

MATH 2318-04 (16525): Linear Algebra

Spring 2024, MW 1:00 pm–2:30 pm

Course MATH 2318: Linear Algebra (Section 16525)

Instructor Andreas Mang

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Office PGH 614

Office Hours Mo 11:30 AM–12:30 PM or by appointment (andreas@math.uh.edu)

Class Time MoWe 1:00 pm–2:30 pm in SEC 204

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

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1 Prerequisites & Necessary Skills

Credit for or concurrent enrollment in MATH 2414.

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.

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4 Tentative Schedule/Course Content

Course material will be made available section by section on [Canvas](#). 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	<i>Review/Catch up/Special Topics</i>	
	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	<i>Review/Catch up/Special Topics</i>	
	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.	<i>Review/Catch up/Special Topics</i>	
	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).

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6 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 a fixed schedule for office hours (We 10:00 AM–11:00 AM) but am flexible to meet a student's availabilities.

7 Syllabus Revision

The instructor reserves the right to revise or adjust the course syllabus to best accommodate the pace and needs of the students. Notice of such changes will be announced as quickly as possible on Canvas and/or Teams as well as in class.

8 Communication Policy and Announcements

Email is the best way to get in touch with me (email: andreas@math.uh.edu). 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). To access your Cougarnet email, **login** to your Microsoft 365 account with your Cougarnet credentials. Visit **University Information Technology** (UIT) for instructions on how to connect your Cougarnet e-mail on a mobile device. Additional assistance can be found at the **Get Help** page. One possibility to access your email is to **login** to your Microsoft 365 account with your Cougarnet credentials.

9 Attendance Policy & Participation

Attendance is not required, but strongly encouraged. Additional information can be found in §20. Coming to class late or leaving early is disruptive and thus discouraged.

You should be logging onto Canvas on a regular basis to view assignments, course material, contribute to discussions, post questions, read posting of others, etc. Activities and assignments will be posted in advance providing ample time for completion. Please plan your schedules accordingly.

10 Evaluation Criteria

There are two types of assessment: Formative and summative. Formative assessment is for you to determine whether you are learning the material; essentially formative assessment consists of practice questions. There are no grades attached to formative assessment. You will notice that there are questions built into this course to assist you in studying. These questions are not graded; only you will know how well you did on these or whether you decided to skip them. I encourage you to complete all of the formative assessment to ensure the highest possible grade on your summative assessment. Summative assessment is graded. There are multiple summative assignments in this course.

You will be graded in three (3) ways: Students will be evaluated through (i) *homework assignments* (see §10.1), (ii) two *midterm exams*, and (iii) one cumulative *final exam* (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.

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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 **Canvas** as a PDF every Monday at 10:00 pm. This is a sharp deadline; no late submission will be possible. (You can use a 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 **Canvas**. *If you do not submit your homework on time you will receive a score of zero.* See the table below for details about late submissions. The times given below are exact; 1 second beyond any given time window puts you into the next category (per submission time shown on Canvas).

assignment	full credit	late submissions			
		≤60 sec	≤300 sec	≤30 min	>30 min
pencil & paper	20 points	-2 points	-5 points	-10 points	-20 points
matlab	5 points	-1 point	-2 points	-3 points	-5 points

You need to submit your pencil & paper homework as a **PDF**. If you submit it in any other format you will receive *score of zero*. You need to submit your Matlab assignment as an **m-file**. If you submit it in any other format 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 5% of your homework score. The theoretical assignments will be worth 95%.

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).

I maintain a GitHub repository to help students with the Matlab assignments:

- Deployment page: <https://andreamang.github.io/axisb>
- Code Repository: <https://github.com/andreamang/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 (theoretical work). Some of them will resemble problems you have seen in your homework assignments or in class, while some may be brand new to you.

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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 May 1 to May 9, 2024. 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%	$y_1 = 200$	02/19/24 @ 1:00 PM (90 min)	SEC 204
test/midterm 2	20%	$y_2 = 200$	03/25/24 @ 1:00 PM (90 min)	SEC 204
homework	30%	$y_3 = 300$		
final exam	30%	$y_4 = 300$	05/03/24 @ 12:00 PM (90 min)	SEC 204
total	100%	1000		

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

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

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 and time, 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 turn in homework on time 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.

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11 Dropping Policy

During the first week of classes you may drop a class with no grade recorded on your transcript. From the second week of classes through the ninth week (the 'auto W' period), you may withdraw from a class with an automatic grade of 'W'. This will be recorded on your transcript, but not included in your GPA.

After the ninth week (and before the final exam period), a student wishing to withdraw with a grade of 'W' must be passing the course at that time. You must complete a 'Drop Only' form and contact the offices listed for signatures before giving the form to the instructor. The instructor will confirm on the form that you are passing at that time for a 'W' grade or that your grade is an 'F'. This 'F' grade will be included in calculation of your GPA.

Faculty members are required to report any student who stops attending a class and does not withdraw (with a grade of 'W' or 'F'). Failure of a course due to non-attendance may affect financial aid award amounts.

01/31/2024 Official Reporting Day (ORD; withdraw without receiving a grade or drop a course)

04/17/2024 Last day to drop a course or withdraw with a 'W'.

04/29/2024 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.

12 Technical Equipment Needed

Students will need the following equipment to be able to follow classes: • internet connection, • ability to sign into **Canvas** to access course material and assignments, as well as to submit homework assignments, • ability to access MS Teams for communications relevant for this class, and • a 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>.

13 Technical Support

Students who need help accessing Canvas, resetting a password, using email, or with any technology problems, can contact their campus IT Helpdesk through **Live Chat**, **email**, phone-tel:1-713-743-1411 or by **submitting a support ticket**.

Students can also find answers to frequently asked technology questions in the **UH Knowledge Base** or in the **University Information Technology (UITS) quickstart guide**.

14 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).

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Copying or recording synchronous classes and asynchronous course materials without the express prior approval is prohibited. All copies and recordings remain the property of UH and the instructor. UH and the instructor reserve the right to retrieve, inspect, or destroy the copies and recordings after their intended use. These policies are not intended to affect the rights of students with disabilities under applicable law or UH policies.

15 Code of Student Rights, Responsibilities, and Conduct

It is important to build a class climate that is welcoming and safe for everyone. Please display respect for everyone in the class. Students are expected to adhere to the Code of Student Rights, Responsibilities, and Conduct at all times. Any inappropriate behavior, disruptive conduct (e.g., engaging in hostile or disrespectful commentary, or discussing irrelevant evidence) or non-compliance with faculty directions can result in a charge of Academic and/or Personal Misconduct, the consequence of which could be a variety of sanctions either from the instructor or the Dean of Students.

You should avoid racist, sexist, homophobic, or other negative language that may exclude members of our campus and classroom community. This holds for in class communications, email communications, as well as online discussions. Follow established rules of online etiquette to engage with faculty, instructors, teaching assistants, or your fellow students.

16 Accommodations

Every attempt will be made to accommodate qualified students with disabilities (e.g. mental health, learning, chronic health, physical, hearing, vision neurological, etc.) You must have established your eligibility for support services through the appropriate office that services students with disabilities. Note that services are confidential, may take time to put into place and are not retroactive; captions and alternate media for print materials may take three or more weeks to get produced. Please contact your campus office as soon as possible if accommodations are needed. Find your [campus office serving students with disabilities](#).

Any student with a disability who is experiencing barriers to learning, assessment or participation is encouraged to contact the Justin Dart, Jr. Student Accessibility Center (Dart Center) to learn more about academic accommodations and support that may be available to them. Students seeking academic accommodations will need to register with the Dart Center as soon as possible to ensure timely implementation of approved accommodations. Please contact the Dart Center by visiting the website: <https://uh.edu/accessibility> calling (713) 743-5400, or emailing jdcenter@Central.UH.EDU.

17 Academic Honesty

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.

All work should be your original product, unless explicitly noted otherwise. Honesty requires that any ideas or materials taken from another source for either written or oral use must be fully acknowledged.

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Any materials you reference or take from others should be properly cited. Cheating, plagiarism, or fabrication in any form will not be tolerated, regardless of any justification. Offering the work of someone else as one's own is plagiarism. The language or ideas thus taken from another may range from isolated formulas, sentences, or paragraphs to entire articles copied from books, periodicals, speeches, or the writings of other students. The offering of materials assembled or collected by others in the form of projects or collections without acknowledgment also is considered plagiarism. Any student who fails to give credit for ideas or materials taken from another source is guilty of plagiarism.

Academic misconduct will not be tolerated. The minimum consequence is failing the assignment. In a case of more serious offense, a student may fail the course. *Students should not present work from other courses in this class (i.e., using pieces of previous papers you have done is considered plagiarism).* I may use the services of [to](#) check for originality of your written work.

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.

18 Title IX Sexual Misconduct

As your instructor, one of my responsibilities is to help create a safe learning environment on our campus. Title IX and our own Sexual Misconduct policy prohibit sexual misconduct. If you have experienced sexual misconduct, or know someone who has, the University can help. If you are seeking help and would like to speak to someone confidentially, you can make an appointment with [CAPS](#).

It is also important that you know that federal regulations and University policy require me to promptly convey any information about potential sexual misconduct known to me to our Deputy Title IX Coordinator or UH's Title IX Coordinator. In that event, they will work with a small number of others on campus to ensure that appropriate measures are taken and resources are made available to the student who may have been harmed. Protecting a student's privacy is of utmost concern, and all involved will only share information with those that need to know to ensure the University can respond and assist.

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](#).

19 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

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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.

20 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](#).

If you plan to be absent from class activities for longer periods of time, please let me know and complete your work in advance. For a scheduled assignments or other course events, arrange with me for earlier date. In case you miss these scheduled events, you will receive a zero.

21 Late Registration

No special accommodations will be made for students who register late for this class, miss class, or are denied access to [Canvas](#) 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 [Canvas](#). 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.

22 Resources for Online Learning

The University of Houston is committed to student success, and provides information to optimize the online learning experience through our [Power-On](#) website. Please visit this website for a comprehensive set of resources, tools, and tips including: obtaining access to the internet, AccessUH, Blackboard, and Canvas; using your smartphone as a webcam; and downloading Microsoft Office 365 at no cost. For questions or assistance contact UHOnline@uh.edu.

23 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.

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24 Mental Health and Wellness Resources

The University of Houston has a number of resources to support students' mental health and overall wellness, including CoogsCARE and the UH Go App. UH Counseling and Psychological Services (CAPS) offers 24/7 mental health support for all students, addressing various concerns like stress, college adjustment and sadness. CAPS provides individual and couples counseling, group therapy, workshops and connections to other support services on and off-campus. For assistance visit <https://uh.edu/caps>, call 713-743-5454, or visit a Let's Talk location in-person or virtually. Let's Talk are daily, informal confidential consultations with CAPS therapists where no appointment or paperwork is needed.

The Student Health Center offers a Psychiatry Clinic for enrolled UH students. Call 713-743-5149 during clinic hours, Monday through Friday 8 a.m. - 4:30 p.m. to schedule an appointment.

The A.D. Bruce Religion Center offers spiritual support and a variety of programs centered on well-being.

Need Support Now? If you or someone you know is struggling or in crisis, help is available. Call CAPS crisis support 24/7 at 713-743-5454, or the National Suicide and Crisis Lifeline: call or text 988, or chat 988lifeline.org.

25 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>.

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