

Course Description and Objectives

Linear algebra not only is a mathematically interesting subject on its own right, but also offers an array of powerful tools in scientific discipline. Applications in physics (and hence in almost of all of the sciences), statistics, and computing are perhaps the most common ones. For example, because of the way computers store and modify data, matrix is a natural object of study in computer science. A good understanding of matrices is essential in devising expedited algorithms for matrix operations. Personally, I've used linear algebra and matrices in classical mechanics when solving differential equations (physics), in analyzing a huge data set of loans (finance/statistics), and, of course, in many math courses, such as dynamical systems.

In my undergraduate days, I heard my math and physics professors often say “you can never know enough linear algebra.” My experiences tell me this maxim is worth following. Regardless of your field of study--science, statistics, applied math, or math--I strongly encourage you to get all of the course material under your belt. I can guarantee you will need to know about matrices in the near to distant future, whether in your upper-level engineering, science, or math courses, or in your job as an engineer (electrical, software, etc.), data analyst, or academic. Learning it now will save your time later.

I will discuss applications time permitting. But the priority goes to the foundation.

Our main goal is to understand the following concepts:

- solution to systems of linear equations
- matrix algebra
- matrix reductions
- linear transformations
- matrix inverses
- determinants
- matrix rank and dimension
- orthogonal projections and Gram-Schmidt process
- eigenvalues and eigenvectors

- diagonalization and spectral theorem
- least square solutions

In reality, we will encounter more concepts than the 11 listed above, but these are the major concepts in our course. All concepts that we will encounter in the course will be related to at least one of these in some manner. All major concepts are closely related to each other, too.