Mathematics 2270-2
Linear Algebra
Fall semester 2004

Text: Linear Algebra with Applications, third edition, by Otto Bretscher
When: MW 4:10pm-6:00pm
Where: WBB 617
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Course web page: www.math.utah.edu/~allaud/2270/F04-WebPage.html

Prerequisites: Math 1210-1220, or Math 1250-1260, first year Calculus. Previous exposure to vectors, either in a multivariable Calculus course (e.g. 2210 or 1260) or in a Physics course, is helpful but not essential.

Course outline: This is the first semester in a year-long sequence devoted to linear mathematics. Our topic this semester is linear algebra, a fundamental area of mathematics that is used to describe and study a multitude of subjects in science and life. The origins of this field go back to the algebra which one must solve to find the intersection of two lines in a plane, or of several planes in space, or more generally the solution set of one or more simultaneous “linear” equations involving several variables.

The course begins in chapter 1 by studying linear systems of equations and the Gauss-Jordan method for systematically solving them. Linear algebra always has a “linear geometric” interpretation, and we begin studying the linear geometry of the Euclidean plane in chapter 2, as well as the relation between inverse matrices and inverse transformations. In chapter 3 we undertake a more systematic exploration of the linear geometry related to transformations and subspaces of \(\mathbb{R}^n\).

The relatively concrete concepts for subspaces of \(\mathbb{R}^n\) which we discuss in chapter 3, concepts including span, independence, basis, dimension and coordinates, actually apply to many other spaces, called “vector spaces” or “linear spaces”. These generalized notions have many common applications to seemingly diverse areas of mathematics, including the study of differential equations in Math 2280. So, in chapter 4 we study these notions abstractly.

You know what it means for two directions to be perpendicular, and may already have used the “dot product” to test for this condition. This notion of “orthogonality” is a major theme of linear algebra, and is the focus of chapter 5. We will study orthogonal projections and transformations, Gram-Schmidt orthogonalization, methods of least squares, notions of orthogonality for functions, Fourier series.

You have probably used determinants as a computational tool in high school algebra, but are probably not aware of all their uses and why their magic properties work. We will study determinants in detail in chapter 6, including their important geometric meaning related to oriented areas and volumes.

Related to the geometry of linear transformations there are special vectors known as eigenvectors. They also arise in the study of dynamical systems and in differential equations. These are the topics of chapter 7. In chapter 8 we will see some initial applications of eigenvectors, related
to conic sections, quadric surfaces, and the multivariable second derivative test. In Math 2280 you will see many more applications.

**Note:** we should be able to cover chapter 8, but if I need more time to make sure the first 7 chapters are well understood, I will skip part of this last chapter.

**computer projects:** There will be approximately 3 computer projects during the semester, to enhance and expand upon the material in the text. They will be written in the software package MAPLE. I do not assume you have had any previous experience with this software and I will make the necessary introductions during the first visit to the lab.

**tutoring center:** The Math Department Tutoring Center is located in Mines 210, and is open for free tutoring from 8 a.m. to 8 p.m. on M-Th, and from 8 a.m to 2 p.m. on Friday. Some, but not all of the math tutors welcome questions from Math 2270 students. To see the times and specialities of various tutors, consult the web address [www.math.utah.edu/ugrad/tutoring.html](http://www.math.utah.edu/ugrad/tutoring.html).

**grading:** There will be two midterms, a comprehensive final examination, and homework. (Homework assignments and other course information will be posted on the course web page.) Each midterm will count for 25% of your grade, homework (including book and Maple assignments) will count for 25%, and the final exam will make up the remaining 25%. I will post the due dates of homework assignments and Maple projects. A homework grader will partially grade your assignments.

As the homework is worth the same than an exam, I will not accept late assignments, you must be on time. Contact me in advance if for some important reason you know you will not be able to hand in a homework. Moreover homework is a good way to check that you have understood the material and also to discover features beyond the course.

**ADA Statement:** The American with Disabilities Act requires that reasonable accomodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact me at the beginning of the semester to discuss any such accommodations for the course.