Math 2568 Section 40 - Linear Algebra
Autumn 2022

Instructor: Prof. Maria Angelica Cueto (cueto.5@osu.edu)

Contact information: All electronic communications for this course should be done via the messaging tools on Carmen. We kindly request you not to email the instructor directly. Messages should be limited to procedure, scheduling or private matters (e.g. involving grades). Mathematical questions will not be answered electronically.

Course information

Websites: https://carmen.osu.edu
https://people.math.osu.edu/cueto.5/teaching/2568/Au22/indexS10.html

Lectures: M-W-F 11:30am-12:25pm (in Lazenby Hall (LZ) 002).

Office Hours: Mon 6-7pm and Th 10-11am (and by appointment), held online via Zoom. Questions can also be posted on Carmen's discussion boards.

Textbook: L.W. Johnson, R.D. Riess, J.T. Arnold: *Introduction to Linear Algebra*, 5th edition, Pearson.

Course description: This course is designed to introduce ideas from linear algebra, with emphasis on both its theoretical and practical aspects. Topics include matrix algebra, vector spaces and linear maps, bases and dimension, eigenvalues and eigenvectors, applications.

Prerequisites: A grade of C- or above in 1172, 1544, 2153, 2162.xx, 2182H, or 4182H; or a grade of C- or above in both 1152 and CSE 2321; or credit for 154, 254.xx, 263.xx, 263.01H, or 264H. Not open to students with credit for 4568 (568), 5520H (520H), or 572.

Course Content: The course will be divided into four parts (covering Chapters 1 through 6 of the textbook). In the first part, we will study matrices and linear systems of equations. In the second part, we will review vectors in the plane and in space, and extend this to higher dimensions. We will study the notion of a vector space in $\mathbb{R}^n$, subspaces, linear independence, dimension, bases of subspaces, orthonormal bases, and linear maps. In the third part, we will work with abstract vector spaces, and extend the constructions done for $\mathbb{R}^n$ to the abstract setting. We will also discuss determinants of square matrices and their properties. In the last part of the course we will discuss the notion of eigenvalues and eigenvectors, both over real and complex numbers. A detailed list of topics can be found below.

Coursework submissions: You will be submitting all coursework in person during class hours. Dates are listed on the calendar. **If you are ill, notify the instructor but do not come to class to turn in your assignments or take the quizzes.**

Grading. The grade will be based on homework assignments (15%), quizzes (10%), two midterms (20% each), and the final exam (35%). Your course letter grade will then be determined based on:

(1) your **course percentile** (your relative rank among your peers), and (2) my determination of the overall class performance level. A reasonable percentile-to-letter-grade **estimate** is the following:

Letter grade	A	A-	B+	B	B-	C+	C	C-	D+	D	E
Percentile range	100-93	93-90	90-87	87-83	83-80	80-77	77-73	73-70	70-67	67-60	60-0

If your degree program requires a certain letter grade in this course, it is a good idea to think about the likelihood of you ending up in each of the above ranges above early in this semester.

Homework: Homework is an essential component of this course. Problems will be assigned from the course's textbook. **The goal of each homework set is to help you understand the material and to prepare you for the tests.** It is thus imperative that you start working on each assignment as soon as we view the material in class. Take time to understand the questions and think about how to solve each problem before seeking help from the instructors and your classmates. Feel free to post questions on Carmen discussion board if you are stuck on a problem.

You are strongly encouraged to discuss the problems with me and your classmates, but your write ups must be your own. If you use other people's ideas, including from an online source, you must state this explicitly. Active participation on Carmen discussion forum will contribute towards your homework grade.

There will be a total of 11 homeworks this semester (see the course schedule for due dates). Each homework will be graded for correctness and clarity of explanations. Only three problems from each set will be graded. Each homework set will be worth 20 points (5 points per problem graded plus 5 extra points for completion). **No late homework will be accepted without medical excuse, but the lowest score will be dropped.**

Showing Your Work: Mathematics is not just about deriving the correct numerical solution to a problem. It is also about convincing others that your method of calculation is appropriate. *Insufficiently supported answers may receive partial or no credit on quizzes and exams.*

Missed Coursework: No late exams will be accepted without prior written permission. All requests for rescheduling (e.g. due to sickness, athlete duties or unforseen circumstances) must be made in writing at least 48 hours before the regularly scheduled time. Within 48 hours of an exam or quiz only documented legitimate family or medical emergencies will be considered as excuses.

Exams: There will be three exams: two midterms and one final exam. Midterms will take place during regular class hours (see dates below). The dates of the final exam are tentative and the location is still to be determined.

Midterm 1: Friday Oct. 7, 2022 (in class). Topics: $\S1.1 - 1.3, 1.5 - 1.7, 1.9, 2.1 - 2.4, 3.1 - 3.3$.
Midterm 2: Monday, Nov. 21, 2022 (in class). Topics: $\S3.4 - 3.7, 5.1 - 5.4, 5.7, 5.9, 6.1 - 6.3$.
Final: Thursday Dec. 15, 2022 (10:00-11:45am). Topics: cumulative, focused on $\S4.1 - 4.7$.

All exams will be closed-book and the use of calculators or other electronic devises is not permitted. All students are expected to abide by the rules of *Academic integrity*. Honesty is the foundation of good academic work. When you are solving the exams, avoid engaging in plagiarism, unauthorized collaboration, cheating, or facilitating academic dishonesty. For more information, see the *General policies* section below.

Class Participation and Attendance. Mathematics is a human activity. We will cover the material in an **interactive fashion** each lecture. It is important to stay actively engaged with the material and connected with both the instructor and your classmates, by attending class and using Carmen's discussion board.

Frequent absences are likely to be noted and may factor into the grade in borderline cases.

Course Topics

The following is a complete list of each section of the textbook that we will cover this semester:

Ch. 1 Matrices and Systems of Linear Equations
- 1.1 Introduction to Matrices And Systems of Linear Equations
- 1.2 Echelon Form and Gauss-Jordan Elimination
- 1.3 Consistent Systems of Linear Equations
- 1.5 Matrix Operations
- 1.6 Algebraic Properties of Matrix Operations
- 1.7 Linear Independence and Nonsingular Matrices
- 1.9 Matrix Inverses and Their Properties

Ch. 2 Vectors in 2-Space and 3-Space
- 2.1 Vectors in the Plane
- 2.2 Vectors in Space
- 2.3 The Dot Product and the Cross Product
- 2.4 Lines And Planes in Space

Ch. 3 The Vector Space $\mathbb{R}^n$
- 3.1 Introduction to the Vector Space $\mathbb{R}^n$
- 3.2 Vector Space Properties of $\mathbb{R}^n$
- 3.3 Examples of Subspaces
- 3.4 Bases for Subspaces
- 3.5 Dimension
- 3.6 Orthogonal Bases for Subspaces
- 3.7 Linear Transformation from $\mathbb{R}^n$ to $\mathbb{R}^m$

Ch. 4 The Eigenvalue Problem
- 4.1 The Eigenvalue Problem for 2×2 Matrices
- 4.2 Determinants and the Eigenvalue Problem
- 4.4 Eigenvalues and the Characteristic Polynomial
- 4.5 Eigenvectors and Eigenspaces
- 4.6 Complex Eigenvalues and Eigenvectors
- 4.7 Similarity Transformations and Diagonalization

Ch. 5 Vector Spaces and Linear Transformations
- 5.1 Introduction to Vector Spaces and Linear Transformations
- 5.2 Vector Spaces
- 5.3 Subspaces
- 5.4 Linear Independence, Bases and Coordinates
- 5.7 Linear Transformations
- 5.8 Operations With Linear Transformations
- 5.9 Matrix Representations Of Linear Transformations

Ch. 6 Determinants
- 6.1 Introduction to Determinants
- 6.2 Cofactor Expansions Of Determinants
- 6.3 Elementary Operations And Determinants
- 6.4 Cramer's Rule

Health and safety policies

All students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (see https://safeandhealthy.osu.edu), which includes following university vaccination and mask policies.

If you are feeling ill, do not attend class in person and get tested for Covid-19.

General policies

Free face masks are available for students, faculty and staff at a variety of campus locations including: all recreation facilities, most university libraries and the Ohio Union information desk. Masks can be picked up during business hours. A list of pick-up locations can be found at

https://safeandhealthy.osu.edu/personal-protection-hygiene

The Ohio State University Wexner Medical Center's `Cornavirus Outbreak site` includes the latest information about COVID-19 as well as guidance for students, faculty and staff.

The `Office of Student Life's ''We Are Here For You''` page includes several resources to support your mental, physical and financial health.

Course technology

The course will be delivered in person, but office hours will be held online, over CarmenZoom. To participate in office hours, you should be able to connect to CarmenZoom with audio, video and chat participation. Course annoncements will be made through Carmen. **It is strongly encouraged that you connect to Carmen regularly (at least three times a week).**

If you are concerned about privacy, you are welcome to use the virtual background feature provided by Zoom. For help setting up your personal background see:

`https://support.zoom.us/hc/en-us/articles/210707503-Virtual-Background`

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at

`https://ocio.osu.edu/help/hours`.

Support for urgent issues is available 24x7.

- *Self-Service and Chat support:* `http://ocio.osu.edu/selfservice`
- *Email:* `8help@osu.edu`;   *Phone:* 614-688-HELP (4357);   *TDD:* 614-688-8743.

General policies

Academic Misconduct Statement: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term academic misconduct includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-48.7). For additional information, see the Code of Student Conduct at `http://studentlife.osu.edu/csc/`.

Statement on Title IX: Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at `titleix@osu.edu`

Disability Statement: The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. More information can be found on this website.

If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; http://www.ods.osu.edu/; 098 Baker Hall, 113 W. 12th Ave.

Your mental health: As a student you may experience a range of issues that can cause barriers to learning such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a students ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Lifes Counseling and Consultation Service (CCS) by visiting https://ccs.osu.edu or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766. Emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at

https://suicidepreventionlifeline.org

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Tutoring Center: Free tutoring is available in the *MSLC Tutor Room* (1st floor & Basement of Cockins Hall, 1958 Neil Ave) if you need help with any of the course material. You will need to schedule an appointment to get assistant. More information is available at

https://staging.mslc.osu.edu/tutoring/appointment-tutoring.