MATH 2270-001: Linear Algebra
Time: MTWTh 10:00-11:00 am  Room: WEB L103

Instructor: Jenny Kenkel
Office: JWB 115
Email: kenkel@math.utah.edu (preferred method of contact)

Office Hours:
Tuesday, 8:30 am - 9:30 am
Wednesday, 1 pm - 2 pm
Thursday, 11:30 am - 12:30 pm
or e-mail me and I’d be happy to meet with you another time!


Course Web Page:
All course information and announcements will be posted on the Canvas page, which can be accessed through your CIS. It also contains material that may help you succeed in this course. I will assume that you are keeping up to date with its contents. I will try to keep your grades as accurate as possible on Canvas, but use common sense.

Prerequisites: C or better in MATH 2210 or MATH 1260 or MATH 1280 or MATH 1321 or MATH 1320.

Course Description: We start by thinking of vectors and matrices as arrays of numbers, then we progress to thinking of vectors as elements of a vector space and matrices as linear transformations. In our study of vectors and matrices, we learn to solve systems of linear equations, familiarize ourselves with matrix algebra, and explore the theory of vector spaces. Key topics covered in this course include Euclidean space, linear systems, Gaussian elimination, determinants, inverses, vector spaces, linear transformations, quadratic forms, least squares and linear programming, eigenvalues and eigenvectors, and diagonalization.

Course Outcomes: At the end of the course, students will be able to:

- Understand the mathematical notation and geometric interpretation involved in the study of linear systems, and make connections between the two.
  - Students will understand the connection between $Ax$ and a linear combination of vectors.
  - Students conceptualize matrices as linear transformations and as encoding bilinear forms (inner products).
  - Students should understand the properties of vector spaces, in particular $\mathbb{R}^n$ as a vector space. The students extend this notion as they learn vector spaces isomorphic to $\mathbb{R}^n$ have the same algebraic properties as $\mathbb{R}^n$.

- Perform matrix computations and understand them as examples of abstract mathematical concepts.
  - Students will perform row reductions and put matrices into echelon forms. Students will connect this to several theorems regarding span, linear independence, determinant, invertibility, and rank.
– Student calculate matrix-vector and matrix-matrix products and think about these processes in the context of linear transformations.

– Students find determinants, eigenvectors, and eigenvalues and link these concepts to existence and uniqueness of solutions. Students use eigenvalues and eigenvectors find a basis in which the properties of the linear transformation become transparent.

– Students compute dimension and bases of vector spaces and develop these ideas in the context of linear transformations and change of coordinate systems.

• Recognize applications and interpretations of linear algebra concepts.

– Students will develop approximations using orthogonal projection and Gram-Schmidt orthogonalization.

– Students will link various linear algebra concepts to applications in computing.

Teaching and Learning Methods

This class will not be purely lecture based. This course has been constructed around research-based practices to best help you learn and grow in your mathematical thinking. I would like to be transparent with you about my teaching methods in order to make this course as productive for you as possible.

Growth Mindset, Making Mistakes, and Failure: Mathematics is not an innate ability; it is a skill we learn and refine through hard work and persistence. I strive to challenge you to engage with difficult problems in this class. Some times you will solve them, and some times you will not. It may be uncomfortable to encounter problems you cannot (yet) solve, but failed attempts in math are very informative and an important part of the mathematical process. I hope to build your comfort with the struggle of growing mathematically. This is not meant to be discouraging; if you are trying and growing, you are learning.

Learning Groups: Communication and collaboration is an important part of being a professional mathematician, computer scientist, physicist, or professional anything. This class will be organized into learning groups so that you have a group of your peers with whom you can ask questions, get feedback, and build connections. The learning group structure is also intended to foster a welcoming and safe learning environment in the classroom.

If you are having any difficulty with your group members or the group learning situation, for any reason, please don’t hesitate to let me know.

Active Learning: Research shows that we retain only around 5% of what we hear in a lecture, compared to 70% of what we practice by doing and over 90% of what we teach others. In this class we will use a combination of learning strategies, including lecture, discussion, group problem sessions, and video lectures. The more actively engaged you are in your own learning process, the more information you are likely to retain. I encourage you to help others understand the material, whether it’s through your video lectures or during in-class assignments. This process benefits everyone, but it’s especially helpful when you’re the one who is teaching.
Course Work and Evaluation

Grading: The grades of homework, exams, and finals will weight as follows in your overall average.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Quizzes</td>
<td>15%</td>
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<tr>
<td>Video Lecture Assignments</td>
<td>10%</td>
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<tr>
<td>Midterm Exams</td>
<td>30%</td>
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<tr>
<td>Final</td>
<td>30%</td>
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Grading Scale: The grade scale will be the usual:
A (93-100), A- (90-92), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), D+ (67-69), D (63-66), D- (60-62), E (0-59).

I reserve the right to curve grades at the end of the semester, but it will only be in your favor (that is, if you receive an 85 percent, you will get a B or better).

Homework: Homework will be assigned weekly from the textbook. Homeworks will be assigned on Tuesdays and collected the following Tuesday. All homework assignments and due dates will be posted on the course webpage. Homeworks will be completed outside of class and all students must turn in their own homework assignments. The lowest two homework scores will be dropped. No late homeworks will be accepted.

Quizzes: There will be quizzes during the last ten minutes of class. You can work in groups of 1, 2, or 3 students. Please write on your quiz the names of your group members, if you worked in a group. Each student must turn in their own quiz. Quizzes will be on the material that was on the most recent homework, that is, the homework you turned in the Tuesday before. Since you will not have yet gotten back your homework, homework solutions will be posted Tuesday after class for you to go over before the quiz. The lowest two quiz scores will be dropped. There will be no makeup quizzes.

Video Lecture Assignments: There are two components to the video lecture assignments: video lectures and video summaries. Students will be responsible for creating 2 video lectures and posting them in their Learning Community group on Canvas. Each video will be a 5-10 minute lecture on an assigned topic. In weeks that students are not responsible for creating a video lecture, they must complete a summary based on another student’s video. These are credit/no credit assignments; that means, if you follow the instructions, you will receive full credit. For more details on the video lecture assignments, including a schedule and video resources, please see the course webpage.

Exams: There will be three midterm exams and one final exam. Exam dates and times are listed on the course schedule. There will be no makeup exams. However, if the percentage earned on your Final exam is higher than either of your Midterm exams, I will replace one Midterm score with the Final. The final will be cumulative.

Tentative Topics:
Midterm 1: Chapter 1
Midterm 2: Chapters 2, 3
Midterm 3: Chapters 4, 5
Final: Cumulative (Chapters 1-7)
Other Policies and Resources

**Math Tutoring Center:** Do not hesitate to come to my office during office hours or by appointment to discuss a homework problem or any aspect of the course. Additionally, the T. Benny Rushing Mathematics Tutoring Center offers free tutoring. Beginning Thursday, May 18th, tutoring will be available from 8am to 8pm Monday through Thursday and 8am to 4pm on Friday. Their website can be found here:

https://www.math.utah.edu/ugrad/tutoring.html

If you want to hire an outsider tutor (for a fee), you can find a list of such people through the math department.

**Veteran’s Center:** If you are a student veteran, the University of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class.

**LGBT Resource Center:** If you are a member of the LGBTQIA* community, I want you to know that my classroom is a safe zone. Additionally, the University of Utah has an LGBT Resource Center on campus. They are located in Room 409 in the Olpin Union Building. Hours: M-F 8-5pm. You can visit their website to find more information about the support they can offer, a list of events through the center and links to additional resources: http://lgbt.utah.edu/. Please also let me know if there is any additional support you need in this class.

**The Americans with Disabilities Act:** The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801- 581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581- 2677(COPS).

**Calculators:** I will not allow you to use calculators on the midterms or the final exam. Calculators may be appropriate on certain homework problems, but I encourage you not to become dependent on them. If you do not already have a calculator, you do not need to buy one for this course. All calculations that you might need to do can be completed using Wolfram Alpha, which is available online for free.

**Cheating:** If you cheat on any assignment, I will give you a zero on that assignment. Depending on the severity of the cheating, I may decide to fail you from the class. In all cases of academic dishonesty, I will
report the incident to the Dean of Students.

**Disclaimer:** I reserve the right to change any information in this syllabus throughout the semester. If I make a change to the course policies, I will inform you in class, and post an updated version of the syllabus to canvas. I will hold you accountable for information that is stated in class or posted on canvas.

**Important Dates:**

- **Drop Deadline** ......................... Wednesday, May 24
- **Memorial day (NO CLASS)** ................... Monday, May 29
- **First Midterm** ......................... **June 5**
- **Withdraw Deadline** ...................... Friday, June 23
- **Second Midterm** ......................... **June 26**
- **Independence Day (NO CLASS)** ........ Tuesday, July 4
- **Third Midterm** ......................... **July 17**
- **Pioneer Day (NO CLASS)** ............... Monday, July 24
- **Course Final** .... Thursday, August 3 (10:00-am - 12:00 pm)