

## OSU Course Syllabus – Math 342-003 – Winter 2019

Linear Algebra II

MWF 4pm-4:50pm in Learning Innovation Center 307

Th 4pm-4:50pm in Rogers Hall 230

Instructor: Chris Orum

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Office: Kidder Hall 258

Office Hours: Tues., 11:30 - 12:30, Wed., 11:00 - 12:00, Thurs., 12:00 - 1:00, and by appointment.

**Credit hours:** 4

**Prerequisite:** MTH 341 with C<sup>-</sup> or better.

### Course Description

Abstract (real or complex) vector spaces, linear transformations, inner product spaces, orthogonality, eigenspaces and diagonalization, spectral theorems, singular value decomposition.

MTH 342 Learning outcomes A successful student in MTH 342 will be able to:

1. Recognize and give examples of abstract (real and complex) vector spaces other than  $\mathbb{R}^n$ .
2. Apply invariance of dimension to find a basis for a given finitely generated abstract vector space.
3. Compute the matrix representation of a linear transformation with respect to a given basis, and perform algebra on linear transformations.
4. Determine whether a given matrix is diagonalizable and determine a diagonalizing matrix.
5. Express geometric properties of vectors and sets of vectors in an inner product space using techniques such as orthogonality, projections, and the Gram-Schmidt algorithm.
6. Identify classes of matrices for which all eigenvalues are real numbers.
7. Apply projection matrices and singular value decompositions of matrices to least square fitting problems or other related problems.

### Topics covered (with approximate ammount of time)

- Definition of an abstract (real or complex) vector space, subspace. (0.5 week)
- Linear dependence and independence, spanning set, basis, invariance of dimension of finite-dimensional vector space. (2 weeks)
- Linear transformation and its matrix representation and change of basis, algebra of linear transformations including composition of operators and matrix multiplication, rank-nullity theorem. (1.5 weeks)
- Invariant subspaces, direct sum of subspaces, diagonalizability. (1.5 week)
- Inner product spaces (IPS), orthogonality, Gram-Schmidt process. (1 week)
- Operators on IPS, adjoint operator, spectral theorems. (1.5 weeks)
- Singular value decomposition. (1 week)

**Midterm Exam:** Thursday, Feb. 14, 4:00 - 4:50 pm, Rogers Hall 230.

**Final Exam:** Thursday, March 21, 2:00 - 3:50 pm. The final exam is comprehensive. It may be scheduled for a room other than LINC 307.

## Course Resources

### 1. Texts:

Linear Algebra, As an Introduction to Abstract Mathematics (“The UC Davis text”),  
[https://www.math.ucdavis.edu/~anne/linear\\_algebra/mat67\\_course\\_notes.pdf](https://www.math.ucdavis.edu/~anne/linear_algebra/mat67_course_notes.pdf)

Linear Algebra Done Wrong by Sergei Treil (“LADW”),  
[https://www.math.brown.edu/~treil/papers/LADW/LADW\\_2017-09-04.pdf](https://www.math.brown.edu/~treil/papers/LADW/LADW_2017-09-04.pdf)

2. Access to Matlab. Matlab is installed on most of the lab computers at Oregon State University. It is also freely available to install on a laptop if you are a student at Oregon State University:  
<http://is.oregonstate.edu/service/software/matlab>

## Sources of help outside of class

- Please contact me or the TA for help on any part of the course. You may see me during my office hours or send me an email to set up an appointment.
- Form study groups.
- The Math and Statistics Learning Center (MSLC) in Kidder 108 is available for free drop-in tutoring help. It is open from 9am to 5pm Monday through Thursday, and 9am to 4pm on Friday, from Week 2 through Week 10. The MSLC tutors are not available during finals week.
- MSLC tutors are also available in Kidder 108 Sunday through Thursday from 7pm to 10pm.
- The Academic Success Center located in Waldo Hall: <https://success.oregonstate.edu/>

## Homework Assignments and Labs

- Assignments will be due in class on the due date, unless (more likely) the assignment requires an online submission to Canvas, in which case it will be due at 11:59 PM on the due date.
- For assignments that are handed in on paper: put your full name and assignment number clearly on the first page and **Staple** multiple pages together.
- For some problems you will want to work out the solution, then write the final solution neatly to submit. Show your work. Just writing down an answer without showing the steps to arriving at the answer is not sufficient for credit. If the problem says “explain” then you need to explain your reasoning, using English with complete and coherent sentences. Marks may be deducted for poor presentation or work that is difficult to follow.
- You are encouraged to work together on the problems. However, your solutions must include careful explanations written by yourself and in your own words.

## Labs

- We will have in-class labs. You are expected to work with other students in the class on these.

## Quizzes

- We may have some regular in-class quizzes, announced in advance, and some take-home quizzes.

## Lecture Discussion Quizzes

- We may have some ‘lecture discussion quizzes’. For these quizzes, you are expected to share your reasoning with fellow students. This type of quiz can occur at any time during class.

## Exam Policy

- No calculators may be used during the exams. No electronic devices may be used on the exams.

### Attendance and Communication

- Attendance and participation is expected. Attendance will be taken on most days. Put your initials next to your name on the class list that is passed around in class. This is worth 10% of your grade.
- Use your official university email address for correspondence concerning the course.
- I will use the Canvas to post course materials, make announcements, and record grades. The running total that Canvas provides will not be accurate until the end of the term.

### Expectations

- I encourage you to work together on assigned problems for the purpose of planning and thinking through solutions. It is your responsibility to understand what you are doing. The writing of assignments must be done individually. Identically written work on different papers will result in points being deducted from both papers.
- Tests (midterm, final) must be done individually. Communication between students concerning the test is not allowed.
- Email correspondence related to the course should be sent from your official university email address. I prefer that you send email to me directly – not from inside Canvas.
- Ask questions in class.

### Grading

- Your grade will be calculated as follows: Assignments, which includes in-class labs, quizzes, lecture discussion quizzes (40%), exams (50%), Attendance and Participation (10%). Exam scores will be computed as the better of 15% midterm + 35% final or 22% midterm + 28% final.
- Your grade in the course will not be 'harder' than:  
A/A- 90% - 100%; B-/B/B+ 80% - 89.99%; C-/C/C+ 70% - 79.99%; D-/D/D+ 60%-69.99%.

### Academic Honesty and Student Conduct

Academic dishonesty is defined as an intentional act of deception in one of the following areas:  
Cheating - use or attempted use of unauthorized materials, information, or study aids.

Fabrication - falsification or invention of any information.

Assisting - helping another commit an act of academic dishonesty.

Tampering - altering or interfering with evaluation instruments and documents.

Plagiarism - representing the words or ideas of another person as one's own.

Students are expected to be familiar with the policies stated on this syllabus, and the relevant parts of Oregon State University's Code of Student Conduct: <https://studentlife.oregonstate.edu/sites/studentlife.oregonstate.edu/files/code-of-student-conduct-102218.pdf>

### Students With Disabilities

Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at <http://ds.oregonstate.edu>. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.