

Instructor: Jason Siefken

([siefkenj@math.northwestern.edu](mailto:siefkenj@math.northwestern.edu))

Office: Locy 203

Office Hours: T 1:00–2:00, W 2:00–4:00, or by appointment

Class: MWF 9:00–9:50 in Locy 318

Disc. Section: Th 9:00–9:50 in TEC M177

Textbook: *Linear Algebra and Its Applications* 5th Edition, by David Lay

Webpage: <http://www.math.northwestern.edu/~siefkenj/math240>

Linear algebra is the study of vectors, “flat spaces” like lines and planes, and linear transformations like rotations and scalings. Vectors originated in the study of physics and the 3D world, but through the mathematical practice of *abstraction*, we now use vectors to represent non-spacial things like physical forces, computer graphics, and music.

Transformations are functions that move vectors around, and in this class we will focus on *linear transformations*. Why? Because although humankind has striven to understand the non-linear phenomena of the universe, we haven’t gotten very far—the non-linear equations governing fluid flow still haven’t been solved! However, we have a complete theory of linear equations and linear transformations. One approach to answering general questions about the universe is to convert the problem into a linear one—one that we can understand better.

This course will also serve, for many of you, as an introduction to higher mathematics. That is, this course is not about memorizing procedures and solving scripted problems. This course is about harnessing logical thinking and creativity to convey sophisticated mathematical ideas to others. You heard right—math is a window through which humans understand the world, and ultimately it’s only useful if we can both understand the underlying ideas and communicate them to others

## LEARNING OUTCOMES

After taking this course, you will be able to:

- Solve systems of linear equations and matrix equations, write vectors in different bases, use the geometry of subspaces like row spaces, column spaces, null spaces, and eigenspaces to solve problems, and switch between geometric and algebraic points of view to aid problem solving.
- Work independently to understand concepts and procedures that have not been previously explained to you.
- Clearly and correctly express the mathematical ideas of linear algebra to others.

## TO SUCCEED

Learning is hard! It is exercise for the mind, and like exercise, when you’re doing it, it feels pretty uncomfortable (and if it doesn’t, you’re probably doing it wrong). Here are some tips to help you succeed academically (getting the grade you want) and intellectually (learning the most you can).

- Form a regularly-meeting study group of 3–4 people. Having others studying around you will help you study, and having someone to talk about confusing problems with will help you both productively struggle (which is how real-world problems are solved).
- Read the textbook *before* class. In class we will be working on problems that we haven’t gone over before. If you expose yourself to the concepts prior to class, you’ll get a lot more out of it.

## PREREQ'S

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To be prepared for this course, you should have a solid understanding of vectors in  $\mathbb{R}^n$ , dot and cross products, equations of lines and planes, and complex numbers.

## ASSESSMENT

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Your test-like assessment is divided into two categories: skill checks and take-home exams. You will be told ahead of time what procedures you will be responsible for executing on each skills check (for example, row reducing, writing down a complete solution to a system of linear equations, etc.). Your take-home exams will consist of non-routine problems and are a chance for you to demonstrate your ability to think mathematically and communicate clearly. Unlike homework, you must work individually on take-home exams and should not communicate with other students about the exam content until all exams are turned in.

Participation 5% It is essential that you attend and participate in both class and section. You don't have to be the most talkative person in the class to participate. If your participation grade is in jeopardy, you'll get a reminder before it's too late.

Skills Check 1 5% In-class on Thursday, October 13.

Take-home Midterm 1 10% Assigned Thursday, October 13. Due Monday, October 17.

Skills Check 2 5% In-class on Thursday, November 10.

Take-home Midterm 2 10% Assigned Thursday, November 10. Due Monday, November 14.

Homework 30% **Homework:** Homework will be assigned throughout the term and typically due at the beginning of class on Thursdays. You are encouraged to work together to solve homework problems, but *you* must write up your solutions to be turned in.

Most homework will focus on explaining problems rather than just "solving" them, and some homework must be typed in the  $\text{\LaTeX}$  typesetting system.  $\text{\LaTeX}$  is the industry standard for typing mathematics and other scientific papers. It has a learning curve but is well worth the effort. See the course webpage for details.

Final Skills Check 15% A comprehensive 2 hour skills check will be held on Thursday, December 8 at 3:00–5:00 PM in Locy 318.

Take-home Final 20% Due Monday, December 5

## POLICIES

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I have carefully planned the midterm and skills check dates, so please ensure you are available for each. If you miss a skills check for a justified reason (illness, family affliction, or other reason recognized by Northwestern's policies), I may be able to excuse it for you by weighting other tests more heavily. However, *there will be no makeup exams*.

If you have a disability/health consideration that may require accommodations, please contact the Office of Services for Students with Disabilities and register for AccessibleNU as soon as possible. All information will remain confidential. <http://www.northwestern.edu/accessiblenu>  
For the rest of Northwestern's policies, please see <http://policies.northwestern.edu>