MTH 308 Linear Algebra and Differential Equations

Spring 2023

Lecture MTW in Centennial 2311, **Lab** Th in Wing 6

Instructor: Chad Vidden
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Office Hours: See Canvas for schedule, or by appointment, virtual office hours by request
Course Website: UWL Canvas Site: http://www.uwlax.edu/canvas/
Textbook: *Linear Algebra and its Applications by Lay et al, 5th Edition*

Course Description: This course will study linear algebra with emphasis on computer programming and applications. Specific topics include systems of linear equations, matrix operations, linear independence, linear transformations, matrix factorization, vector spaces and subspaces in R^n, basis and dimension, determinants, eigenvalues and eigenvectors, diagonalization, systems of first order linear differential equations, dynamical systems, inner products and orthogonality, least squares, and singular value decomposition. Software will be integrated throughout the course to complement mathematical content. Lect. 3 credit, Lab. 1 credit.

Prerequisite: Grade of "C" or better in MTH 208 or MTH 265 or (MTH 207 and CS 225 or MTH 225). CS 120 or concurrent enrollment highly recommended.

Course Contents: Linear equations in linear algebra (Chapter 1); Matrix algebra (Chapter 2); Determinants (Chapter 3); Eigenvalues and eigenvectors (Chapter 5); Orthogonality and least squares (Chapter 6); Symmetric matrices and quadratic forms (Chapter 7).

Course Objectives: By the end of this course, the student should be able to:

- Be computational proficient using both hand calculations as well as computer programming to solve problems of linear algebra.
- Demonstrate understanding of the theory of linear algebra.
- Solve problems which apply linear algebra and first order systems of differential equations to fields such as physics, engineering, chemistry, biology, economics, and computer science.

Learning Outcomes: By the end of this course, the student should be able to:

- Demonstrate proficiency of solving systems of linear equations by Gaussian elimination.
- Demonstrate proficiency of matrix calculations including multiplication, linear transformations, matrix inverses, and determinants.
- Demonstrate proficiency in calculation of eigenvalues and eigenvectors as well as matrix diagonalization.
- Demonstrate proficiency in solving linear systems of differential equations.
- Demonstrate understanding and applying the singular value decomposition of a matrix.
- Demonstrate understanding of vector spaces and subspaces of R^n in connection to the row, column, and null space of a matrix.
- Demonstrate understanding of linear independence basis, dimension and rank when applied to vector spaces of R^n.
- Demonstrate understanding of inner product, norm, and orthogonality. Write computer scripts to solve practical problems and illustrate theoretical results.
- Synthesize computational, programming, and theoretical results with applied projects.

Grading Policy: Each portion of your grade is worth the following out of a **possible 800 points**.

- Quizzes: (12 points) x (10 quizzes) = 120 points
- Lab Assignments: (15 points) x (10 labs) = 150 points
- Projects: (40 points) x (2 projects) = 80 points
- Chapter Exams: (100 points) x (3 exams) = 300 points
- Comprehensive Final Exam: 150 points

Your final letter grade will be no worse than as listed below. There will be **no curve at any point.**

A:	736 - 800 points	(92 % - 100 %)
A/B:	704 - 736 points	(88 % - 92 %)
B:	656 - 704 points	(82 % - 88 %)
B/C:	624 - 656 points	(78 % - 82 %)
C:	560 - 624 points	(70 % - 78 %)
D:	480 - 560 points	(60 % - 70 %)
F:	0 - 480 points	(0 % - 60 %)

Textbook Homework: Homework from each section will be assigned from the textbook. Problems will be used exactly for quiz questions, so completing all homework prior to taking a quiz is recommended. The complete collection all prior homework problems will be accepted on Exam days for bonus. Students are encouraged to work in groups and ask questions in class or office hours.

Self-Graded Quizzes: Self-graded quizzes will be assigned each Monday and due Wednesdays. See Canvas for self-graded quiz guidelines.

Lab Assignments: Thursday of each week is lab day. Lab assignments will be completed using the R programming language and Jupyter notebooks. Labs are assigned at the beginning of class on Thursdays and due the following Monday at midnight. Students are encouraged to work together on labs. *No prior coding experience is required.* See the course Canvas website for details.

Projects: Two group projects will be assigned throughout the semester and will focus on modern applications of concepts from this class. See Canvas webiste for details.

Exams: Three in-class exams will be given covering content grouped by textbook chapters. Exam problems and structure will closely resemble that of in-class quizzes. Makeup exams will not be given without acceptable reason.

Final Exam: The final comprehensive exam will be on **Wednesday, May 11 from 4:45-6:45pm**.

Important Semester Dates: UWL academic calendar
`https://www.uwlax.edu/records/dates-and-deadlines/`

Resources:

- Desmos graphing tool: `https://www.desmos.com/`
- Geogebra graphing tool: `https://www.geogebra.org/`
- MIT linear algebra: `https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/`
- MIT applied matrix methods: `https://ocw.mit.edu/courses/mathematics/18-065-matrix-methods-in-dat`
- Computational tool: `http://www.wolframalpha.com/`
- Textbook homework answers: `https://www.slader.com/`
- AI generated solutions: `https://www.symbolab.com/`

Wisdom: Heed the following advice.

- How should I use the textbook?
  - Browse a section before seeing it in lecture, again after. Work through all text examples in detail before attempting homework problems (don't copy, write down problem, try to solve, check your work against text solution). Consider all homework problems. Carefully work through problems which you are unsure of and keep detailed solutions in a dedicated notebook.
- What if I get stuck on homework?
  - Complete in the following order: Re-read notes and textbook section. Move on to the next problem and revisit. Step away for 30 mins and try again. Bring question to your weekly HW group meeting. Visit the Mathematics Learning Center in 273 Murphy Library (`https://www.uwlax.edu/murphy-learning-center/`). Come to office hours.
- What should I do during class?
  - Review yesterday's notes when sit down. Consider the warm up problem. Take new notes, but make them your own. Add spoken comments, your own thoughts and reminders, other student questions, etc.
  - Think. Question in your mind what is said. What do/don't you understand? Think of questions to ask. Talk to neighbor during working sessions. Ask questions.
- What should I expect from this class?
  - Fast pace and heavy workload. Self study, freedom to learn in your own style, and interactive lecture. Less feedback, grading, and interaction. No in - class review for exams. Longer, harder exams and lower course grades. No calculators or formula sheets.
- Why do I need math?
  Focus on growing these skills throughout the semester.
  - Attention to detail / accuracy of result. Can you consistently perform long calculations without making any mistakes?
  - Communication / writing style. Does your writing clearly and concisely explain what you know? When writing solutions, is it clear to the instructor you understand content?
  - Logical thinking / ability to abstract. Does seeing a concept applied to only a few examples allow you to execute it in a number of analogous settings?

UWL syllabus polocies
See `https://www.uwlax.edu/info/syllabus/` for important statements. Especially not the comments related to Covid-19, academic dishonesty, and student accommodations.

Disclaimer: This syllabus is subject to change at any time. Changes will be announced, and an updated syllabus will be posted on the course website.

Covid Pandemic Consideration
I recognize this is a difficult time for every student in this course, and some students may be operating under additional constraints compared to normal semesters. As an instructor, I will be understanding and flexible of individual student circumstances regarding course deadlines. Do reach out to me if you are struggling to keep up. I will do everything I can to help you.