Math 150
Linear Algebra
Fall 2021

Section 01
MTWF
2:00 - 2:50 pm
Hirt 305

Instructor

Dr. Lauren Williams
Old Main 404
lwilliams@mercyhurst.edu
(814) 824-2226

Important Dates

Aug 25	First Class
Aug 30	Add-Drop Deadline
Sep 29	**Exam I**
Oct 19	Advising Day
Nov 3	**Exam II**
Nov 12	Pass-Fail Deadline
Nov 19	Withdrawal Deadline
Dec 9	Last Class
Dec 15	**Final Exam 1-3 pm**

Office Hours

Monday 12:00 - 12:50
Monday 4:00 - 5:00
Tuesday 9:00 - 10:00
Tuesday 1:00 - 1:50
Wednesday 12:00 - 12:50
Friday 8:00 - 8:50
and by appointment

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. We will also have time dedicated to applying the ideas learned in class to actual problems.

Topics will include vectors and vector arithmetic, solutions of linear systems, Gaussian elimination, inner products, vector spaces and subspaces, the four fundamental subspaces, determinants, eigenvalues and eigenvectors, symmetry, linear transformations, and applications.

Course Objectives

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

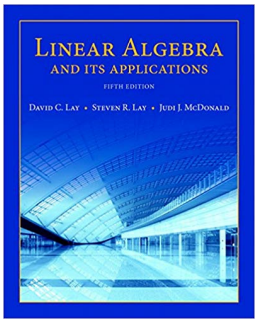
- describe the solution(s) of a system of linear equations, or decide that one does not exist.
- perform arithmetic operations on vectors and matrices, where defined.
- calculate the determinant of a matrix, and understand its significance.
- define a vector space and determine whether or not a set is a vector space.
- find the basis and dimension of a vector space.
- define and identify linear transformations and their properties.
- define and compute eigenvalues and eigenvectors.
- explain the geometric effect of a linear transformation on 2-dimensional and 3-dimensional spaces.

Dr. Williams' Website: https://www.integral-domain.org/lwilliams/

Prerequisites

Math 170 or equivalent, or instructor permission.

Required Materials



Textbook

Linear Algebra and its Applications, by David Lay, Steven Lay, and Judi McDonald, 5th Edition. If you have a different edition of the textbook, it is up to you to make sure the sections and assigned problems are the same.

You will not be expected to bring your textbook to class. If you prefer to purchase or rent an electronic version of the text, you are welcome to do so.

Course Components

Quizzes

Keeping up with the homework will ensure that you are prepared for the quizzes, which will feature problems very similar to those in the homework. Quiz grades will not be based strictly on whether or not you found the correct answer. Your work must also be written clearly, and with proper notation, to receive full credit.

If you miss a quiz, you must make arrangements to take it before the graded quizzes are returned to the class; this will typically be the next class meeting.

Exams

There will be two midterm exams given throughout the semester, in addition to a final exam. The material on the exams will be similar to topics covered on quizzes and homework. All exams should be considered cumulative; each exam will include some material from the previous exams.

If you need to miss class during a scheduled exam for a documented, excused reason (illness, family emergency, athletics), you will be able to make up the exam. You must schedule a time to retake any exam within one week of the day the exam was given in class.

Labs

While understanding the theory and mechanics of linear algebra is critical to truly applying it, the majority of the calculations we'll do "by hand" in class are actually done by a machine in the real world.

To help balance these two sides of linear algebra, we'll use most of our Tuesday class meeting time to explore applications and see how a computer algebra system (CAS) can make our work easier and faster.

In particular, we'll be experimenting with several libraries developed in the Python programming language. You will not have any required lab assignments for this course. Instead, consider the lab meetings as a kind of "show and tell" for linear algebra.

You will not need any supplies for these lab meetings. If you have a laptop, you are welcome to bring it and follow along or experiment on your own.

Grading

Your final grade will be calculated as follows:

Component	Value	Total Points
Quizzes (8 best)	20 points each	**160 points**
Exams (2)	100 points each	**200 points**
Final Exam	140 points each	**140 points**
		500 points

Your letter grade will be based on the total number of points you earn throughout the semester:

Grade	Percentage	Points Needed
A	90	**448**
B+	87	**433**
B	80	**398**
C+	77	**383**
C	70	**348**
D+	67	**333**
D	60	**298**

Other Course Information

- If you are struggling with a topic, please come to office hours as soon as possible. Tutoring for this course can not be expected through our usual department tutors, but it may be possible to arrange private assistance. Don't let yourself fall behind!
- There are other linear algebra 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. Two free texts available online:
  - Linear Algebra, by Jim Hefferon, Saint Michael's College
    http://joshua.smcvt.edu/linearalgebra/
  - A First Course in Linear Algebra, by Robert Beezer, University of Puget Sound
    http://linear.ups.edu/
- You are free to use any electronics (phone, tablet, laptop, etc) in class, but please use devices in a way that does not distract other students in the class.

ADA and Learning Differences

Mercyhurst University is committed to making reasonable accommodations for qualified students, and employees with disabilities as required by law. Please refer to the HUB

https://lakersmercyhurst.sharepoint.com/sites/StudentsHub

and select the Services tab, then ADA Accommodations from the dropdown for instructions to request an accommodation. You may also contact Susan Reddinger, ADA Coordinator, ADA@mercyhurst.edu, 814-824-2362, Egan Hall 200. For students with questions about Academic Support, please refer to the HUB

https://lakersmercyhurst.sharepoint.com/sites/StudentsHub

and select the Academic Resources tab, then Academic Support for more information.

Title IX Information

Mercyhurst is committed to providing an environment free from sex discrimination, including sexual harassment and sexual violence. Please refer to the HUB:

https://lakersmercyhurst.sharepoint.com/sites/StudentsHub

and select the Resources tab, then Title IX – Sexual Respect from the dropdown for more information. If you would like to file a sexual misconduct complaint, please contact Ann Miller, Title IX Coordinator and Compliance Officer, titleix@mercyhurst.edu, 814-824-2363. Please be aware that in compliance with Title IX, educators must report incidents of sexual assault/harassment, stalking, and domestic/dating violence. If you disclose any of these situations in class, in papers, or to me personally, I am required to report it to the Title IX Coordinator (or any of the Deputy Title IX Coordinators).

Academic Honesty

Students are required to uphold academic integrity throughout the course. In particular, plagiarism of any sort, unauthorized collaboration on exams, quizzes and other assignments, and other incidences of academic dishonesty will be handled according to the policies set forth in the Student Handbook.

Course Evaluations

Near the end of the semester, you will be asked to complete an online course evaluation. The evaluation will be completed in class during the last two weeks of the semester using any laptop, tablet, or mobile device. The response tool allows you to note aspects of the course that helped you learn, as well as aspects that might be modified to help future students learn more effectively. You will receive an email letting you know when the evaluation window for our class is open. Please note that these course evaluations are anonymous and instructors do not see the results until after the grades for the course are submitted.

Covid

Masks

University policy requires all individuals to wear face coverings while indoors on campus. Masks are not required while sitting alone at your office desk or while eating.

Food and Drink in the Classroom

In light of the COVID-19 situation, eating is not permitted in classrooms, labs, or other academic spaces. A water bottle or cup with a lid (and preferably a straw) is permitted to be used in classrooms and labs to help prevent a student from becoming dehydrated. Masks should be pulled only slightly away from the bottom of the face to take a quick drink and immediately replaced to cover the mouth and nose.

Homework

Suggested problems from the textbook for each section we will cover are included in this syllabus. Your work will not be collected. However, actually working through these problems is the key to your success in this class. Attending every class is not enough; mathematics can only be learned through practice. It is expected that you spend approximately 8-12 hours per week studying the material outside our class meetings, according to the typical 2-3 hours per credit rule.

Most of the problems will have solutions in the back of the textbook. Make sure to check your work. The exams will be based primarily on these problems. While you are encouraged to work together on the homework, be sure you understand all material on your own before a quiz or exam.

Sec.	Problems
1.1	1, 3, 7, 9, 11, 13, 15, 17, 19, 21, 23, 24, 26
1.2	1, 5, 7, 9, 11, 13, 15, 19
1.3	1, 5, 9, 11, 13, 15, 19, 23
1.4	1, 5, 7, 9, 11, 13, 15, 21, 25, 37
1.5	1, 3, 5, 7, 9, 11, 33, 35
1.7	1, 3, 5, 7, 9, 11, 15-20, 21, 29, 31
1.8	1, 3, 5, 9, 11, 13, 15, 17
1.9	1, 3, 9, 15, 17, 19, 21, 37
2.1	1, 3, 5, 7, 9, 11, 12, 15, 23, 27
2.2	1, 3, 5, 7, 9, 17, 18, 29, 31, 33
2.3	1, 3, 5, 7, 9, 13, 15, 23, 33
2.5	3, 5, 9, 11, 19
3.1	1, 3, 5, 9, 11, 13, 19, 21, 23, 37, 41
3.2	15, 17, 19, 21, 23, 25, 27, 29, 33, 35, 37, 39
3.3	1, 3, 5, 7, 19, 21, 23, 27
4.1	1, 3, 5, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17, 18, 21
4.2	1, 3, 5, 7, 9, 11, 23
4.3	1, 3, 5, 7, 9, 15, 19, 21
4.5	1, 3, 5, 7, 9, 11, 13, 15, 17, 25
4.7	1, 7, 9
5.1	1, 3, 5, 7, 9, 11, 13, 17, 19, 21, 24
5.2	1, 3, 5, 7, 9, 13, 15, 21
5.3	1, 5, 7, 9, 11, 21, 27
5.5	1, 3, 5
6.1	1, 3, 5, 7, 9, 11, 15, 17, 19, 23, 25, 27
6.2	1, 5, 9, 11, 13
6.4	1, 5, 11, 15

Math 150 Linear Algebra - Fall 2021 Semester Schedule

Monday	Tuesday	Wednesday	Friday
		Aug 25 Class Intro	**Aug 26** 1.1 Systems of Linear Equations
Aug 30 *Add/Drop Deadline* 1.1 Systems of Linear Equations	**Aug 31** Lab: Intro to Python	**Sep 1** 1.2 Row Reduction and Echelon Forms	**Sep 3** Quiz 1.2 Row Reduction and Echelon Forms
Sep 6 *Labor Day*	**Sep 7** Lab: Interpolation	**Sep 8** 1.3 Vector Equations	**Sep 10** Quiz 1.4 The Matrix Equation $Ax = b$
Sep 13 1.5 Solution Sets of Linear Equations	**Sep 14** Lab: Consumption Matrices	**Sep 15** 1.7 Linear Independence	**Sep 17** Quiz 1.8 Introduction to Linear Transformations
Sep 20 1.8 Introduction to Linear Transformations	**Sep 21** Lab: Leslie Models	**Sep 22** 1.9 The Matrix of a Linear Transformation	**Sep 24** Quiz 2.1 Matrix Operations
Sep 27 2.2 The Inverse of a Matrix	**Sep 28** Lab: Color Transformation	**Sep 29** **Exam I**	**Oct 1** 2.2 The Inverse of a Matrix
Oct 4 2.3 Characterizations of Invertible Matrices	**Oct 5** Lab: Matrices in Physics and Engineering	**Oct 6** 2.5 Matrix Factorization	**Oct 8** Quiz 2.5 Matrix Factorization
Oct 11 3.1 Introduction to Determinants	**Oct 12** Lab: Hill Ciphers	**Oct 13** 3.1 Introduction to Determinants	*Oct 15* *Fall Break*
Oct 18 3.2 Properties of Determinants	*Oct 19* *Advising Day*	**Oct 20** 3.2 Properties of Determinants	**Oct 22** Quiz 3.3 Cramer's Rule
Oct 25 4.1 Vector Spaces and Subspaces	**Oct 26** Lab: Principal Component Analysis	**Oct 27** 4.1 Vector Spaces and Subspaces	**Oct 29** Quiz 4.2 Null Spaces, Column Spaces
Nov 1 4.3 Linearly Independent Sets and Bases	**Nov 2** Lab: Linear Algebra Meets Statistics	**Nov 3** **Exam II**	**Nov 5** 4.5 The Dimension of a Vector Space, 4.6 Rank
Nov 8 4.5 The Dimension of a Vector Space, 4.6 Rank	**Nov 9** Lab: Coordinate Systems	**Nov 10** 5.1 Eigenvectors and Eigenvalues	**Nov 12** Quiz 5.1 Eigenvectors and Eigenvalues
Nov 15 5.2 The Characteristic Equation	**Nov 16** Lab: Page Rank	**Nov 17** 5.3 Diagonalization	**Nov 19** Quiz 5.3 Diagonalizations
Nov 22 5.3 Diagonalization	**Nov 23** Lab: Data Clustering	*Nov 24* *Thanksgiving Break*	*Nov 26* *Thanksgiving Break*
Nov 29 5.4 Eigenvalues and Linear Transformations	**Nov 30** Lab: Complex Numbers	**Dec 1** 6.1 Inner Product, Length, Orthogonality	**Dec 3** Quiz 6.1 Inner Product, Length, Orthogonality
Dec 6 6.2 Orthogonal Sets	**Dec 7** Lab: Gram-Schmidt	**Dec 8** Review/Recap	*Dec 10* *Reading Day*
Dec 13	*Dec 14*	**Dec 15** **Final Exam 1-3 pm**	