Mathematics 2270—1 Linear Algebra — Fall 2019

SYLLABUS - VERSION 6 - please discard all earlier versions!

Week	Date	Lecture	Topic	Textbook	Assignment
1	M 08/19/19	1	Introduction and Technicalities		
1	T 08/20/19	2	Systems of Linear Equations	1.1	
1	W 08/21/19	3	Row Reduction and Echelon Forms	1.2	
1	F 08/23/19	4	How to solve a linear system by hand		
2	M 08/26/19	5	Vector Equations	1.3	hw 2 op
2	T 08/27/19	6	The Matrix Equation $Ax = b$	1.4	
2	W 08/28/19	7	Solution Sets of Linear Systems	1.5	
2	F 08/30/19	8	Linear Independence	1.7	
3	M 09/02/19		**NO CLASS**		hw 3 op
3	T 09/03/19	9	Linear Transformations	1.8	hw 2 cl
3	W 09/04/19	10	The Matrix of a Linear Transformation	1.9	
3	F 09/06/19	11	Matrix Operations	2.1	
4	M 09/09/19	12	Review		hw 4 op
4	T 09/10/19	13	more Review		hw 3 cl
4	W 09/11/19	14	Exam 1 on Chapter 1		
4	F 09/13/19	15	Inverse of a Matrix	2.2	
5	M 09/16/19	16	Characterizations of Invertible Matrices	2.3	hw 5 op
5	T 09/17/19	17	Partitioned Matrices	2.4	hw 4 cl
5	W 09/18/19	18	Matrix Factorizations	2.5	
5	F 09/20/19	19	Introduction to Determinants	3.1	
6	M 09/23/19	20	Properties of Determinants	3.2	hw 6 op
6	T 09/24/19	21	Cramer's Rule, Volume, Linear Transformation	3.3	hw 5 cl
6	W 09/25/19	22	Vector Spaces and Subspaces	4.1	
6	F 09/27/19	23	Null Spaces, Column Spaces, and Linear Transformations	4.2	
7	M 09/30/19	24	Review		hw 7 op
7	T 10/01/19	25	more Review		hw 6 cl
7	W 10/02/19	26	Exam 2 on Chapters 2 and 3		
7	F 10/04/19	27	Linearly Independent Sets, Bases	4.3, 4.5	
8	M 10/07/19		**NO CLASS**		
8	T 10/08/19		**NO CLASS**		
8	W 10/09/19		**NO CLASS**		
8	F 10/11/19		**NO CLASS**		
9	M 10/14/19	28	Coordinate Systems and Isomorphisms	4.4	hw 8 op
9	T 10/15/19	29	Rank of a Matrix	4.6	hw 7 cl
9	W 10/16/19	30	Change of Basis	4.7	
9	F 10/18/19	31	Difference Equations	4.8	
10	M 10/21/19	32	Eigenvectors and Eigenvalues	5.1	hw 9 op
10	T 10/22/19	33	The Characteristic Equation	5.2	hw 8 cl
10	W 10/23/19	34	Diagonalization	5.3	
10	F 10/25/19	35	More on Eigenvalues	5.4-5	
11	M 10/28/19	36	The Gershgorin Theorem		hw 10 op
11	T 10/29/19	37	The Google Page Rank		hw 9 cl
11	W 10/30/19	38	Inner Product, Length, and Orthogonality	6.1	
11	F 11/01/19	39	Orthogonal Sets	6.2	
12	M 11/04/19	40	Review		hw 11 op
12	T 11/05/19	41	more Review		hw 10 cl
12	W 11/06/19	42	Exam 3 on Chapters 4 and 5		
12	F 11/08/19	43	Orthogonal Projections	6.3	
13	M 11/11/19	44	The Gram-Schmidt Process, The QR Factorization	6.4	hw 12 op
13	T 11/12/19	45	Least Squares Problems	6.5	hw 11 cl
13	W 11/13/19	46	Linear Models	6.6	
13	F 11/15/19	47	Inner Product Spaces	6.7	

Notes

Tentative: **This syllabus is subject to change!**

Linear Algebra: Linear Algebra is the mathematics of functions between **finite dimensional linear spaces**. The elements of those spaces are **vectors**, and the functions are **matrices**. That sounds pretty dry. But Linear Algebra is as central and fundamental to problem solving in Science and Engineering as is Calculus. That's why you need to learn about it. You will also see that it has a beautiful, rich, and *comprehensible* structure. I trust and hope that you will enjoy this class.

Instructor: Peter Alfeld, JWB 127, 801-581-6842, pa@math.utah.edu.

Class Home Page **www.math.utah.edu/~pa/2270**

Where and When: Our class meets MTWF 9:40-10:30am. On MWF we will meet in LCB 219, and on Tuesdays we meet in JFB 102.

Office Hours: I'm usually around and you should have no trouble finding me. I'll be pleased to meet with you before class in my office (JWB 127). You are also welcome just to drop by my office at any time, but be aware that I might not be there, or busy with somebody else. I teach another class right after ours, so I will have to leave right after class. If you need to make a special trip or other arrangements to see me let's make an appointment so you can be sure I'll be available.

Important Dates:

8/19/19 Classes begin

8/23/19 Last day to add a class without a permission code

8/30/19 Last day to drop a class without being charged tuition

10/18/19 Last day to withdraw from a class. You will be charged tuition.

12/5/19 Classes end.

12/6/19 Reading Day (no class)

12/12/19 Final Exam (8:00-10:00am, in LCB 219)

Grading: 13 home works (3% each), 4 exams (8% each), and one final exam (29%).

Fixed Scale: Grading is according to the following fixed scale.

$\geq 90\%$	$\geq 85\%$	$\geq 80\%$	$\geq 75\%$	$\geq 70\%$	$\geq 65\%$	$\geq 60\%$	$\geq 55\%$	$\geq 50\%$	$\geq 45\%$	$\geq 40\%$	**else**
A	**A−**	**B+**	**B**	**B−**	**C+**	**C**	**C−**	**D+**	**D**	**D−**	**E**

Class Notes: I prepare for class by writing notes before class. These will be online and you can look at them before class. They will contain gaps that we will fill in together, during class. I plan to project those notes onto a screen and fill them in by writing on my tablet. Later that day I will replace the online notes with their annotated version. An asterisk on our home page will mark that the replacement took place. The main purpose of making my notes available in this fashion is to enable you to pay full attention to our discussion without being distracted by having to take detailed notes

yourself. However, otherwise these notes come without warranties expressed or implied. The notes may contain errors (that hopefully will be recognized and corrected in class), and I may deviate from them during class. In particular, these notes are not eligible for our one point contest (see below).

Textbook: David Lay, Linear Algebra and its Applications, 5th. ed., ISBN 978-0-321-98238-4.

Home Work: There will be weekly home work assignments via MyLab Math. Home works will open every Monday morning one minute after midnight, and close eight days later on Tuesday evenings, one minute before midnight. The home work assignments will be taken from the textbook and will follow our class work closely. Each home work contains problems associated with the textbook sections we will cover that week. Thus at the beginning of the week we will not yet have discussed the subject matter for the home work of that week. That subject matter will be covered completely by the Friday of that week. The first home work will not count towards your grade since it may take some time to get things set up and working, and people may register for the class only after the semester has started.

Mid Term Exams: There will be four midterm exams. You will answer the exam questions on the exam itself. The exams are no books, notes, or electronic devices. The only item you need to bring to the exam is a dependable writing utensil.

Final Exam: The final exam will be a comprehensive written exam in LCB 219 on

Thursday, December 12, 2019, 8:00am-10:00am,

in our LCB 219. The format will be the same as the midterms, except the exam will be twice as long. It will cover the entire semester about evenly.

One Point Contest: I want the assignments in this class to be perfect, and fix any errors as soon as possible. Therefore, if you discover a mathematical or factual error in the printed materials (i.e., the home work problems, exams, or exam answers) and you bring it to my attention before I can fix it, you will receive one extra percentage point towards your final grade. This is fair because it requires you to think deeply about a problem, and it may also alleviate your frustration due to, for example, a mistake being confusing or causing you to waste time. But note that this contest only applies to **mathematical** and **factual** errors. I also appreciate if you bring other mistakes, like misspellings or grammatical errors, to my attention, but there are no extra points for those. The contest also does not apply to the daily class notes.

Make ups: You should make every effort to participate in all midterm exams. If you have to miss a midterm for a legitimate reason, then talk to me, preferably before, but no later than one week after the midterm. I will add the weight of the exam you missed to the weight of your final exam. Thus effectively you will get the same percentage on the missed midterm as you will on the final. That's reasonable since the final is comprehensive. If you need to miss an exam because of official university business and this procedure does not meet your needs please talk with me to make an alternative arrangement. Each individual home work counts for very little of your grade, you can do it anywhere you have an internet connections, and you do have a few days to make up the work if you fall behind. Therefore there will be no makeups for home works. Any make-up or substitute for the final exam itself will be an oral exam, and will be available only in exceptional circumstances.

How to Succeed in this Class

- **Promise:** If you follow the suggestions in this section you will **save time** and **understand** the subject more **deeply and more effectively**.

- Mathematics in general, and Linear Algebra in particular, is **hierarchical**. Everything we do in an organized class like this is a small extension of what we did previously, often the day before. If you understand what we did yesterday you will **easily understand** what we do today. If you do not, what we do today will be confusing, and making sense of it will be **difficult and time consuming**.

- Read the relevant section in the textbook before each class. After class make sure you understand what we did in class.

- Pay careful attention to the precise language we will develop in this class. If you don't understand a word or phrase, **stop**, go back and review that word or phrase before going on. If you don't understand the language you can't effectively think about the subject, and you won't understand it.

- Do the home work problems corresponding to a certain textbook section after we cover the topic in class, and before you attend the next class.

- Nowadays most linear algebra problems are solved by computer. We need to understand linear algebra so that we can tell computers what to do, and to understand what they are doing. So this class is focused on understanding concepts, facts, properties, and connections. We will do some (small) computations to deepen our understanding, and it's in the nature of computer graded home work that much of it is computational. However, you want to concentrate your attention on the concepts, rather than acquiring computational facility.

- You will often need to read my or your notes, or the textbook, **repeatedly** before you understand what's happening.

- **Come to class.** I will cover much more verbally than what is written in the notes.

- I recommend that you form a **study group** with one or two class mates and meet on a regular basis to study together and to work on the home work together. The purpose of the home work is to help you understand the subject, so you should organize your team work so that every member of your group understands fully what is happening in each problem.

- **Seek help!** Talk with your class mates, ask tutors in the math center, and don't hesitate to contact me with your queries.

Legal Matters

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 they are responsible for acting consistently with its content.

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 the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Sexual Misconduct: Title IX (of the Education Amendments Act of 1972) 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, veteran's 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).

Wellness Statement: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a students ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776. (Note: While I have no special expertise in these matters please don't hesitate to talk with me privately and confidentially about your personal circumstances if you believe this may be useful.)

Student Information: The instructors in our department have access to the following information about the students registered in their classes: Name, preferred name (if entered in your CIS account), your contact information, your student ID number, and your photograph (to help us learn your names) on your University ID card. Most of us, including me in particular, do not have access to other parts of your University Record.

Safety Statement: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.