MATH 150 Linear Algebra
Spring 2015 · Syllabus

Class Information

Instructor: Dr. Lauren Williams
Class Meeting: MWF 10:30 - 11:35 in Hirt 209, T 11:40 - 12:45 in L306
Office: Old Main 401 (Tower)
Office Phone: (814) 824-2226
Office Hours: Mon 9:15-10:15 and 1-2, Tues 9:15-11:30, Wed 9:15-10:15 and 12:30-2, Fri 9:15-10:15
Email: lwilliams2@mercyhurst.edu
Website: `http://math.mercyhurst.edu/~lwilliams`

Course Description

This is a one semester course in linear algebra with computer applications. We will be covering the following topics: matrices and matrix properties, vectors and vector spaces, linear systems, and linear transformations. The class lectures will focus primarily on definitions and theory, with some simple calculations being performed without the aid of a computer. After learning the basic principles and theory of each topic, we will reinforce the material using the open source mathematics software SAGE. Through a series of lab experiments, you will also gain familiarity with the programming language Python. Many of these lab experiments will focus on applications of linear algebra to other areas of mathematics and other fields, including data science.

Topics will include vectors and vector arithmetic, solutions of linear systems, LU factorization, vector spaces and subspaces, the four fundamental subspaces, projections, determinants, eigenvalues and eigenvectors, symmetry, singular value decomposition, linear transformations, and applications.

Course Objectives

On successful completion of the course, students should be able to:

- describe the solution(s) of a system of linear equations, or be able to decide that one does not exist.
- be able to perform arithmetic operations on vectors and matrices, where defined.
- calculate the determinant of a matrix, and understand its significance.
- define a vector space and determine whether a set is a vector space.
- find the basis and dimension of a vector space.
- define and describe the four fundamental subspaces.
- define and identify linear maps.
- define and compute eigenvalues and eigenvectors.
- explain the geometric effect of a linear transformation on 2-dimensional spaces.
- produce and utilize simple Sage programs to perform computations related to all of the above topics.

Textbook

Introduction to Linear Algebra, by Gilbert Strang, 4th Edition (older editions are fine too). No other supplies are required for the course.

Homework

You will be given take home assignments approximately every week. These assignments will include questions taken directly from the text as well as additional problems related to topics well see in class. Late work will not be accepted. The assignments will be posted below, along with solutions after assignments are due. Your lowest homework grade will be dropped when calculating your final grade.

Lab Assignments

In addition to the homework assignments, you will have a weekly lab assignment. These will typically be completed during the lab meetings. If you need additional time on the lab, or if you are absent, the lab work may be completed at home and turned in by Friday of the week the assignment is given. Your lowest lab assignment grade will be dropped when calculating your final grade.

Lab assignments will be completed online through the course website. The site also features several tutorials on Sage and Python programming, including basic mathematics, plotting, lists, functions, loops, and a special tutorial on linear algebra with Sage.

You do not need to purchase any software or equipment for the labs, but you are free to use your own computer if you prefer.

Midterm Exams

We will have two midterm exams. You will be given an exact list of topics, along with a review sheet, approximately one week before each exam. Use of notes, textbooks, calculators, electronic devices, or other materials will not be permitted during an exam.

Exam Dates:
Wednesday, March 4
Wednesday, April 15

Final Exam

The final exam will be cumulative, and is scheduled for **Monday, May 11, 10:30-12:30.**

Final Grades

Grades will be calculated as follows:

30% - Average of midterm exams
30% - Average of homework assignments
15% - Average of lab assignments
25% - Final Exam

Grading scale:

F	D	D+	C	C+	B	B+	A
0-59	60-64	65-69	70-77	78-83	84-89	90-93	94-100

Quiz and exam grades will be posted on Blackboard, so you can keep track of your progress at any time.

Other Course Information

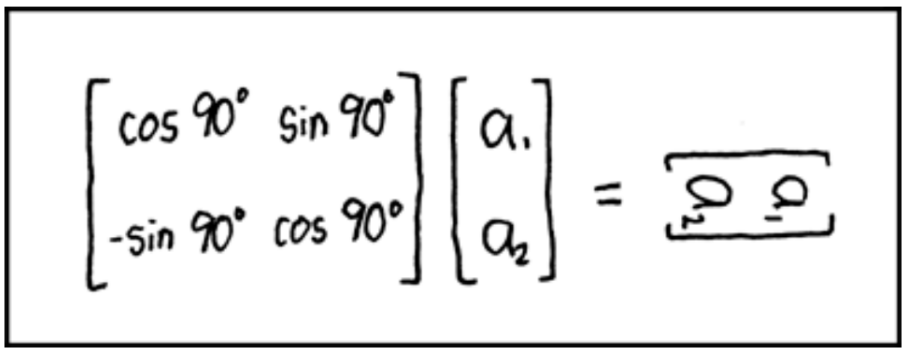
- You are neither expected nor required to purchase any materials for the course aside from the required textbook. Mathematical software could be used to check your work, but should not be relied on to do the work for you.
- I will attempt to return emails as thoroughly and promptly as possible. However, it is generally better to ask complicated questions during class or in office hours. If you have a question about the homework, it is quite likely someone else has the same question, so you're doing the class a favor by asking!
- There are other textbooks available in the library and in my office. Due to book prices, you may not want to invest in a second book, but it can be helpful to have alternate sources or see topics explained in other ways.
- I do not keep detailed lecture notes. It is highly recommended that you establish contacts among your classmates to get notes in case you miss class.
- Attendance is not required, but coming to class regularly will generally improve your grade. You are responsible for any work material covered in your absence. Please contact me if you are absent for an extended period.

Support of the Mercy Mission

This course supports the mission of Mercyhurst University by creating students who are intellectually creative. Students will foster this creativity by: applying critical thinking and qualitative reasoning techniques to new disciplines; developing, analyzing, and synthesizing scientific ideas; and engaging in innovative problem solving strategies.

Learning Differences

In keeping with college policy, any student with a disability who needs academic accommodations must call Learning Differences Program secretary at 824-3017, to arrange a confidential appointment with the director of the Learning Differences Program during the first week of classes.



xkcd.com

Useful Links

Below are a few links to some mathematics related websites and free linear algebra textbooks.

If you discover any resources that you find helpful during the semester, please let me know so I can add it to the list below.

- Sage
  `http://www.sagemath.org`
  An open source mathematics software system. Runs natively on Linux and Mac, but you can also run it within your browser. We'll be using this in the labs.

- MIT OpenCourseWare Site
  `http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/index.htm`
  A complete course designed by Gilbert Strang, using our textbook. Contains lecture notes, videos, homework assignments with solutions, exams, and links.

- Applets
  `http://math.mercyhurst.edu/~lwilliams/applets/appletmenu.html`
  I have created several applets for linear algebra that run in your browser and do not require Java or Flash.

- Khan Academy Linear Algebra Page
  `http://www.khanacademy.org/math/linear-algebra`
  Video tutorials for a range of topics we'll be covering. If you're not familiar with Khan Academy, be sure to look at the other subject pages, too.

- Linear Algebra, by Jim Hefferon, Saint Michael's College
  `http://joshua.smcvt.edu/linearalgebra`
  Free textbook in pdf format.

- A First Course in Linear Algebra, by Robert Beezer, University of Puget Sound
  `http://linear.ups.edu`
  Also free in pdf format, with an option to purchase a relatively inexpensive hardcover edition.

- Wolfram Alpha
  `http://www.wolframalpha.com`
  Ask it anything, and it'll almost always answer. Search for 'linear algebra' to see a list of functions you might be interested in. Then try some non-math related queries. From the makers of Mathematica.

- Linear Algebra Course Assistant
  `http://products.wolframalpha.com/courseassistants/linear-algebra.html`
  An app available for iOS, Android, or Windows Phone for linear algebra, also from Wolfram.

- The Math arXiv
  `http://arxiv.org/archive/math`
  An e-print archive with thousands of freely available papers in all areas of math (there's also a large physics arXiv). Most won't help with homework, but if you're interested in what mathematical research looks like, this is the place to start.

Math 150 Linear Algebra Course Schedule

Jan 28	**Topic**: Intro and Review	
Jan 30	**Topic**: 1.1 Vectors and Linear Combinations	
Feb 2	**Topic**: 1.2 Lengths and Dot Products	
Feb 4	**Topic**: 1.3 Matrices	**Homework 1 Due**
Feb 6	**Topic**: 2.1 Vectors and Linear Equations	
Feb 9	**Topic**: 2.2 The Idea of Elimination, 2.3 Elimination Using Matrices	
Feb 11	**Topic**: 2.3 Elimination Using Matrices	**Homework 2 Due**
Feb 13	**Topic**: 2.4 Rules for Matrix Operations	
Feb 16	**Topic**: 2.5 Inverse Matrices	
Feb 18	**Topic**: 2.5 Inverse Matrices	**Homework 3 Due**
Feb 20	**Topic**: 2.7 Transposes and Permutations	
Feb 23	**Topic**: 3.1 Spaces of Vectors	
Feb 25	**Topic**: 3.2 The Nullspace of A: Solving $Ax = 0$	**Homework 4 Due**
Feb 27	**Topic**: 3.3 The Rank and Reduced Echelon Form	
Mar 2	Review for Exam I	
Mar 4	**EXAM I**	**Homework 5 Due**
Mar 6	**Topic**: 3.4 The Complete Solution to $Ax = b$	
Mar 9 - 13	*Mid Semester Break - NO CLASS*	
Mar 16	**Topic**: 3.4 The Complete Solution to $Ax = b$	
Mar 18	**Topic**: 3.5 Independence, Basis, and Dimension	**Homework 6 Due**
Mar 20	**Topic**: 3.6 Dimensions of the Four Subspaces	
Mar 23	**Topic**: 4.1 Orthogonality of the Four Subspaces	
Mar 25	**Topic**: 4.2 Projections	**Homework 7 Due**
Mar 27	**Topic**: 4.3 Least Squares Approximations	
Mar 30	**Topic**: 4.4 Orthogonal Bases and Gram-Schmidt	
Apr 1	**Topic**: 5.1 The Properties of Determinants	**Homework 8 Due**
Apr 2	**Topic**: 5.2 Permutations and Cofactors	
Apr 3	*Easter Break - NO CLASS*	
Apr 6	*Easter Break - NO CLASS*	
Apr 8	**Topic**: 5.3 Cramer's Rule, Inverses, and Volumes	**Homework 9 Due**
Apr 10	**Topic**: 5.3 Cramer's Rule, Inverses, and Volumes	
Apr 13	Review for Exam II	
Apr 15	**EXAM II**	**Homework 10 Due**
Apr 17	**Topic**: 6.1 Introduction to Eigenvalues	
Apr 20	**Topic**: 6.2 Diagonalizing a Matrix	
Apr 22	**Topic**: 6.4 Symmetric Matrices, 6.5 Positive Definite Matrices	**Homework 11 Due**
Apr 24	**Topic**: 6.6 Similar Matrices	
Apr 27	**Topic**: 6.7 Singular Value Decomposition	
Apr 29	**Topic**: 7.1 The Idea of a Linear Transformation	**Homework 12 Due**
May 1	**Topic**: 7.2 The Matrix of a Linear Transformation	
May 4	**Topic**: 7.2 The Matrix of a Linear Transformation	
May 6	Review for Final Exam	**Homework 13 Due**
May 8	*Reading Day - NO CLASS*	
May 11	**FINAL EXAM 10:30-12:30**	