MATH 253A - Linear Algebra–Fall 2022

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Office Hours: Tuesday 8:30 - 11:30, Wednesday 10 - 11:30, Friday 10 - 11:30, and by appointment.
Text: *Linear Algebra with Applications*, Fifth Edition, by Otto Bretscher

Overview: Linear algebra plays a fundamental role in beginning to build the infrastructure of modern mathematics. In addition, the linear spaces we study in this course reappear in pretty much every branch of mathematics, and so they play a big role in all other courses offered by the department. You will learn to understand and use the language and theorems in both abstract and applied situations, gain insight into the nature of mathematical inquiry, and learn how to reason carefully and precisely about formally described situations.

In this course, you will

- develop a basic understanding of linear spaces, linear functions, matrices, and their applications.
- increase your appreciation of the power of abstract thinking.
- learn how to represent linear transformations as matrices, determine their images and kernels, find their eigenvalues, and generally examine linear transformations as deeply as possible.
- apply methods of linear algebra in various different settings, from differential equations to discrete dynamical systems.
- understand simple proofs and to produce examples of your own.
- prepare for more advanced mathematics courses.
- understand the role of hypotheses in mathematical statements and therefore be able to recognize the limits of applicability of standard results.

Semester Plan: We plan to cover the following sections in the textbook:

1. Linear Equations
Introduction to Linear Systems, Matrices, Vectors, and Gauss-Jordan Elimination, On the Solutions of Linear Systems; Matrix Algebra

2. Linear Transformations
Introduction to Linear Transformations and Their Inverses, Linear Transformations in Geometry, Matrix Products, The Inverse of a Linear Transformation

3. Subspaces of R^n and Their Dimensions
Image and Kernel of a Linear Transformation, Subspace of R^n ; Bases and Linear Independence, The Dimension of a Subspace of R^n, Coordinates

4. Linear Spaces
Introduction to Linear Spaces, Linear Transformations and Isomorphisms, The Matrix

of a Linear Transformation

5. Orthogonality and Least Squares
Orthogonal Projections and Orthonormal Bases, Gram-Schmidt Process and QR Factorization, Least Squares and Data Fitting

6. Determinants
Introduction to Determinants, Properties of the Determinant

7. Eigenvalues and Eigenvectors
Diagonalization, Finding the Eigenvalues of a Matrix, Finding the Eigenvectors of a Matrix, More on Dynamical Systems

Coursework: Your responsibilities include *reading the text*, *homework, quizzes*, *exams*, and a *final project*.

Reading: You are expected to be reading the material we are covering on a regular basis. This should include working through the examples and proofs in the text on a separate piece of paper to make sure that you understand every step.

Homework: There will be two types of homework for this course: pre-class exercises, and problem sets. The assigned homework is a intended to help you discover which topics you understand and which material needs to be reviewed in more depth. You may find that you need to do more problems than what is assigned for you to master the material. I will be happy to meet with you during office hours to follow up on any solutions that you didn't understand.

Pre-class Exercises: Pre-class exercises will be posted each day based on the reading. They are meant to to help you engage with the new definitions and theorems and self-assess your understanding. You should submit a pdf of your solutions to these exercises on Moodle before 8 am on the day they are due. You do not have to type these solutions. You work will be graded on completeness/effort only.

Problem Sets: Homework will be assigned daily on Moodle each week and are collected once each week, typically on Wednesdays. If you are sick or must otherwise miss class, ask someone to bring your homework to class or my office before the end of the class. I will drop your lowest homework score which will account for any unforeseen event that would prevent you from having your homework done on time.

Quizzes: We will have short quizzes this semester every Monday at the end of class. The quizzes are intended to help you practice the appropriate skills and to give you feedback on your progress. The material on these quizzes will be similar in scope to the assigned homework problems.

Exams: There will be two in-class exams and a final in this course. Exams are scheduled as follows:
Exam 1: October 7.
Exam 2: November 9.
The time of the final exam will be announced by the registrar later in the semester. College policy

says that the final exam can only be rescheduled if you have three or more finals scheduled close together or you have a religious holiday conflict. You can read the details on the registrar's webpage.

You must contact me before an exam if you will not be able to attend and we can discuss whether a make-up exam or other accommodation is reasonable or not.

Projects: We will complete the semester with a final group project that will culminate in a presentation to the entire class during the last two weeks of the semester. The projects will involve learning about certain applications of linear lagebra. I will give you more information about the projects and my expectations later in the semester.

Grading: Your grade will be determined as follows:

homework 15 %
quiz average 20 %
each exam 20 %
presentation 5 %.

Attendence:. Attendance is not part of the final grade in this course. I expect you to be in class unless you are sick, are observing a religious holiday, or have a professional obligation. If missing a class is unavoidable, please notify me in advance.

Community Standards: Collaboration is a big part of this course and will be explicitly permitted on many assignments. I encourage you to work together on the homework problems, but you must write up your solutions independently. This means that you should understand and be able to explain everything that you turn in. For proofs, you can work with each other on the outline, but your final draft should be written individually. Handing in work that someone else completed and you don't understand is a form of plagiarism. **To make this clear, you need to list the names of anyone who helped you (including the TAs) on your homework.** The quizzes and the exams should be completed without help from a person or book.

I know about Chegg and other online solution boards. It is usually very obvious when a student consults an online solution board to do their homework. Using these solutions boards is a form of academic dishonesty. It is also likely to be detrimental to your learning. When learning mathematics (or any topic) the struggle is important! It is what helps your brain form new connections and learn material. Before you consult an online solution board, ask yourself, what is motivating you to do so? Are you stuck? Come to my office hours, visit with the TA, or ask a friend for help. Are you worried about your grade? Keep in mind, it is unlikely that having the "wrong" answer to a single homework problem (or several) will negatively affect your grade. What is likely is that being found responsible for an academic honesty violation *will* have a negative affect on your grade. Stress and perceived pressure/high stakes can lead us to make decisions we might later regret. Before you make such a decision, pause and reconsider. The grading of this course is meant to help motivate you to maintain your academic integrity.

Accommodations for Learning Differences: Students with learning differences are encouraged to meet with me to discuss strategies for success. I am committed to helping all students succeed and to making reasonable accommodations for documented learning differences.