

# Math 2331-02 (4191): Linear Algebra

## Spring 2019, MW 1:00 pm–2:30 pm

**Instructor** Andreas Mang

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🌐 <https://www.math.uh.edu/~andreas>

**Office** PGH 614

**Office Hours** MW 11:00 pm–12:00 pm or by appointment ([andreas@math.uh.edu](mailto:andreas@math.uh.edu))

**Class Time and Place** MWF 1:00 pm–2:30 pm in CBB 110

**Course Website** <https://www.math.uh.edu/~andreas/teaching/math2331-SP19/>

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## 1 Prerequisites

Credit for or concurrent enrollment in MATH 1432.

## 2 Textbook

*Linear Algebra and Its Applications*, 4th Edition, by David C. Lay. ISBN10: 0321385179 ISBN13: 9780321385178

## 3 Course Content

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.

## 4 Dates, Recommended References & Other Readings

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

Week	Date	Topic	
1	01/14	Systems of Linear Equations	§1.1
	01/14	Row Reduction and Echelon Forms	§1.2
	01/16	Vector Equations	§1.3
	01/16	The Matrix Equation $\mathbf{Ax} = \mathbf{b}$	§1.4
2	01/21	<b>UH Holiday (no class)</b>	
	01/23	Solutions Sets of Linear Systems	§1.5
	01/23	Linear Independence	§1.7
3	01/28	Introduction to Linear Transformations	§1.8
	01/28	The Matrix of a Linear Transformation	§1.9
	01/30	Matrix Operations	§2.1
	01/30	The Inverse of a Matrix	§2.2
4	02/04	Characterization of Inverse Matrices	§2.3
	02/04	Partitioned Matrices	§2.4
	02/06	<i>Review/Catch up/Special Topics</i>	
5	02/11	<i>Review/Catch up/Special Topics</i>	
	02/13	<b>Midterm Exam #1</b>	§2.5
6	02/18	Matrix Factorization	§2.5
	02/18	Subspaces of $\mathbb{R}^n$	§2.8
	02/18	Introductions to Determinants	§3.1
	02/18	Properties of Determinants	§3.2
	02/20	Vector Spaces and Subspaces	§4.1
	02/20	Null Spaces, Column Spaces, and Linear Transformations	§4.2
7	02/25	The Dimension of a Vector Space	§4.5
	02/25	Rank	§4.6
	02/27	Change of Basis	§4.7
	02/27	Eigenvectors and Eigenvalues	§5.1
8	03/04	The Characteristic Equation	§5.2
	03/04	Digitalization	§5.3
	03/06	Eigenvectors and Linear Transformations	§5.4
	03/06	<i>Review/Catch up/Special Topics</i>	
9	03/11	<b>UH Holiday (no class)</b>	
	03/13	<b>UH Holiday (no class)</b>	
10	03/18	Inner Product, Length, and Orthogonality	§6.1
	03/18	Orthogonal Sets	§6.2
	03/20	<i>Review/Catch up/Special Topics</i>	
11	03/25	<b>Midterm Exam #2</b>	
	03/27	Orthogonal Projections	§6.3
	03/27	The Gram-Schmidt Process	§6.4
	04/01	Least-Squares Problems	§6.5
12	04/01	Diagonalization of Symmetric Matrices	§7.1
	04/03	Quadratic Forms	§7.2
	04/03	The Singular Value Decomposition	§7.4
	04/08	<i>Review/Catch up/Special Topics</i>	
13	04/10	<i>Review/Catch up/Special Topics</i>	
	04/15	<i>Review/Catch up/Special Topics</i>	
14	04/17	<i>Review/Catch up/Special Topics</i>	
	04/22	<i>Review/Catch up/Special Topics</i>	
15	04/24	<i>Review/Catch up/Special Topics</i>	
	04/29	<b>Last Day of Class</b>	
16	05/06	<b>Final</b>	

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## 5 Attendance Policy

Attendance is not required, but strongly encouraged. A student is considered present only if he/she has arrived on time and remains until the class is dismissed. Coming to class late or leaving early is disruptive and thus discouraged.

## 6 Dropping Policy

<b>January 30, 2019</b>	Official reporting day (ORD); drop a course without receiving a grade.
<b>April 4, 2019</b>	Last day to drop a course or withdraw with a 'W'.
<b>April 29, 2019</b>	Last day of class.

## 7 Evaluation Criteria

Students will be evaluated through homework assignments (see §7.1), (closed book, in class) quizzes (see §7.2), and two (closed book) midterm exams and one cumulative (closed book) final (see §7.3). The grading criteria are described in §8.

### 7.1 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. The homework has to be handed in every Monday at the end of the class, i.e.,  $\approx 2:15$  pm (i.e., whenever I leave the classroom). This will also be the *sharp* deadline for Matlab assignments to be submitted (see the homework cover sheet for detailed instructions on how to hand in the homework); if your Matlab homework arrives at 2:16 pm you will get a score of zero. If you turn in your homework after I left the classroom, you will get 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, stop by my office and hand it in *before the assigned due date*. Homework scores cannot be changed after one week after they have been returned.

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, neatly written, and stapled. It is also expected that you do not only send in (by email; see above) your Matlab solutions but also attach them to your handwritten homework (printout). I reserve the right to deduct points if these rules are not followed. There will be **no makeup homework** (see §8 and §9 for details).

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

- Deployment page: <https://andreamang.github.io/axisb>
- Code Repository: <https://github.com/andreamang/axisb>

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## 7.2 Quizzes

There will be a total of at most 10 quizzes (in class). These quizzes will cover the material of the homework you handed in on Monday that week. They will cover theoretical homework only (i.e., not the Matlab assignments). The day a quiz will take place will **not** be announced in class (“pop quizzes”). There will be **no makeup quizzes** (see §8 and §9 for details). Illegible answers will be assumed to be incorrect and will receive no credit.

## 7.3 Exams

During the semester there will be two midterm exams and one 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 and quizzes, 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. Illegible answers will be assumed to be incorrect and will receive no credit. There will be **no makeup exams** (see §8 and §9 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 1–9, 2019. The schedule for exam can be found in the schedule for the class (see §4) and, in greater detail, in §8.

## 8 Grading

The scheme for grading is tentative. The final grade for the class will be determined as follows:

category	percentages	points	when (duration)	where
test/midterm 1	20%	$y_1 = 100$	02/13 @ 1 pm (75min)	CBB 110
test/midterm 2	20%	$y_2 = 100$	03/25 @ 1 pm (75min)	CBB 110
homework and quizzes	30%	$y_3 = 150$		
final exam	30%	$y_4 = 150$	05/06 @ 2 pm (90min)	CBB 110
total	100%	500		

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

$$x = 100\% \left( \frac{1}{500} \sum_{i=1}^4 y_i \right).$$

The letter grade will be assigned as follows.

letter grade	percentage
A	$90\% \leq x \leq 100\%$
B	$80\% \leq x < 90\%$
C	$70\% \leq x < 80\%$
D	$60\% \leq x < 70\%$
F	$x < 60\%$

The lowest homework and quiz scores 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, quizzes, and homework assignments can be disputed until **one week** (7 days) after they have been returned. After that the grade cannot be changed.

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## 9 Makeup Policy

Not turning in homework by the assigned due date, missing a quiz, or not being present for 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.

## 10 Recording

If an individual student receives approval through the Student Academic Adjustments/Auxiliary Aids Form classroom activities may be recorded by that individual students for the personal, educational use of that student, and may not be further copied, distributed, published or otherwise used for any other purpose without the express written consent of the instructor. All students are advised that classroom activities may be taped by students for this purpose. Only audio recordings are permitted. No video recordings are allowed.

## 11 Academic Honesty/Honor Code

Plagiarism and cheating are serious offenses. The University policies on scholastic dishonesty will be strictly enforced (see Catalog/Student Handbook for more details).

## 12 Students Disability Services/Special Needs

If a student has a disability and would like to request classroom accommodations, please see me after class or during office hours to discuss arrangements as soon as possible (see contact information above).

**Academic Adjustments/Auxiliary Aids:** The University of Houston System 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 students who have a disability. In accordance with Section 504 and ADA guidelines, University of Houston 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 visit The Center for Students with DisABILITIES (CSD) website at <http://www.uh.edu/csd> for more information.

**Accommodation Forms:** Students seeking academic adjustments/auxiliary aids must, in a timely manner (usually at the beginning of the semester), provide their instructor with a current Student Accommodation Form (SAF) (paper copy or online version, as appropriate) from the CSD office before an approved accommodation can be implemented.

Details of this policy, and the corresponding responsibilities of the student are outlined in The Student Academic Adjustments/Auxiliary Aids Policy (01.D.09) document under [STEP 4: Student Submission (5.4.1 & 5.4.2), Page 6]. For more information please visit the Center for Students with Disabilities Student Resources page.

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Additionally, if a student is requesting a (CSD approved) testing accommodation, then the student will also complete a Request for Individualized Testing Accommodations (RITA) paper form to arrange for tests to be administered at the CSD office. CSD suggests that the student meet with their instructor during office hours and/or make an appointment to complete the RITA form to ensure confidentiality. RITA forms must be completed at least 48 hours in advance of the original test date. Please consult your counselor ahead of time to ensure that your tests are scheduled in a timely manner. Please keep in mind that if you run over the agreed upon time limit for your exam, you will be penalized in proportion to the amount of extra time taken.

### **13 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 (<http://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. No appointment is necessary for the "Let's Talk" program, a drop-in consultation service at convenient locations and hours around campus. [http://www.uh.edu/caps/outreach/lets\\_talk.html](http://www.uh.edu/caps/outreach/lets_talk.html).

### **14 Help**

CASA offers tutoring for mathematics students, and proctored testing for students in all subject areas. The CASA Tutoring Center offers tutoring to all students enrolled in undergraduate mathematics courses. It is located in room 222 — Garrison Gym. During weekdays, the Department of Mathematics offers tutoring for more advanced-level, undergraduate math courses. Tutoring sessions are located in M.U.S.L. 11 Fleming (basement). Tutoring hours are subject to change, so please check the dedicated websites before planning your schedule. More information on tutoring services, including scheduling information, can be found here: <http://www.uh.edu/nsm/math/undergraduate/academic-assistance/Support-and-Tutoring>.

### **15 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.