Math 351: Elementary Linear Algebra (Class No: 2937)

Meets: MW 4:30 – 5:45p in SL 137
Final Exam: Monday, December 15, 3:30p – 5:30p

Instructor: Carl Cowen **Office:** LD 224P **Phone:** 278-8846
Office Hours: MWF 10:30 – 11:00a, MW 3:00 – 4:00p, or by appointment
E-mail: ccowen@iupui.edu
URL: http://www.math.iupui.edu/~ccowen/Math351.html

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 second floor of LD. 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

Text: *Introduction to Matrix Analysis for Engineering and Science,*
by Carl Cowen (ISBN 0-9650717-6-6)

Books on reserve in the library that cover the topics of the course include the text and:

Linear Algebra and Its Applications, by Gilbert Strang.

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 given during Final Exam week (December 15). The first of the midterm tests will be a pencil and paper test lasting one hour. If possible, the second midterm test and the final exam will be held in the computer lab, with 1.5 hours for the midterm and 2 hours for the final exam.

Weekly homework and occasional quizzes will make up about 10–15% 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. No make-up/late quizzes will be graded for credit; the lowest quiz grade will be dropped, with missed quizzes counted as zeros.

If there is time in the course, there will be a project that will count about 5–10% of your grade. The project originated with a problem from Ford Motor Company. The problem data for each student will be different, but students are encouraged to work in groups to develop a strategy for the solution of the problems. If you choose to work in a group, together you need to solve all the problems from the students in the group and each participant will get the average grade for the problems assigned to group members.

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 unless *explicitly* asked to do so!) 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

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 services for learning or other disabilities at IUPUI can be found at `http://life.iupui.edu/aes/`

Some Important Dates

September 1	Labor Day, no classes
October 14	Last day to withdraw with automatic "W" (with permission of advisor)
November 11	Last day to withdraw (requires permission of advisor and instructor)
November 26	Thanksgiving Break!! no classes
December 15	Final Exam, 3:30p – 5:30p

Approximate Course Outline

Section numbers refer to the text *Introduction to Matrix Analysis for Engineering and Science* by Carl Cowen, Fifth Preliminary Edition.

Section	*Topic*	*Lectures*
1.2,3	Matrix algebra	2
2.2	Systems of linear equations	1
2.3	Gaussian elimination	2
2.4	Inverses	1
2.6	Determinants	1
3.2,3	Vector spaces and subspaces, Linear combinations, spanning	1
3.4	Linear independence	1
3.5	Basis	1
3.6	Dimension	1
3.7,8	Rank-Nullity Theorem	1
	Midterm Test I (probably Monday, October 6)	
4.2	Inner products	1
4.3	Gram-Schmidt algorithm	1
4.4	Orthogonal complements and duality	2
4.5	Matlab commands 'orth' and 'null'	1
5.2	Inconsistent systems	1
5.3	Least squares fitting of data	1
	Midterm Test II (possibly November 5, probably in computer lab)	
5.5	Project on circles in space	–
6.2	Eigenvalues and eigenvectors	2
6.3,4	Systems of differential equations	2
6.5	Similarity and diagonalization	2
(6.6)	Matrix exponential	(?)
(6.7)	More differential equations	(?)
7.1	Hermitian matrices	2
	Review	1
	Final Exam (Monday, December 15, 3:30p – 5:30p, probably in computer lab)	