu.edu/student-success`) through peer tutoring and supplemental instruction (SI).

Academic Integrity: Any work you submit in this course must be your own, and not copied from a friend, book, online resource, or anywhere else. Carnegie Mellon's academic integrity policies as stated in the student handbook will be strictly enforced.
See `cmu.edu/policies/student-and-student-life/academic-integrity.html`

Accessibility: If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at `access@andrew.cmu.edu`.

2 Description of the course

From the course catalog: A first course in linear algebra intended for scientists, engineers, mathematicians and computer scientists. Students will be required to write some straightforward proofs. Topics to be covered: complex numbers, real and complex vectors and matrices, rowspace and columnspace of a matrix, rank and nullity, solving linear systems by row reduction of a matrix, inverse matrices and determinants, change of basis, linear transformations, inner product of vectors, orthonormal bases and the Gram-Schmidt process, eigenvectors and eigenvalues, diagonalization of a matrix, symmetric and orthogonal matrices.

Lectures 3 and 4 are specifically intended for students of computer science. In addition to the topics outlined in the course catalog, this course will focus on applications to computer science.

Learning objectives: Students will

- Identify which systems of linear equations have solutions, and find a complete solution.
- Identify which square matrices are invertible, and find the inverse of an invertible square matrix.

- Interpret matrices as linear transformations on vector spaces.
- Be familiar with the language of vector spaces, including span, linear independence, basis, and dimension.
- Find the rank of an $m \times n$ matrix, and describe the four fundamental subspaces corresponding to the matrix, including their dimensions.
- Find the projection of a vector onto a subspace and interpret as the best least squares solution to a system of equations.
- Find and interpret important matrix factorizations: LU, QR, diagonalization, and singular value decomposition.
- Find the determinant and eigenvalues of a square matrix and interpret them geometrically.
- Interpret the singular value decomposition of a matrix in terms of a best-fit subspace, best low-rank approximation, or principal component analysis.
- Perform matrix computations and find and manipulate matrix factorizations using Julia.

3 Take care of yourself

Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at `cmu.edu/counseling/`. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

CaPS: 412-268-2922
Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police
On campus: CMU Police: 412-268-2323
Off campus: 911

If you have questions about this or your coursework, please let me know. Thank you, and have a great semester.