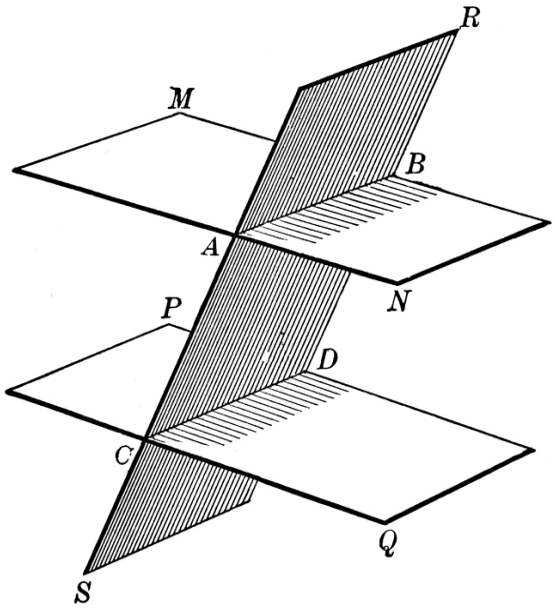
ma211: Linear Algebra I - f24



Class Meetings

- Fall 2024 (Aug26 → Dec13)
- MWF 9:00-9:50AM
- JXJ 3315
- zoom link - passcode 446763

▼ Instructor

Daniel Rowe
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I'm an associate professor of mathematics in the Mathematics and Computer Science Department at Northern Michgan University. I've been a professor at NMU for nine years, and I am very passionate about the praxis of doing mathematics

and teaching it. I grew up on a fishing camp in Northwestern Ontario, Canada.

▼ Need Math Help?

- Office Hours
- W 1-2, R 10-11, F 11-12
- JXJ 2228
- zoom link - passcode 809390
- read the relevant section(s) of our materials
- study all posted solutions
- re-watch the recorded lectures
- math tutor lab

▼ Class Structure

- hybrid-flexible, in-person and over zoom
- recordings available 2-3 days after each class
- strive for in-person attendance
- avoid becoming reliant on zoom and recordings!
- use them for extenuating circumstances only
- engagement is vital to learning mathematics (or anything)
- I don't take daily attendance, but...
- overall attendance is 5% of your grade

- (35%) Homework
- (10%) Collaborative In-Class Quizzes
- (20%) Traditional In-Class Midterm Exam
- (30%) Traditional In-Class Final Exam
- (5%) Attendance

▼ Grade Scale

A (92-100%)
A- (90-91%)
B+ (86-89%)
B (82-85%)
B- (80-81%)
C+ (76-79%)
C (72-75%)
C- (70-71%)
D+ (66-69%)
D (62-65%)
D- (60-61%)
F (⩽ 59%)

▼ Learning Outcomes

This is a course on the fundamentals of linear algebra. We will study matrices, matrix multiplication, and how to express linear systems via matrices. We consider the geometry of linear systems and then solve them via elementary matrices and echelon forms. Then we move on to vector spaces, subspaces, linear transformations, and the dimension formula. Finally we look at concepts related to a single linear operator: the determinant, conjugacy, eigenspaces, characteristic polynomials, and diagonalization. Throughout this course we will study various applications of linear algebra, for example, analyzing network flows, balancing chemical equations, calculating volumes, analyzing long term behaviour of markov processes, and solving recurrence relations.

▼ Success in College Courses

- the instructor's **job** is to ensure the course content is clear, organized, and interesting

- your **job** is to attend as many classes as you can, engage your mind, ask questions, read, and budget (at least) 1-2 focused hours every week to work on the course content

▼ Academic Honesty

In the spirit of academic honesty, credit for this section is due to Asher Auel, as this is an adapted form of their discussion of academic honesty in mathematics.

- Working with others on mathematics, and using electronic resources is both *highly encouraged* and *fun*. You may work with anyone (e.g. classmates, non-classmates, tutors, etc.) If this is done well, you'll learn more effectively and efficiently.

  Here's the fundamental rule:

  > **Work with anyone or anything to develop your own personal understanding of the ideas required to *solve* your homework problem, but always *write-up* the final draft by yourself and in your own words.**

- Writing up the final draft is just as important as figuring out the problems on scratch paper with your friends, using the internet, ChatGPT, etc. If you work with people, or use electronic resources on a particular homework:

You must list your collaborators and electronic sources at the top of the very first page. This makes the process completely transparent and honest.

▶ **A Note About Copying Mathematics**

▶ **Punishments**

▼ Accessibility

If you have a need for disability-related accommodations or services, please inform the Coordinators of Disability Services in the Dean of Students Office at 2001 C. B. Hedgcock Building (227-1737 or disability@nmu.edu). Reasonable and effective accommodations and services will be provided to students if requests are made in a timely manner, with appropriate documentation, in accordance with federal, state, and University guidelines.

▼ Reading Materials

- here are my hand-written notes on linear algebra.
- the following are good, free, open textbooks on linear algebra:
- *Linear Algebra*, Jim Hefferon, 4E.
- *Fundamentals of Matrix Algebra*, Gregory Hartman.
- *Linear Algebra*, Cherney, Denton, Thomas, Waldron.
- check out these practice problems and their solutions.

▼ Homework + Quizzes + Exams

- hw1 (due 9/8 @ 11:59PM)
- hw2
- hw3
- hw4
- hw5
- hw6

- quiz1
- quiz2
- quiz3

- practice_midterm
- midterm_exam

- practice_final

- final_exam

▶ **Extra Credit Problems**

▼ **Submitting Your Work**

- for quizzes, midterm, final: physical paper in-class
- for extra credit: email me a .pdf (read instructions in the link above)
- for homework: put a **.pdf file** inside our shared google folder
- the shared google folder will be titled *f24_ma211_yourlastname*
- I will share it with you within first two weeks of class
- please don't submit anything via email attachment
- name your files in an organized manner, for example: **hw1_Jane_Smith.pdf**
- always **show your work** and keep it organized
- **indicate/circle/highlight** your answers
- answer the questions in the **correct order**

▶ **Late Submissions**

▶ **Checking Your Grade**

Schedule + Recordings

> colored text = clickable links
> late homework may be submitted anytime during the semester
> before the solutions are posted (-0%), otherwise (-50%)

wk1: aug26 → aug30

□ study this webpage and all class information
□ study the lectures
□ start working on hw1

8/26
- announcements
- introduction to solving linear systems
- matrices

8/28
- matrix sizes, locating entries
- matrix multiplication
- the meaning behind matrix multiplication

8/30
- geometry of vectors
- geometry of solution sets
- augmented matrix forms
- parametric vector form of solution sets

wk2: sept2 → sept6

□ study the lectures
□ keep working on hw1

9/2
- Labor Day - no class

9/4
- parametric vector form of solution sets
- geometry of solution sets
- 1 eq in 3 var = plane in R^3
- help with hw1

9/6
- elementary row operations
- intro to solving linear systems

wk3: sept9 → sept13

□ study the lectures
□ start working on hw2

9/9
- intro to solving linear systems
- reduced-row echelon forms (RREFs)

9/11
- the Gaussian Elimination process
- solving systems of equations

9/13
- more examples of solving systems

wk4: sept16 → sept20

□ study the lectures
□ keep working on hw2

9/16
- help with hw2

9/18
- applications of solving systems:
- balancing chemical equations
- analyzing network flows

9/20
- analyzing network flows

wk5: sept23 → sept27

□ study the lectures
□ start working on hw3

9/23
- another network flow example
- fitting curves through points

9/25
- fitting curves through points
- linear families of linear systems

9/27
- discussion of hw3
- colors R,Y,B versus O,G,P

wk6: sept30 → oct4

□ study the lectures
□ keep working on hw3

9/30
- discussion of hw3
- abstract vector spaces

10/2
- help with hw3
- examples of vector spaces
- the span of a collection of vectors

10/4
- independence/dependence
- bases and dimension

wk7: oct7 → oct11

□ study the lectures
□ start working on hw4

10/7
- review of bases and dimension
- subspaces of vector spaces

10/9
- finding the equation(s) for a subspace

10/11
- finding the equation(s) for a subspace

wk8: oct14 → oct18

□ study the lectures
□ keep working on hw4
□ study for midterm exam next wed

10/14
- orthogonal complements: $W^{\perp}$

10/16
- help with hw4
- practice midterm

10/18
- help with hw4
- practice midterm

wk9: oct21 → oct25

□ study the lectures
□ midterm exam on wednesday
□ start working on hw5

10/21
- practice midterm

10/23
- midterm exam (9:00AM → 11:59PM)

10/25
- row ops = left-multiplication by elem. matrices
- col ops = right-multiplication by elem. matrices
- nullspaces are preserved by row ops
- column spaces are preserved by col ops
- The Rank-Nullity Theorem

wk10: oct28 → nov1

□ study the lectures
□ keep working on hw5

10/28
- elementary matrices
- introduction to inverses

10/30
- inverses of elementarties
- inverses of general matrices

11/1
- the determinant of an nxn matrix
- examples

wk11: nov4 → nov8

□ study the lectures
□ finish up hw5

11/4
- determinants via elementary matrices
- intro to the cofactor expansion formula

11/6
- more on the cofactor expansion formula
- examples
- help with hw5

11/8
- help with hw5

wk12: nov11 → nov15

□ study the lectures
□ start working on hw6

11/11
- the vector cross product

11/13
- more on the cross product
- intro to eigenvalues and eigenvectors

11/15
- eigenvalues, eigenvectors, eigenspaces
- the characteristic polynomial

wk13: nov18 → nov22

□ study the lectures
□ keep working on hw6

11/18
- eigenvalues, eigenvectors, eigenspaces
- algebraic and geometric multiplicities
- a 3x3 example

11/20
- eigenvalues, eigenvectors, eigenspaces
- a 3x3 example
- diagonalizability

11/22
- Application of Diagonalization #1:
- Markov Chains

wk14: dec2 → dec6

□ study the lectures
□ finish up hw6

12/2
- Application of Diagonalization #1:
- Markov Chains
- Application of Diagonalization #2:
- Recursive Sequences

12/4
- Application of Diagonalization #2:
- Recursive Sequences
- help with hw6

12/6
- help with hw6
- final exam review

wk15: dec9 → dec13 (FINAL EXAM WEEK)

□ final exam date: TBA
□ special office hour: TBA
□ traditional in-person exam
□ no electronic devices
□ complete any late homework for 50%
□ try an extra credit problem?

class evaluations
- please fill out the class evaluation
- I would REALLY appreciate it!
- the evaluation link is active: TBA