Linear algebra with computer science applications
CSCI 2820
Fall 2022

Instructor:
Rebecca Morrison
ECOT 820
rebeccam@colorado.edu

Class details:
Class meetings: MWF 10:10 - 11:00, ECCR 265
Office hours: Tu 2:00 - 3:30 and by appointment
TA: Shadi Kalat, shta5644@colorado.edu
Grader: Meghank Kankanala, meghank.kankanala@colorado.edu

Materials:
Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares.
Boyd and Vendenberghe. Available online here: http://vmls-book.stanford.edu/vmls.pdf
Lecture notes (R. Morrison)
Canvas will be used to post and collect homework, and for homework solutions, announcements, student-led discussions, etc.

Course description

This course will introduce the basic concepts of linear algebra: vectors, matrices, and the computations we can do with them. Linear algebra is an incredibly powerful area of mathematics and computer science. The objects used and operations done in linear algebra are relatively straightforward. At the same time, there are countless applications; the subject is fundamental to many developing areas today such as machine learning, artificial intelligence, image processing, finance, and control, to name just a few. In this course, we will become comfortable working with the basic structures and also explore several computer science applications throughout the semester.

Course objectives

In this course, students will learn how to:

- Describe vectors and how to add, scale, and take the inner product
- Describe matrices and how to add, scale, and multiply them
- Compute with linear functions
- Solve sets of linear equations and linear dynamical systems
- Find the inverse of a matrix
- Formulate common algorithms such as clustering and least squares data fitting
- Explore numerous and relevant applications in computer science today

- Understand the meaning of determinants, eigenvalues, and eigenvectors
- *Think critically, creatively, and independently in order to formulate and solve many varied problems*

Course outline, by week*

8/22 Ch 1: Vectors

8/29 Ch 2: Linear functions

9/5 Ch 3: Norms and distance

9/12 Ch 5: Linear independence

9/19 Ch 6: Matrices

9/26 Class project (Ch 4: Clustering), Review, **Exam 1 on 9/30** (Ch 1-3, 5)

10/3 Ch 7: Matrix examples

10/10 Ch 8, 9: Linear equations, linear dynamical systems

10/17 Ch 10: Matrix multiplication

10/24 Ch 11: Matrix inversion

10/31 Ch 12, 13: Least squares, least squares data fitting

11/7 Class project, Review, **Exam 2 on 11/11** (Focus on Ch 6-11)

11/14 Lecture notes: Determinants

11/21 Fall break

11/28 Lecture notes: Eigenvalues and eigenvectors

12/5 Class project, Review

TBD Final exam (Cumulative)

*Note that this schedule is approximate and subject to minor modifications.

Course work and grading

Grades will be determined based on the following: homework (20%), in-class check-ins (5%), two midterm exams (25% each), and a final exam (25%).

- **Homework:** To review and solidify the basic concepts of the course, students will solve a series of exercises as homework. Homeworks will be assigned every Friday, and due the following Friday on Canvas. Please upload an acceptable format, such as jpg or pdf. (You may take a picture of written howework and upload that.) The two homeworks with the lowest scores will be dropped. If you are very sure that the homework has been misgraded, you may contact the grader directly. Otherwise, please accept the grade and try to understand what you could do better or make clearer next time.
  - **Late policy:** Homework grades will be discounted by 10% every day that the homework is late. After Sunday midnight, late homework will not be accepted.

  - **Homework solutions:** Homework solutions will be posted on Canvas the Monday after they are due.

- **Check-ins:** There will also be class "check-ins" once or twice a week. Each check-in will test you with a small question or two about recent material. You will receive a point for completion, regardless of whether or not your answer is correct. The intent here is that you receive frequent and helpful feedback. If you find that you are struggling with these, that is a good sign to ask a fellow classmate, the course staff, or me for help. *The topics of these questions will also function as a study guide for exams.*
- **Exams:** There will be two in-class exams and a final. Each exam will be cumulative but will focus on the more recent material.
- **Extra credit:** If you would like extra credit, you may do the following: Go to a seminar/colloquium on campus. Write a page or two with the following information: name of speaker, title and date of presentaton, and department. Also answer these questions: 1) What did you find interesting about the talk? 2) How was linear algebra used in the speaker's research? 3) What question(s) did you have about the research? This must be typed and turned in (on paper or emailed to me) by the start of the following Monday class period. Each (acceptable) paper will add 0.5% to your final grade.

Note: You may choose whether or not to attend class, and I aim to make class worth your time. If you do attend, I expect you to arrive on time and stay until the end.