MATH 2210Q-010 and 012
Applied Linear Algebra
Spring 2026

Instructor:
Erin Rizzie, Ph.D.
erin.rizzie@uconn.edu

Meeting: **Section 010:** TuTh 12:30-1:45 pm in MONT 321

Office Hours: I encourage you to drop in to my office (MONT 411) with your questions during these times – no appointment needed!

Tuesdays 9:30-10:30 am
Thursdays 10:30 am-11:30 am
Fridays 12:30-1:30 pm
or by appointment (i.e., email me with a list of your available times if you need to see me outside of the above times)

Text: We will use *Understanding Linear Algebra*, a free open-source text by David Austin available at https://understandinglinearalgebra.org/ula.html

Prerequisite: Math 1132 or 1152. **Note:** This course is a prerequisite for Math 3210.

Goals & Expectations: The goal for the semester is to learn, understand and be able to work with the main ideas of linear algebra, including systems of linear equations, matrices, vector spaces (concrete and abstract) and their bases, linear transformations and change of basis matrices, eigenvectors and eigenvalues, various matrix factorizations, and the applications of these ideas. This means that you should not only be able to work through problems similar to those done in class and on the homework, but also that you should be able to articulate the ideas presented in the course in a clear and coherent manner. This course will have concrete and abstract components. Being able to explain why something is true will constitute a significant part of the course.

Students will develop a conceptual understanding of the course material in an inquiry-based classroom, which requires a lot of independent work, group work, and class discussions. There will be no lecture.

Learning outcomes: The following learning outcomes talk about the big content ideas I'm designing this course for you to learn. I think these are probably exhaustive, with some overlap.

1. Describe the ways that augmented and coefficient matrices can be used to answer questions about the solution sets systems of linear equations
2. Use matrices to represent, operate on, and answer questions about linear transformations
3. Discuss various kinds of vector spaces and subspaces, and explain how to determine whether a set is a vector space
4. Identify bases of vector spaces and represent vectors relative to different bases of the spaces in which they are elements
5. Identify vector(s) whose direction is unchanged by a given linear transformation, and discuss when and how these vectors can be used to completely describe the linear transformation
6. Determine the geometric properties (length, direction, angles) of vectors and sets of vectors, and form an orthogonal basis from a non-orthogonal basis for a space
7. Explore the ways in which matrices, vectors, and linear algebraic methods are used today in computing and other applications

Participation: The best way to learn math (or anything, for that matter) is to practice it actively. You will spend much of your time in class working on problems with your peers and talking to others about your solutions to problems. Therefore, participation is required and will be graded in two parts:

1. **Preparation:** Activities will be assigned after each class meeting that you are expected to complete before coming to the class meeting. At the start of each class, one or more students will be selected to share their answer(s) to these activities. You should be ready to discuss these every class meeting.
2. **In-Class Participation:** Activities will be done in groups during class. You will be required to complete and submit your solutions these activities via HuskyCT before the following class meeting. During each class, I will also record your name when I see you working actively on the day's activities.

If you have an extenuating circumstance that requires you to miss class, please contact me as soon as possible once you know that you will miss class so that we can arrange another way for you to earn participation credit for the missed day(s).

Each student in this class is vital to the success of the classroom community, which why it is important that we all respect each other, carefully consider one another's ideas, and value each other's contributions. I am very serious about helping to create a classroom environment in which everyone feels free to ask questions, raise concerns, make mistakes, celebrate successes, and so on. You are expected to behave courteously and respectfully to your classmates and to me, but please do not stop yourself from asking a question because you fear it will sound stupid or obvious. We are all here to learn together, which means we will struggle often.

Group Activities: In class, you will work in groups to complete activities from *Understanding Linear Algebra* to help you understand the course learning objectives. You are expected to be fully present during these work times and group and whole-class discussions, to complete activities outside of class as needed, and to bring your questions about the activities to class and/or office hours.

Quizzes: There will be short quizzes given most Thursdays throughout the term, during our class meeting time. Please contact me as soon as possible if you must miss a quiz. In general, you will not be able to make up a quiz missed for reasons other than illness or personal or family emergencies.

Grading Policy: Your quizzes and exams will be returned to you with comments via HuskyCT in a timely manner, usually within a week. You may resubmit any work that does not earn an S (see below) **within one week** after it is initially graded.

Exams: There will be two exams during class time, tentatively scheduled for **March 5 and April 30**. You are expected to work independently on these exams.

Applications Project: If you wish to earn an A in the course, you will complete a final project describing the linear algebra involved in a contemporary application. This project will be due during the last week of classes. More details will be available as the end of the semester nears.

Final Portfolio: All students will submit a final portfolio demonstrating their proficiency with the learning outcomes for the course in lieu of a final exam.

You'll choose your favorite and best work from your homework, quizzes, and exams, and then provide some surrounding discussion, which might include things like:

- how this work demonstrates your learning;
- why you chose this work in particular -- what makes it your favorite, why you think it's your best work, etc.;
- what tools and techniques a solution uses, and maybe a little about how you've used those tools and techniques in other problems;
- etc., etc.

Choose work that demonstrates your proficiency in as many of the learning outcomes as possible. Give a few different examples for each outcome, if possible.

Your portfolio will also include a reflection on your work in the class and how it places your work in the letter grade table below.

Standards for Submitted Work: Work that you submit to me will be returned with comments and a score of S (Success), R (Needs Revision), or N (Not Assessable). Here's what I mean by these:

- **S** – Successful work meets all standards listed below
- **R** – Please revise and resubmit ASAP. Comments will indicate where you have work still to do
- **N** – I am unable to determine from your work whether you have gained some understanding of these topics. This may mean that you did not explain your reasoning, your answer was not related to the question, you did not submit your own work, you used an inappropriate method for the problem type, or a number of other things that you will hear about from me in the comments.

These standards should be met for work to be considered successful:

- Clear: Easy to read and understand how the solution brings us from start to finish; free from confusion and ambiguity
- Logical: Discusses reasoning in a step-by-step process from start to finish
- Justified: Explains solution in a way that another student taking this course for the first time can be reasonably expected to follow
- Accurate: Free from errors or mistakes
- Complete: Fully answers the question(s) asked
- Precise: Carefully names all variables used and is consistent with naming and relevant definitions

Revision of Work: You are encouraged to resubmit work that earns an R or N until you earn an S.

- Rewrites **must** include thoughtful reflection on your original work, what you revised, **and why**. It's not enough to say "[x] was wrong, so I fixed it" -- you have to talk about why you got [x] wrong in the first place and what you learned that changed your mind. What do you know now that you didn't know before? Who or what helped you learn?
    - If your rewrite does not include thoughtful reflections, I'll ask you to add them.
    - A good reflection will include about 2-3 sentences about why you tried what you tried initially, what didn't work, and how your revision is an improvement.
- **All revisions should be completed within one week** after I give the class feedback on the original submission

Grading: At the end of the term, you're going to submit a Final Portfolio and Letter Grade Reflection, where you will tell me how you did and thus what grade you earned in the course, based on the following rubric we're going to create together.

You can use any assessments throughout the course (online homework, activities, quizzes, exams, and applications project) as evidence in this discussion. I will probably agree with you, because you know yourself, your work, and your understanding pretty well. If I don't, we'll talk about it.

Letter grade	Description of work and participation
A	Successful completion of the Applications Project before the deadline, PLUS: 80% of exam problems correct, AND Quizzes: 80% fully revised to 5, AND activities: 90% complete, AND portfolio: 21 pieces of work (3 per learning outcome), w/ thoughtful reflections, AND participation: 70% of class days actively working on activities
B	70% of exam problems correct, AND Quizzes: 70% fully revised to 5, AND activities: 80% complete, AND portfolio: 18 pieces of work (≥2 per learning outcome), w/ thoughtful reflections, AND participation: 60% of class days actively working on activities
C	60% of exam problems correct, AND Quizzes: 60% fully revised to 5, AND activities: 70% complete, AND portfolio: 14 pieces of work (≥2 per outcome for ≥5 outcomes), w/ thoughtful reflections, AND participation: 50% of class days actively working on activities
D	50% of exam problems correct, AND Quizzes: 50% fully revised to 5, AND activities: 60% complete, AND portfolio: 7 pieces of work from ≥3 outcomes, w/ thoughtful reflections, AND participation: 40% of class days actively working on activities
F	Does not demonstrate understanding or participation at the level of any other letter grade

The distinctions of "+". within each letter grade will be based on "extra" achievements such as more presentations and/or homework problems. If you have achieved all but one level in a given category (and that level is still at the requirement for the grade level immediately below it), you will receive the "-" grade for that letter.

How to Succeed in this Course: For many of you, this course will involve more conceptual and abstract ideas than you are used to seeing in mathematics classes. This will take some adjustment, and now is the best time to develop the habits that will help you succeed. These include:

- This is a 3-credit course. **You should expect to spend a minimum of six hours a week outside of class working on the course requirements for a passing grade**, or more for higher grades.
- carefully completing preview activities before class
- actively participating in class
- completing in-class activities as necessary outside of class
- resubmitting work as necessary for understanding and completion
- asking and answering questions to and from your peers and instructor
- working through the assigned homework (much of which should be done without your book/notes to prepare you for quizzes and exams), identifying any remaining trouble areas, and working through more problems or asking for help in those areas –from me or other students
- focusing on developing the ability to explain your ideas, both verbally and in writing, correctly using the vocabulary defined in the course
- finding your mathematics support community – classmates, office hours, online Q center tutoring, etc.

Academic Integrity: Please respect your and others' work and academic experience. You are expected to turn in work that reflects your own understanding of the topics. Therefore, your writing should not bear resemblance to that of any other student in the course or to any other sources used, and any ideas used for which any other party had a share in developing should be cited as such.

You may use any citation format – for example, a parenthetical at the end of your solution: "(I got the idea for my solution to #2 from 3Blue1Brown on YouTube: https://www.youtube.com/watch?v=P2LTAUO1TdA&t=2s&ab_channel=3Blue1Brown)," or "(I worked with Jaime from my group on #4)."

Tentative Course Schedule

I'm aiming to have us focus on the following topics in the given weeks, but expect some variation and overlap depending on where we are in our discussions.

Week 1	Solving Linear Systems
Week 2	Pivots and Solution Spaces
Week 3	Vectors and Linear Combinations; Matrix Multiplication
Week 4	Span and Linear Independence
Week 5	Linear Transformations
Week 6	More Linear Transformations; Inverse Matrices
Week 7	Bases and Coordinate Systems; Image Compression

Exam 1- March 5 – Covering Material from Weeks 1-6

Week 8	Determinants; Vector Spaces and Subspaces

March 11-19 – No Classes – Spring break

Week 9	More Subspaces; Eigenvalues and Eigenvectors
Week 10	Eigenvalues and Eigenvectors; Diagonalization
Week 11	Markov Chains; Google's PageRank Algorithm
Week 12	Dot Product, Transpose, and Orthogonality
Week 13	Orthogonal Bases and Projections
Week 14	Constructing Orthogonal Bases

Exam 2- April 30 – Covering Material from Weeks 7-13

Applications Project Due May 1

May 4-8 – Final Exam Week – Final Portfolio Due

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