MATH 2318-04(17778): Linear Algebra
Spring 2023, MW 1:00 pm–2:30 pm

Course MATH 2318: Linear Algebra (Section 17778)

Instructor Andreas Mang

✉ andreas@math.uh.edu

☎ 713.743.7409

🌐 https://www.math.uh.edu/~andreas

Office PGH 614

Office Hours MW 10:00 AM–11:00 AM or by appointment (andreas@math.uh.edu)

Class Time MW 1:00 pm–2:30 pm in CBB 110

Course Website https://www.math.uh.edu/~andreas/teaching/math2318-SP23

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

1 Prerequisites

Credit for or concurrent enrollment in MATH 2414 (formerly, MATH 1432).

2 Textbook

This course will be based on the following textbook: Linear Algebra and Its Applications by David C. Lay, Steven R. Lay & Judi J. McDonald, Pearson, 6th Edition, 2020 (ISBN-13: 9780136880929).

You will not be required to purchase this textbook. All material discussed in class will be provided. Nonetheless, note that it may be helpful to go over the material in the book after or before it is discussed in class.

3 Course Description

Linear Algebra, rich in applications within mathematics and to many other disciplines, is potentially the most interesting and worthwhile undergraduate mathematics course you will complete. For many of you this is the first course to begin bridging the gap between concrete computations and abstract reasoning. Later in your career, computers will do the calculations, but you will have to choose the calculations, know how to interpret the results, and then explain the results to others. Understanding the notions of vector spaces, linear (in)dependence, dimension, and linear transformations will help you make sense of matrix manipulations at a deeper level, clarifying the underlying structure. A key aim of this course is that you will not only be equipped with a computational ability but with the ability to use these notions in their natural scientific contexts, and with an appreciation of their mathematical beauty and power.

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

4 Tentative Schedule/Course Content

Course material will be made available section by section on Blackboard. A detailed, tentative schedule can be found below.

Week	Topic	
1	Systems of Linear Equations	§1.1
	Row Reduction and Echelon Forms	§1.2
	Vector Equations	§1.3
	The Matrix Equation $\mathbf{Ax} = \mathbf{b}$	§1.4
2	Solutions Sets of Linear Systems	§1.5
	Linear Independence	§1.7
	Introduction to Linear Transformations	§1.8
	The Matrix of a Linear Transformation	§1.9
3	Matrix Operations	§2.1
	The Inverse of a Matrix	§2.2
	Characterization of Inverse Matrices	§2.3
	Partitioned Matrices	§2.4
4	Matrix Factorization	§2.5
	Subspaces of $\mathbb{R}^n$	§2.8
5	*Review/Catch up/Special Topics*	
	Midterm Exam #1	
6	Introductions to Determinants	§3.1
	Properties of Determinants	§3.2
	Vector Spaces and Subspaces	§4.1
	Null Spaces, Column Spaces, and Linear Transformations	§4.2
7	The Dimension of a Vector Space	§4.5
	Rank	§4.6
	Change of Basis	§4.7
	Eigenvectors and Eigenvalues	§5.1
8	The Characteristic Equation	§5.2
	Digitalization	§5.3
	Eigenvectors and Linear Transformations	§5.4
9	*Review/Catch up/Special Topics*	
	Midterm Exam #2	
10	Inner Product, Length, and Orthogonality	§6.1
	Orthogonal Sets	§6.2
11	Orthogonal Projections	§6.3
	The Gram-Schmidt Process	§6.4
	Least-Squares Problems	§6.5
	Diagonalization of Symmetric Matrices	§7.1
12	Quadratic Forms	§7.2
	The Singular Value Decomposition	§7.4
13 ff.	*Review/Catch up/Special Topics*	
	Last Day of Class	
	Final	

5 Course Delivery Format

This course will be delivered face-to-face (in person). In between class meetings, there may also be asynchronous activities to complete (e.g., homework assignments).

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

6 Syllabus Changes

Please note that the instructor may need to make modifications to the course syllabus and may do so at any time. Notice of such changes will be announced as quickly as possible through (specify how students will be notified of changes).

7 Attendance Policy

Attendance is not required, but strongly encouraged. Additional information can be found in §16. Coming to class late or leaving early is disruptive and thus discouraged.

8 Dropping Policy

02/01/2023   Official reporting day (ORD); drop a course without receiving a grade.
04/19/2023   Last day to drop a course or withdraw with a 'W'.
05/01/2023   Last day of class.

If you stop participating in assignments, and do not drop, and your name appears on the final class roll, you will receive a grade of F at the end of the semester.

9 Technical Equipment Needed

Students will need the following equipment to be able to follow classes: ● internet connection, ● ability to log in to Blackboard for online assignments, ● ability to access MS Teams for communications relevant for this class, and ● scanner or certain smartphone apps so that you can submit your homework as a PDF file. For technical problems, please contact UH IT Help Desk; your instructor might not be able to help with technical issues. Students that do not have access to the required equipment can find the needed computer equipment in the library. Additional information and technical support is available at https://www.uh.edu/infotech.

10 Evaluation Criteria

Students will be evaluated through homework assignments (see §10.1), two midterm exams, and one cumulative final (see §10.2). The grading criteria are described in §10.3.

For any assignment or test, illegible answers will be assumed to be incorrect and will receive no credit.

10.1 Homework Assignments

Homework assignments will be given on a weekly basis. There will be a total of approximately 10 homework assignments. Homework assignments will consist of exercises taken from the textbook (see §2; ''paper and pencil'') and programming exercises (Matlab; https://www.mathworks.com/products/matlab.html). In fairness to fellow students and graders, late homework will not be accepted. However, your lowest homework score throughout the term will be dropped to allow for missed assignments. Digital copies of your completed homework assignments have to be uploaded on Blackboard as a PDF every Monday at 10:00 pm (this is a sharp deadline; no late submission will be possible). (You can use a

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

scanner app on your preferred mobile device to create a PDF for upload if you do not have access to a scanner.) This will also be the *sharp* deadline for Matlab assignments to be submitted on Blackboard. *If you do not submit your homework on time you will receive a score of zero.* A list of problems will be posted by the previous Monday. If you cannot hand in your homework on the designated due date, make contact me by email *before the assigned due date. Homework scores cannot be changed after one week after they have been returned.* The homework will count 30% towards your overall grade (see §10.3). The Matlab assignments will be worth 10% of your homework score. The theoretical assignments will be worth 90%.

It is expected that you express your ideas clearly, legibly, and completely, which often requires complete English sentences (i.e., a justification) rather than a long string of equations or unconnected mathematical expressions. Illegible answers will be assumed to be incorrect and will receive no credit. Homework can and should be worked on and discussed with others. Collaboration is a big part of learning and of scholarship in general. I strongly encourage you to participate in study groups with fellow students attending this course. However, your write-up of the homework has to be independent, and in your own words. Your homework needs to be complete and neatly written. I reserve the right to deduct points if these rules are not followed. There will be *no makeup homework* (see §10.3 and §10.4 for details).

To help students with the Matlab assignments I provide a GitHub repository:

- Deployment page: https://andreasmang.github.io/axisb

- Code Repository: https://github.com/andreasmang/axisb

10.2 Exams

During the semester there will be two midterm exams and one (*cumulative*) final exam. The exams will contain a mixture of computational and conceptual problems. Some of them will resemble problems you have seen in your homework assignments or in class, while some may be brand new to you.

Exams shall be worked on independently and without the use of your textbook, homework, and class notes (*closed book*). Illegible answers will be assumed to be incorrect and will receive no credit. There will be **no makeup exams** (see §10.3 and §10.4 for details). Exam grades can be disputed until one week after they have been returned. After that your grade cannot be changed.

The exam period for the final is April 28 to May 6, 2023. A tentative schedule for the exams can be found in §10.3.

10.3 Grading

I reserve the right to modify the grading system. The final grade for the class will be determined as follows:

category	percentages	points	when (duration)	where
test/midterm 1	20%	$y_1 = 200$	02/15/23 @ 1:00 PM (90 min)	CBB 110
test/midterm 2	20%	$y_2 = 200$	03/22/23 @ 1:00 PM (90 min)	CBB 110
homework	30%	$y_3 = 300$		
final exam	30%	$y_4 = 300$	05/10/23 @ 2:00 PM (90 min)	CBB 110
total	100%	1000		

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

Final letter grades assigned for this course will be based on the percentage, x, of total points/semester score earned. That is,

$$x = 100\% \left(\frac{1}{1000} \left(\sum_{i=1}^{4} y_i \right) \right), \tag{1}$$

where y_i is the points per category as found in the table above. The letter grade will be assigned as follows:

letter grade	percentage	letter grade	percentage
A	$93\% \leq x \leq 100\%$	C	$73\% \leq x < 77\%$
A$-$	$90\% \leq x < 93\%$	C$-$	$70\% \leq x < 73\%$
B+	$87\% \leq x < 90\%$	D+	$67\% \leq x < 70\%$
B	$83\% \leq x < 87\%$	D	$63\% \leq x < 67\%$
B$-$	$80\% \leq x < 83\%$	D$-$	$60\% \leq x < 63\%$
C+	$77\% \leq x < 80\%$	F	$x < 60\%$

The lowest homework score obtained in this course will be dropped to allow for missed assignments. The lowest test/midterm exam score will be replaced by the grade of the final exam (with the appropriate 20% weighting for midterm exams), if the grade for the final exam is better. Grades for exams and homework assignments can be disputed until *one week* (7 days) after they have been returned. After that the grade cannot be changed.

10.4   Makeup Policy

Not turning in homework by the assigned due date or not taking an exam results in a *score of zero*. There will be *no makeup assignments*. Technology failures will not be accepted as reason for missed assignment due dates. Therefore, do not leave anything to the last minute. It is the student's responsibility to identify alternative ways to complete or submit an assignment. Exceptions are possible in the case of extreme circumstances, such as a documented, serious illness. In the event that a student cannot be present to turn in homework or take an exam on the day it is held the student needs to speak to me in advance, and make every attempt to do the work before (and not after) the rest of the class.

11   Office Hours

Office hours will take place either in person or online in one-on-one meetings (based on the student's preference). Please send me an email to make an appointment for office hours. I will keep the schedule for office hours (MoWe 10:00 AM–11:00 AM) open.

12   Dissemination of Course Material

The materials provided by the instructor in this course are for the *use of the students enrolled in the course only*. Course materials and course recordings (if permission was warranted) may not be further disseminated without instructor permission. This includes sharing content to commercial course material suppliers or public domain platforms. Students are also prohibited from sharing materials derived from the instructor's content (e.g., a student's lecture notes).

13   Recording of Class

Students may not record all or part of class, livestream all or part of class, or make/distribute screen captures, without advanced written consent of the instructor. If you have or think you may have a disability such that you need to record class-related activities, please contact the Justin Dart, Jr. Student Accessibility Center. If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Classes may be recorded by the instructor. Students may use instructor's recordings for their own studying and notetaking. Instructor's recordings are not authorized to be shared with anyone without the prior written approval of the instructor. Failure to comply with requirements regarding recordings will result in a disciplinary referral to the Dean of Students Office and may result in disciplinary action.

14   Cell Phones and Electronic Devices

During class and exam periods, all cell phones and other electronic devices must be turned off and kept in a secure location away from the students immediate view. The use of laptop computers in class is only permitted if students are using the computers to take notes or for purposes related to the class.

15   Academic Honesty/Honor Code

High ethical standards are critical to the integrity of any institution, and bear directly on the ultimate value of conferred degrees. All UH community members are expected to contribute to an atmosphere of the highest possible ethical standards. Maintaining such an atmosphere requires that any instances of academic dishonesty be recognized and addressed. The UH Academic Honesty Policy is designed to handle those instances with fairness to all parties involved: the students, the instructors, and the University itself. All students and faculty of the University of Houston are responsible for being familiar with this policy.

Posting answers for homework assignments online (at group chats or other online tools) is considered an academic honesty violation. Students are expected to know the difference between "getting and/or giving help on a problem" and "getting/giving answers to a problem." If a student is caught sharing answers (in person or online), they might be reported to the departmental hearing officer for an academic honesty violation. If a student becomes aware of cheating or any other violations; that student is responsible for informing the instructor.

16   Excused Absence Policy

Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston Undergraduate Excused Absence Policy and Graduate Excused Absence Policy for reasons including: medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Under these policies, students with excused absences will be provided with an opportunity to make up any quiz, exam or other work that contributes to the course grade or a satisfactory alternative. Please read the full policy for details regarding reasons for excused absences, the approval process, and extended absences. Additional policies address absences related to military service, religious holy days, pregnancy and related conditions, and disability.

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

17   Late Registration

No special accommodations will be made for students who register late for this class, miss class, or are denied access to Blackboard owing to late registration. It is the sole responsibility of the student to seek out and obtain course materials or announcements if they miss class or cannot access these items through Blackboard. No make-up exams or extensions on assignments will be granted for late registration. If you do encounter problems accessing the course material, please contact the TA and instructors immediately for help, in person and via email. We are best able to help you the sooner you let us know.

18   Communications and Announcements

Email communications related to this course will be sent to your Exchange Email Account, which each University of Houston student receives (or whichever email address is linked to your student ID on ACCESS UH). Exchange email accounts can be accessed by logging into Office 365 with your Cougarnet credentials or through Acccess UH. They can also be configured on IOS and Android mobile devices. Additional assistance can be found at the Get Help page.

19   Reasonable Academic Adjustments/Auxiliary Aids

The University of Houston complies with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, pertaining to the provision of reasonable academic adjustments/auxiliary aids for disabled students. In accordance with Section 504 and ADA guidelines, UH strives to provide reasonable academic adjustments/auxiliary aids to students who request and require them. If you believe that you have a disability requiring an academic adjustments/auxiliary aid, please contact the Justin Dart Jr. Student Accessibility Center (formerly the Justin Dart, Jr. Center for Students with DisABILITIES).

20   Mental Health/CAPS Statement

Counseling and Psychological Services (CAPS) can help students who are having difficulties managing stress, adjusting to college, or feeling sad and hopeless. You can reach CAPS (`https://www.uh.edu/caps`) by calling 713-743-5454 during and after business hours for routine appointments or if you or someone you know is in crisis. Also, there is no appointment necessary for the "Let's Talk" program (`https://www.uh.edu/caps/outreach/lets-talk`), which is a drop-in consultation service at convenient locations and hours around campus.

21   Religious Holy Days

Students whose religious beliefs prohibit class attendance or the completion of specific assignments on designated dates may obtain an excused absence. To do so, please make a written request for an excused absence and submit it to your instructor as soon as possible, to allow the instructor to make arrangements. For more information, see the Student Handbook (`http://catalog.uh.edu/index.php`).

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.

22   Title IX/Sexual Misconduct

Per the UHS Sexual Misconduct Policy, your instructor is a "responsible employee" for reporting purposes under Title IX regulations and state law and must report incidents of sexual misconduct (sexual harassment, non-consensual sexual contact, sexual assault, sexual exploitation, sexual intimidation, intimate partner violence, or stalking) about which they become aware to the Title IX office. Please know there are places on campus where you can make a report in confidence. You can find more information about resources on the Title IX website at `https://uh.edu/equal-opportunity/title-ix-sexual-misconduct/resources`.

23   Security Escorts and Cougar Ride

UHPD continually works with the University community to make the campus a safe place to learn, work, and live. Our Security escort service is designed for the community members who have safety concerns and would like to have a Security Officer walk with them, for their safety, as they make their way across campus. Based on availability either a UHPD Security Officer or Police Officer will escort students, faculty, and staff to locations beginning and ending on campus. If you feel that you need a Security Officer to walk with you for your safety please call 713-743-3333. Arrangements may be made for special needs.

Parking and Transportation Services also offers a late-night, on-demand shuttle service called Cougar Ride that provides rides to and from all on-campus shuttle stops, as well as the MD Anderson Library, Cougar Village/Moody Towers and the UH Technology Bridge. Rides can be requested through the UH Go app. Days and hours of operation can be found at `https://uh.edu/af-university-services/parking/cougar-ride`.

Information contained in this syllabus is subject to change without notice. This syllabus provides a general guideline for the course; deviations may be necessary. Students are expected to be aware of any additional course policies presented by the instructor during the course.