MSSC 6040 – Applied Linear Algebra – Fall 2021

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Lectures: MW 5-6:15pm, Cudahy Hall 126
Course Website: D2L https://d2l.mu.edu/d2l/home/451338

Office Hours: Mon 2:00-3:00 pm, Wed 10:30-11:30 am, Fri 10:30-11:30 am, and by appointment.
Note: Office hours will be held virtually on Teams. Search for "Prof. Ongie's Office Hours [Fall 2021]".

Course Description

The main theme of this course is foundational linear algebra considered from a numerical viewpoint. We focus on solutions of linear systems of equations, eigenvalues and eigenvectors, and transformations. The course emphasizes and illustrates proof and numerical implementation using problems arising in applications. Multivariable calculus and linear algebra are prerequisites.

Textbook

Required: *Numerical Linear Algbera* by Lloyd N. Trefethen and David Bau, III. SIAM, 1997.

I will also occasionally post additional notes and supplementary materials on D2L. You are not responsible for textbook material or any other material that is not covered in lecture.

Assessments

Grading Scale

Grades will be based on homework (50% of final grade), one-minute reflections (10% of final grade), a midterm exam (15% of final grade), and a final exam (25% of final grade).

Letter grades will be assigned using the following scale:

A	$93\% \leq$ Percentage $\leq 100\%$	**C**	$73\% \leq$ Percentage $< 77\%$
A-	$90\% \leq$ Percentage $< 93\%$	**C-**	$70\% \leq$ Percentage $< 73\%$
B+	$87\% \leq$ Percentage $< 90\%$	**D+**	$67\% \leq$ Percentage $< 70\%$
B	$83\% \leq$ Percentage $< 87\%$	**D**	$60\% \leq$ Percentage $< 67\%$
B-	$80\% \leq$ Percentage $< 83\%$	**F**	Below 60% Percent
C+	$77\% \leq$ Percentage $< 80\%$		

Homework

- Homework will be due roughly every 2 weeks, and will consist of a mix of textbook problems and MATLAB coding exercises.

- All homework will be submitted virtually to a D2L dropbox. **Your homework must be uploaded as a single pdf file.** There are several free apps to help with this, including Genius Scan and CamScanner among others. Please make sure your scanned homework is legible before uploading. Scanned homework that cannot be read or that is uploaded as multiple files and/or in the wrong format (i.e., not a single pdf) will not be graded and given an automatic 0. Occasionally, you may need to merge pdfs before uploading to D2L. There are several free online apps to do this as well, such as combinepdf.com.

- **Collaboration Policy**: It can be very helpful to study and work with a group. This type of cooperative learning is encouraged. However, be sure that you have a thorough understanding of the concepts as well as the steps used to solve an exercise. You must be able to work through the exercises on your own. Each student must write up their assignment individually and independently and must turn in their own work.

- It is acceptable to consult external resources (like the internet) while doing your homework. **It is not acceptable to copy large chunks of code or math from these external resources.** Solutions copied verbatim from Math StackExchange or similar forums will receive an automatic zero. **You are required to list all external resources used to complete your assignment. This includes names of any classmates you worked with. Failure to do so may be considered plagiarism.**

- No late work will be accepted. However, your single lowest homework score will be dropped at the end of the semester.

Exams

- There will be one midterm exam and a comprehensive final.

- The midterm exam will be in-person and taken during regular class period. If you are unable to attend class on the day of the midterm due to quarantine/illness, please let me know and I can make accommodations.

- The final exam will be a take-home exam and due by upload to a D2L dropbox. You will have roughly one week to complete the exam.

- Make-up exams will not be given unless the student informs, and has a come to a written agreement with, the instructor regarding the absence no later than the day before the exam day. The student is responsible for scheduling their make-up exam.

One-Minute Reflections

- At the end of each class period, I will assign a "one-minute reflection" consisting of a 2-3 short answer questions given as a D2L quiz that will be due by the end of the day. These act as an opportunity to reflect on and solidify what you learned in class, as well as ask for clarification on the lecture material.

Course Technology

MATLAB

- Several assignments will use the MATLAB computing toolbox. However, no previous experience with MATLAB is expected or required.

- Marquette University students may download MATLAB onto their personal computers: `http://www.marquette.edu/its/help/matlab/`. MATLAB is also available in the computer labs of Cudahy Hall and in Engineering and the library.

- Some homework assignments will make usee of the **Image Processing Toolbox**. To add this toolbox to your MATLAB installation, click on the "APPS" tab at the top of the interface, then click the "Get More Apps" button, and search for "Image Processing Toolbox".

- You are encouraged to check access to MATLAB by Friday Sept 10, 2021 to ensure proper access moving forward. Please contact ITS with questions about downloading and installing MATLAB on your device.

LaTeX

- LaTeX (pronounced "lay-tech" or "lah-tech") is a text editor that enables you to create professional-looking mathematical documents. It is very commonly used in mathematics, computer science, physics, engineering, and other STEM fields. **I highly recommend writing up your homework and/or the take-home exam in LaTeX.** Overleaf (`https://www.overleaf.com/`) easy to use free, easy-to-use, online LaTeX editor that I highly recommend (and is, in fact, what I used to create this document).

- I have posted some tutorial information and templates on D2L to help you get started, and I'm always more than happy to help out in office hours.

Course Policies

Masking   Per the current University rules, all students (and the instructor) will be required to wear a face mask that covers the mouth and nose, and engage in social distancing when possible. Students who do not comply will be asked to leave the classroom – no exceptions.

Attendance   Students are expected to attend the in-person lectures. However, due to the ongoing COVID-19 pandemic, I realize that this may not be possible for all students at all times. In the event of a prolonged absence (two or more consecutive in-person lectures), please contact me as soon as possible so that I can make reasonable accommodations, especially if the absence includes an exam date.

Grading Disputes   If you believe that I have made an error in scoring an assignment, you must bring it to my attention **within one week** of the graded assignment being returned. I will carefully reread, and if necessary rescore, the assignment.

Accommodations for Disabilities   If you have a disability and will require accommodations under the Americans with Disabilities Act, you need to provide appropriate documentation to the Office of Disability Services. They will supply you with a letter to give to me detailing the accommodations. If you are unsure of whether you qualify for services, visit the Office of Disability Services' website, `http://www.marquette.edu/disability-services`, or contact them at (414) 288-1645. If you qualify for special accommodations you must work with the course instructor and come to an agreement no less than 7 days prior to the needed accommodation.

Course Schedule

Note: The schedule below is tentative and subject to change.

Mon, Aug 30	Syllabus, Lecture 1 - Linear Algebra Review
Wed, Sept 1	Lecture 1, Cont.
Mon, Sept 6	No class – Labor Day
Wed, Sept 8	Lecture 1, Cont.
Mon, Sept 13	Lecture 2 - Orthogonal Vectors and Matricies
Wed, Sept 15	Lecture 2, Cont.
Mon, Sept 20	Lecture 3 - Norms
Wed, Sept 22	Lecture 4 - Singular Value Decomposition (Part I)
Mon, Sept 27	Lecture 4, Cont.
Wed, Sept 29	Lecture 5 - Singular Value Decomposition (Part II)
Mon, Oct 4	Lecture 5, Cont.
Wed, Oct 6	Lecture 6 - Projectors
Mon, Oct 11	Supplement - Applications of the SVD
Wed, Oct 13	Supplement - Applications of the SVD
Mon, Oct 18	Midterm Review
Wed Oct 20	In-class Midterm Exam
Mon, Oct 25	Lecture 7 - QR Factorization
Wed, Oct 27	Lecture 8 - Gram-Schmidt Orthogonalization
Mon, Nov 1	No class (Online supplemental reading)
Wed, Nov 3	No class (Online supplemental reading)
Mon, Nov 8	Lecture 11 - Least Squares Problems
Wed, Nov 10	Supplement - Applications of Least Squares
Mon, Nov 15	Lecture 12 - Conditioning
Wed, Nov 17	Lecture 13 - Floating Point Arithmetic
Mon, Nov 22	Lecture 14 - Stability
Wed, Nov 24	No class – Thanksgiving Break
Mon, Nov 29	Lecture 24, 25, 27 - Eigenvalue Problems
Wed, Dec 1	Lecture 24, 25, 27, Cont.
Mon, Dec 6	Lecture 32 - Overview of Iterative Methods
Wed, Dec 8	Lecture 38 - Conjugate Gradients; Take-home Final Exam assigned
Wed, Dec 15	Take-home Final Exam due by upload to D2L, 11:59 pm.