

MATH 2270-01: Linear Algebra

Summer 2019 Syllabus

Time and Location: Monday, Tuesday, Wednesday, Thursday 10:00-11:00 in [JFB B-1](#)

Instructor: Sean Groathouse
he/him/his pronouns
preferred name/address: Sean

Email: sean@math.utah.edu

Office Location: [LCB Loft](#) (4th floor)

Office Hours: Mondays 11:15-12:15
Wednesdays 11:15-12:15
before and after class most days
or by appointment

Course Web Page: All course information and announcements will be posted on Canvas:
<https://utah.instructure.com/courses/566249>

Prerequisites: C or better in MATH 2210 or MATH 1260 or MATH 1320 or MATH 1321; or MATH 1220 and full major status in Computer Science or Computer Engineering.

Textbook: *Linear Algebra and its Applications*, 5th edition, by David C. Lay; ISBN: 9780321982384

Course Description: In this course, we study two objects: vectors and matrices. We start by thinking of vectors and matrices as arrays of numbers; then, we progress to thinking of vectors as elements of a vector space and matrices as linear transformations. In our study of vectors and matrices, we learn to solve systems of linear equations, familiarize ourselves with matrix algebra, and explore the theory of vector spaces. Key topics covered in this course include Euclidean space, linear systems, Gaussian elimination, determinants, inverses, vector spaces, linear transformations, quadratic forms, least squares and linear programming, eigenvalues and eigenvectors, and diagonalization. We will also explore applications in computing, science, and engineering.

Expected Learning Outcomes: At the end of the course, students will be able to:

- Understand the mathematical notation and geometric interpretation involved in the study of linear systems, and make connections between the two.
 - Students will understand the connection between Ax and a linear combination of vectors.
 - Students will conceptualize matrices as linear transformations.
 - Students will understand the properties of vector spaces.
- Perform matrix computations and understand them as examples of abstract mathematical concepts.
 - Students will perform row reductions and put matrices into echelon forms. Students will connect this to several theorems regarding span, linear independence, invertibility, and rank.
 - Students will calculate matrix-vector and matrix-matrix products, and think about these processes in the context of linear transformations.

- Students will find determinants, eigenvectors and eigenvalues, and link these concepts to existence and uniqueness of solutions.
- Students will compute dimension and bases of vector spaces, and develop these ideas in the context of linear transformations and change of coordinate systems.
- Recognize applications and interpretations of linear algebra concepts.
 - Students will develop approximations using orthogonal projection and Gram-Schmidt orthogonalization.
 - Students will link various linear algebra concepts to applications in computing, science, and engineering.

Calculators: Calculators are not required and will not be permitted on exams. Calculators (or free online calculator tools, or programming languages) may sometimes be helpful for homework.

Grading: Grades will have the following weights and scale:

Weekly Homework	24%
Weekly Quizzes	10%
Midterm 1	18%
Midterm 2	18%
Final Exam	30%

[93, 100] A	[80, 83) B-	[67, 70) D+
[90, 93) A-	[77, 80) C+	[63, 67) D
[87, 90) B+	[73, 77) C	[60, 63) D-
[83, 87) B	[70, 73) C-	[0, 60) E

Although I'm not philosophically opposed to curving grades, I find it's usually not necessary. If I do need to curve the grades, I will shift everything down by a few points (whatever is needed).

Weekly Homework: Homework will be assigned each week. Homework problems will be posted on Canvas on Tuesdays, and assignments will be due in class on the following Tuesday. I understand that sometimes homework cannot be completed on time due to circumstances beyond your control. While I will not accept late homework, I will drop the lowest two homework scores for each student.

Weekly Quizzes: We will have a short group quiz on Thursday each week that there is no exam. Since Thursday, July 4 is a holiday, we will have the quiz on Wednesday that week instead. There will be no makeup quizzes, but I will drop the lowest two quiz scores for each student.

Midterm Exams: There will be two, 60-minute midterm exams given in our regular classroom, JFB B-1, on Thursday, June 13, and Thursday, July 11. Each midterm exam will include material that has been covered in class since the previous midterm exam. Exam scores will not be dropped, but if your score on that section of the final exam is higher than your score on the midterm exam, your final exam score will replace your lowest midterm exam score when calculating your final course grade.

Final Exam: The final exam for this course will be comprehensive and will take place 10:00-12:00 on Thursday, August 1 in our regular classroom, JFB B-1.

This syllabus can change: I reserve the right to change the syllabus as needed during the semester. Any changes will be announced in class and on Canvas.

Class Policies

- I will post announcements, messages, and grades on Canvas, so it is crucial that you either check Canvas regularly or have Canvas notifications forwarded to an email that you do check.
- Please make sure you do your best throughout the semester, knowing the grading scheme and what's expected of you, and talk to me if you need further study strategies. I am happy to brainstorm ideas to help you maximize your study strategies and improve your mathematical understanding. No extra credit will be provided at the end of the course, so please talk with me early on about any concerns with your grade.
- If you have crisis-level extenuating circumstances which affect your class performance and you need guidance/advice/flexibility, please communicate with me as soon as possible so I can help you in some manner, which I'm truly happy to do. The longer you wait to communicate with me, the less I can do to help.
- If you want to appeal the grading of a homework assignment or exam, you must bring it to me within one week of it being returned. I'm happy to look it over with you, answer any questions you have, and fix any grading issues when appropriate.
- There will be no retakes of exams, for any reason.
- You are encouraged to work with others on the homework, but you must write up solutions yourself.
- Cheating will result in a grade of zero for that homework or exam. Depending on the severity of the cheating, additional consequences may include failing the course.

Other Policies and Resources

Math Tutoring Center: Please do not hesitate to come to office hours or contact me with any questions you have or to discuss anything about the course. Additionally, the T. Benny Rushing Mathematics Tutoring Center offers free tutoring. Tutoring will be available from 8:00 AM to 8:00 PM Monday through Thursday and 8:00 AM to 6:00 PM on Friday, beginning the second week of the semester. Their website can be found here: <https://www.math.utah.edu/ugrad/tutoring.html>

Private Tutoring: University Tutoring Services, 330 SSB (they offer inexpensive tutoring). There is also a list of tutors at the Math Department office in JWB 233.

Computer Lab: Also in the T. Benny Rushing Mathematics Student Center, Room 155C. Same hours as Tutoring center above. <http://www.math.utah.edu/ugrad/lab.html>

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the students' legal name as well as preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS), so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your U-ID card, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

Veterans Center: If you are a student veteran, the University of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8:00 AM – 5:00 PM. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>. Please also let me know if you need any additional support in this class for any reason.

Center for Student Wellness: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., may interfere with a students ability to succeed and thrive at the University of Utah. For helpful resources, contact the Center for Student Wellness: <https://wellness.utah.edu/>

ADA Statement: The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801- 581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585- 2677(COPS).

Faculty and Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know that they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty’s responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. See <http://regulations.utah.edu/academics/6-400.php>

Important Dates: We will meet for class every Monday, Tuesday, Wednesday, and Thursday except for these days:

- Monday, May 27 (Memorial Day holiday)
- Thursday, July 4 (Independence Day holiday)
- Wednesday, July 24 (Pioneer Day holiday)

Last day to add, drop, or elect CR/NC	Wednesday, May 22
Midterm 1	Thursday, June 13
Last day to withdraw	Friday, June 21
Midterm 2	Thursday, July 11
Final Exam	Thursday, August 1

Tentative Schedule:

Week 1 1.1 Systems of linear equations; 1.2 Row reduction and Echelon forms; 1.3 Vector equations; 1.4 Matrix equations

Week 2 1.5 Solution sets of linear systems; 1.6 Applications of linear systems; 1.7 Linear independence; 1.8 Introduction to linear transformations

Week 3 1.9 The matrix of a linear transformation; 2.1 Matrix operations; 2.2 The inverse of a matrix

Week 4 2.3 Characterizations of invertible matrices; 2.4 Partitioned matrices; 2.5 Matrix factorizations; 3.1 Introduction to determinants

Week 5 3.2 Properties of determinants; 3.3 Cramer's rule, volume, and linear transformations; Midterm

Week 6 4.1 Vector spaces and subspaces; 4.2 Null spaces, column spaces, and linear transformations; 4.3 Linearly independent sets and bases; 4.4 Coordinate systems

Week 7 4.5 The dimension of a vector space; 4.6 Rank; 4.7 Change of basis; 4.9 Markov Chains

Week 8 5.1 Eigenvectors and eigenvalues; 5.2 The characteristic equation; 5.3 Diagonalization; 5.4 Eigenvectors and linear transformations

Week 9 5.5 Complex eigenvalues; 5.6 Discrete dynamical systems; Midterm

Week 10 6.1 Inner product, length, and orthogonality; 6.2 Orthogonal sets; 6.3 Orthogonal projections; 6.4 The Gram-Schmidt process

Week 11 6.5 Least squares problems; 7.1 Diagonalization of symmetric matrices; 7.2 Quadratic forms

Week 12 7.3 Constrained optimization; 7.4 The singular value decomposition; Final Exam

Note: This is an approximate schedule, and I may need to adjust the pace for the learning needs of our class.