Math 35100: Elementary Linear Algebra (Class No: 26021)

Prerequisite: Math 17100, Math 26100

Meets: MW 9:00 – 10:15a in IT 069
Final Exam: Wednesday, May 3, 8:00 – 10:00a

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Office Hours: M 1:35-3:00p, Tu 9:30-11:00a, W 3:10-4:00p, or by appointment
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Linear algebra is second only to calculus in terms of importance for applications. In many applications, the problem is formulated mathematically, it is then converted to a linear algebra problem (possibly without the user knowing it), the linear algebra problem is solved using a computer, and, finally, the results are interpreted. For example, many numerical routines for solving differential equations change the problem into a linear algebra problem first.

This is a mathematics course: We will develop the mathematics with theorems and their proofs. Throughout the course, we will remain conscious of the reliance on computers for real world computation, and there will be a formal computer component to the course. Most homework and test questions will be designed for paper and pencil computation, but you will be permitted (encouraged!!) to do your homework using a machine. You will be able to use *Matlab* software, capable of doing all the numerical computations required for the course, on many of the UITS machines on the IUPUI campus, including the lab on the first floor of IT. (*GNU Octave* is a *free(!)* numerical linear algebra package very similar to *Matlab*.) It is planned that the second midterm test and the final exam will be held in a computer laboratory so that you will be able to use *Matlab* software if you wish. The importance of computer computation will affect the development of some of the topics for the course. In many situations in linear algebra, the obvious method is not the one used in practice because it is too prone to error or too time consuming. We will always try to indicate the practical algorithms for solving linear algebra problems, and one of the goals of the course is to make it possible for you to understand the techniques used in linear algebra software, and read the documentation for such software.

The official text will be
Elementary Linear Algebra,
by Howard Anton, 10th edition, Wiley (ISBN 978-0-470-45821-1)
An alternate text, having the perspective of the course, will be
Introduction to Matrix Analysis for Engineering and Science,
by Carl Cowen (ISBN 0-9650717-6-6)
Reserve books in the library covering the topics of the course are both of the texts and also:
Introduction to Linear Algebra, by Gilbert Strang

Note: In this class, the homework assignments will be printed and handed out in class, and posted on the course web page, so it will not be necessary to purchase any text for the sole purpose of gaining access to the homework assignments.

There will be two midterm tests, each counting about 20-25% of your grade, and about 40% of your grade will come from the two–hour final exam scheduled for May 3. The first of the midterm tests will be a pencil and paper test lasting 70 minutes. If possible, the second midterm test and the final exam will be held in the computer lab, with 1.4 hours for the midterm and 2 hours for the final exam.

Weekly homework, class participation, and occasional quizzes will make up the remaining 15-20% of your grade. Make-up/late homework will **not** be graded for credit. Quizzes based on the homework will be announced in advance and will be the done the last ten minutes or so of the class, each quiz counting the same as one homework. No make-up/late quizzes will be graded for credit. The two lowest grades on homeworks or quizzes will be dropped, with missed homeworks and quizzes counted as zeros. In addition, there will be two or three *optional* projects that can be collaborative, that is, they can be individual or group projects. The grade on a completed optional project can replace a missing or low grade on a quiz or homework.

In this course, typically the median scores for tests are about 65% of possible points, with A's being about 85% or above, B's being about 65 to 85%, C's being about 50 to 65%, and D's being about 40-50% of possible points. Approximately this same scale will be used to assign final grades based on the total points from the homework, quizzes, mid-terms, and final exam.

An approximate syllabus is included below, but the developing schedule for the course will be announced in class and will also be on the website for the course, updated regularly.

You should show your all your work on homework and tests. Results of machine computations will be acceptable in **all** homework problems in place of hand computation; "show your work" in this case means writing down the computation you asked the machine to do and giving the result of this computation. (You should **NOT!!** attach a printout of your computer session!) Of course, justification and explanation of your computational work as well as proofs and your work on similar exercises will need to be written in the usual way.

My goals for you in this course are

Short term goal: That you master the ideas and computations of the course, both theoretical and applied.

Short term goal: That you become proficient in the language of linear algebra, as it is used both formally and informally in theoretical discussions and applications to problems from other disciplines.

Short term goal: That you develop your ability to read mathematics and learn from what you read.

Short term goal: That you develop your ability to write mathematics, and begin to develop your skill in creating and writing proofs, which are the explanations of why things in mathematics are true.

Long term goal: That you develop and sustain an excitement about mathematics and its connections to problems in the 'real world' generally, especially the mathematics you need in your professional and personal life, and that you can and do communicate that excitement to others.

General Academic Policies

There are a number of campus-wide policies governing the conduct of courses at IUPUI. These can be found at `http://registrar.iupui.edu/course_policies.html`

The work you submit for homework, quizzes, tests, and the final exam must be your own. For homework you will probably find it beneficial to consult with other students about the material and this kind of conversation and collaboration is encouraged. At the end of the consultation, however, each participant is expected to prepare their own summary of the discussion and their own solutions to the problems. The policies for this class will be those derived from IUPUI's policies on academic conduct and adaptive services. More information about student conduct can be found at

`http://registrar.iupui.edu/misconduct.html`

More information concerning adaptive educational services for learning or other disabilities at IUPUI can be found at `http://aes.iupui.edu/`

Some Important Dates

Date	
January 9	First Day of Classes
March 10	Last day to withdraw with adviser's signature and automatic "W" (Withdrawal after March 10 requires Dean's approval, which is rarely given)
March 11 to March 19	Spring Break!! no classes!
April 28	Last Day of Classes
May 3	Final Exam, 8:00–10:00a

Approximate Course Outline

Section numbers refer to the official text (Anton) and the alternate text (Cowen)

Anton	*Cowen*	*Topic*	*Lectures*
1.3,4,7	1.2,3	Matrix algebra, special types of matrices	1
4.2,9,10	1.3	Linear transformations, matrix multiplication as transformation	1
1.1	2.2	Systems of linear equations	1
1.2	2.3	Gaussian elimination	1
1.5	2.4	Inverses	1
2.1-2.3	2.6	Determinants	1
3.1,4,	3.2,3	Euclidean spaces, real vector spaces, and subspaces,	
4.1,2		linear combinations, spanning	1
4.3	3.4	Linear independence	1
4.4	3.5	Basis	2
4.5	3.6	Dimension	1
4.7,8	3.7,8	Rank-Nullity Theorem	2
		Midterm Test I (late February)	
6.1,2	4.2	Inner products	1
6.3	4.3	Gram-Schmidt algorithm	1
	4.4	Orthogonal complements and duality	2
	4.5	Matlab commands 'orth' and 'null'	1
6.4	5.2	Inconsistent systems	1
6.5	5.3	Least squares fitting of data	1
		Midterm Test II (early April, probably in computer lab)	
5.1	6.2	Eigenvalues and eigenvectors	2
(5.4)	(6.3,4)	Systems of differential equations (if time permits)	(?)
5.2	6.5	Similarity and diagonalization	2
	(6.6)	Matrix exponential (if time permits)	(?)
7.1,2,5	7.1	Hermitian matrices	2
		Review	1
		Final Exam (Wednesday, May 3, 8:00a – 10:00a, probably in computer lab)	