Math 150
Linear Algebra
Spring 2019

Section 01

MTWF

2:00 - 2:50 am

Hirt 213

Instructor

Dr. Lauren Williams

Old Main 404

lwilliams@mercyhurst.edu

(814) 824-2226

Important Dates

Jan 14	First Class
Jan 21	MLK Day
Feb 22	Exam I
Mar 4-8	Spring Break
Apr 2	Advising Day
Apr 12	Exam II
Apr 19-22	Easter Break
May 6	Reading Day
May 8	Final Exam 1-3 pm

Office Hours

Monday 3:00 - 4:00

Tuesday 12:00 - 1:30

Thursday 8:00 - 9:30

Friday 9:00 - 11:00

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 implementing the ideas learned in class using the open source numerical computation software Scilab. 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, 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.
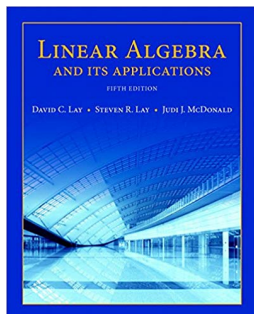
Course Website: http://math.mercyhurst.edu/~lwilliams/Math150/index.php

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.

Software

On Tuesdays, we will explore applications of linear algebra using the computer to solve problems that would be unreasonable to approach by hand. While some programming will be involved, you are not expected to have any experience in programming.

We will be working with the free, open source numerical computation software Scilab. This software is available for download at

https://www.scilab.org/

and may be installed on any computer running Windows, Mac OS, or Linux. You will need to install Java in order to run Scilab.

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.

Stay up to date with homework, and get help if you cannot understand a problem after trying it on your own. Do not ignore a problem that you are struggling with. If you are having trouble with a topic, please come talk to me during office hours, ask questions in class, or seek help from a classmate. You are expected to try to work on all problems on your own first; when coming to my office, be prepared to show me what you've already tried.

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 the 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.

Lab Exam

During the last Tuesday lab meeting, you will be given a set of problems to complete using Scilab. This exam will be open note and based on previous work in the lab, so be sure to take careful notes during each meeting.

Final Exam

The final exam is cumulative, including material from all sections covered in class unless otherwise specified. Most questions on the final will be taken (with minor modifications) from homework, quizzes, and previous exams. Material from the labs and lab exam will NOT be included.

You are required to take the final exam for this course regardless of your average on earlier exams or quizzes. If you will not be able to take the final exam at its scheduled time, please make alternate arrangements as soon as possible. Final exams may be made up for excused absences only.

The final exam is scheduled for Wednesday, May 8, 1:00 - 3:00 pm.

Progress

Quiz and exam grades will be posted on Blackboard throughout the semester.

GRADING

200 POINTS Midterm Exams
2 exams, 100 points each

150 POINTS Quizzes
10 quizzes, 15 points each

75 POINTS Lab Exam

125 POINTS Final Exam

550 POINTS Possible Total

GRADING SCALE

D	D+	C	C+	B	B+	A
328	366	383	421	438	476	493
60%	67%	70%	77%	80%	87%	90%

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!

- Attendance is not required, but is highly recommended. If you have to miss class, read the relevant section of the textbook and try the suggested problems, and ask a classmate for notes and information you may have missed. I do not keep detailed lecture notes for this course.

- 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/

- I do not have a "no electronics" policy, but please remember to mute all devices during lecture, and use devices in a way that does not distract other students in the class.

- You will be allowed to listen to music (with headphones) during exams, but please keep the volume at a level that does not distract other students. Plan a playlist in advance - your phone/player will need to be kept face down on the desk throughout the exam.

Learning Differences

Mercyhurst University is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. Students with disabilities requiring accommodations should complete and submit this form:
https://www.mercyhurst.edu/sites/default/files/uploads/%3Cem%3EEdit%20Simple%3C/em%3E%20Student%20Consumer%20Information/accommodation_general.pdf
and the required documentation to the Director of Equal Opportunity Programs (DEOP), 300 Old Main, aagnew@mercyhurst.edu. Accommodations will not be granted prior to approval by the DEOP and will not be provided retroactively. Further information is available by visiting the Learning Differences website:
http://www.mercyhurst.edu/academics/learning-differences-program

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.

Semester Schedule

Monday	Tuesday	Wednesday	Friday
Jan 14 Class Intro	**Jan 15** Lab	**Jan 16** 1.1 Systems of Linear Equations	**Jan 18**　　*Add/Drop Deadline* 1.1 Systems of Linear Equations
Jan 21 *MLK Day*	**Jan 22** Lab	**Jan 23** 1.2 Row Reduction and Echelon Forms	**Jan 25**　　**Quiz** 1.3 Vector Equations
Jan 28 1.4 The Matrix Equation $Ax = b$	**Jan 29** Lab	**Jan 30** 1.5 Solution Sets of Linear Equations	**Feb 1**　　**Quiz** 1.5 Solution Sets of Linear Equations
Feb 4 1.7 Linear Independence	**Feb 5** Lab	**Feb 6** 1.8 Introduction to Linear Transformations	**Feb 8**　　**Quiz** 1.9 The Matrix of a Linear Transformation
Feb 11 1.9 The Matrix of a Linear Transformation	**Feb 12** Lab	**Feb 13** 2.1 Matrix Operations	**Feb 15**　　**Quiz** 2.2 The Inverse of a Matrix
Feb 18 2.2 The Inverse of a Matrix	**Feb 19** Lab	**Feb 20** Review	**Feb 22** **Exam I**
Feb 25 2.3 Characterizations of Invertible Matrices	**Feb 26** Lab	**Feb 27** 2.4 Partitioned Matrices	**Mar 1**　　**Quiz** 2.5 Matrix Factorizations
Mar 4 *Spring Break*	*Mar 5* *Spring Break*	*Mar 6* *Spring Break*	*Mar 8* *Spring Break*
Mar 11 3.1 Introduction to Determinants	**Mar 12** Lab	**Mar 13** 3.2 Properties of Determinants	**Mar 15**　　**Quiz** 3.3 Cramer's Rule
Mar 18 3.3 Cramer's Rule	**Mar 19** Lab	**Mar 20** 4.1 Vector Spaces and Subspaces	**Mar 22**　　**Quiz** 4.1 Vector Spaces and Subspaces
Mar 25 4.2 Null Spaces, Column Spaces	**Mar 26** Lab	**Mar 27** 4.3 Linearly Independent Sets and Bases	**Mar 29**　　**Quiz** 4.4 Coordinate Systems
Apr 1 4.5 The Dimension of a Vector Space, 4.6 Rank	*Apr 2* *Advising Day*	**Apr 3** 4.7 Change of Basis	**Apr 5**　　**Quiz** 5.1 Eigenvectors and Eigenvalues
Apr 8 5.2 The Characteristic Equation	**Apr 9** Lab	**Apr 10** Review	**Apr 12**　　*Last day to withdraw* **Exam II**
Apr 15 5.3 Diagonalization	**Apr 16** Lab	**Apr 17** 5.5 Complex Eigenvalues	*Apr 19* *Easter Break*
Apr 22 *Easter Break*	**Apr 23** Lab	**Apr 24** 6.1 Inner Product, Length, Orthogonality	**Apr 26**　　**Quiz** 6.2 Orthogonal Sets
Apr 29 7.1 Diagonalization of Symmetric Matrices	**Apr 30** Lab Exam	**May 1** 7.4 Singular Value Decomposition	**May 3** Review
May 6 *Reading Day*	*May 7*	**May 8** **Final Exam 1:00 - 3:00**	

HOMEWORK LIST

Sec.	Problems
1.1	1, 3, 5, 7, 9, 11, 13, 17, 19, 23, 26, 29, 31
1.2	1, 3, 5, 7, 11, 15, 17, 19, 21, 23, 29
1.3	1, 3, 5, 9, 11, 13, 15, 17, 19, 21, 23
1.4	1, 2, 3, 4, 5, 9, 11, 13, 15, 25, 29
1.5	1, 3, 5, 7, 11, 19, 27, 29, 31, 35
1.7	1, 3, 5, 7, 9, 15, 17, 19, 21, 25, 29
1.8	1, 3, 5, 8, 9, 13, 15, 17, 21, 33
1.9	1, 3, 5, 8, 13, 15, 17, 19, 21, 23
2.1	1, 2, 3, 7, 9, 10, 11, 15, 17, 21, 27
2.2	1, 2, 3, 4, 5, 7, 9, 18, 29, 31, 33
2.3	1, 3, 5, 7, 11, 13, 15, 33
2.4	1, 3, 5, 7
2.5	No homework (will not be on exam)
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
4.4	1, 3, 5, 7, 9
4.5	1, 3, 5, 7, 9, 11, 13, 15, 17, 25
4.6	5, 9, 11, 13
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, 3, 5, 7, 9
7.1	No homework (will not be on exam)
7.4	No homework (will not be on exam)