

MATHEMATICS 2270-2. Fall 2002
Linear Algebra

Text: *Linear Algebra with Applications*, (2-nd edition), by Otto Bretscher.

When/Where: MW, 16:30 – 18:30, WBB 617.

Instructor: Prof. Michael Kapovich.

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Office hours: MW 12:00– 12:50 a.m. or by appointment.

Course web page: <http://www.math.utah.edu/~kapovich/teaching11.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.

Sections of the textbook to be covered:

Chapters 1–8. We will cover one section in 1–2 hours.

Exams: There will be a comprehensive final examination and two (1.5 hour long) midterm exams:

Exam 1: October 9.

Exam 2: November 25.

Final Exam: Monday, December 9, 18:00-20:00 in NS 201.

Overview: 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.

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. At the moment it is unclear where our MAPLE class will meet: at first we will try Math. Undergraduate Computer Lab, this is where we meet on Monday, Sept. 16 at our regular time. If this does not work out we will move to South Physics building, room 205. This building lies just north of the Math Department building JWB. Two more MAPLE classes will be held on: October 14 and November 27. We do not assume you have had any previous experience with this software and we will make the necessary introductions during the first visit to the lab.

Tutoring center: The Math Department Tutoring Center is located in T.Benny Rushing Math. Student Center (between JWB and LCB), 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. The tutoring center opens on August 28.

Some, but not all of the math tutors welcome questions from Math 2270 students. To see the times and specialties of various tutors, consult the web address 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 20% of your grade, homework (including book and Maple assignments) will count for 30%, and the final exam will make up the remaining 30%. The book homework will be (typically) assigned on Wednesdays and collected one week later. Maple projects will generally be due 2 weeks after they are assigned. If you are away on the day an assignment is due, you can send it to me by fax. Math department fax number is 581 4148. Put your name as well as *my name and the class number* on the fax sheet.

A homework grader will grade your assignments. The value of carefully working homework problems is that mathematics (like anything) must be practiced and experienced to be learned.

ADA Statement: The American with Disabilities Act requires that reasonable accommodations 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.

Ask questions both during the class, after the class if I have time, by email and during my office hours!

There will be no classes on Monday, September 2nd (Labor Day).