Advanced Linear Algebra: Spring 2017

- **Instructor**: Professor Chris Kottke
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- **Course Webpage**: `http://ckottke.ncf.edu/advlinear/`
- **Lectures**: T,Th 9:00–10:20, Chae Auditorium (may change)
- **Office Hours**: T,Th 4:00–5:00, W 2:30–3:30
- **Textbook**: *Linear Algebra Done Wrong*, by Sergei Treil.
  Freely available at `https://www.math.brown.edu/~treil/papers/LADW/LADW.html`

Course Description: This class is an advanced version of linear algebra. "Advanced" means that we will cover more at a faster pace than the standard linear algebra class; it also means that proofs will be a part of lectures and problems. We will cover vector spaces; linear transformations; systems of equations and row reduction; determinants; eigenvalues, eigenvectors and diagonalization; inner product spaces and the spectral theorem for normal operators; singular value decomposition; and if time permits, Jordan canonical form. When possible, we will emphasize applications.

It is not necessary to have had a previous course in linear algebra. However, this course will move very quickly through the basic material, so students without previous experience in linear algebra should be prepared to make a significant investment of time, and should be comfortable with a proof-based class at this level.

Reading Assignments: A reading assignment for each class will be posted on the course webpage and in the Canvas course prior to each lecture. This reading should be completed *before* the lecture. Unless otherwise specified, you will be responsible for all material in the reading assignment, even if it is not covered in lecture. A provisional lecture schedule appears below.

Homework: Homework problems will be assigned after each lecture, *but will not be collected.* Instead, a selection of these problems will appear on each weekly quiz.

Quizzes: There will be a 15-20 minute quiz at the beginning of lecture each Thursday (excepting any Exam days), which will consist of two to four problems selected from the homework problems from the previous two lectures.

Exams: There will be two in-class midterm exams, and a cumulative final. Provisional dates (which may be subject to change) are as follows:

- Exam 1: Thursday, March 9
- Exam 2: Thursday, April 20
- Final exam: TBD

Assessment: Your course performance (Sat/Unsat) will be evaluated based on quizzes and exams, weighted as below. Class participation and attendance will be reflected in the narrative evaluation.

- Quizzes: 20%
- Exam 1: 20%
- Exam 2: 20%
- Final Exam: 40%

Policies: A student claiming a need for special accommodations because of a disability must work with the Counseling and Wellness Center, which will establish the need for specific accommodations and communicate them to the instructor.

No student shall be compelled to attend class or sit for an examination at a day or time when he or she would normally be engaged in a religious observance or on a day or time prohibited by his or her religious belief. Students are expected to notify their instructors if they intend to be absent for a class or announced examination, in accordance with this policy, prior to the scheduled meeting.

Provisional Lecture Schedule:

Tuesday	**Thursday**
2/7: 1.1, 1.2: Vector spaces, linear combinations, bases	**2/9**: 1.3, 1.4: Linear transformations, matrices
2/14: 1.5, 1.6: Composition, inverses and isomorphisms	**2/16**: 1.7: Subspaces
2/21: 2.1, 2.2: Linear systems, row reduction, echelon forms	**2/23**: 2.3: Analysis of pivots
2/28: 2.4, 2.5: Inverses via row reduction, dimension	**3/2**: General solution of a linear system
3/7: 2.7, 2.8: Fundamental subspaces, rank, change of basis	**3/9:** ***Exam 1***
3/14: 3.1, 3.2: Axioms for determinant	**3/16**: 3.3, 3.4: Existence and uniqueness of determinant
3/21: 3.5, 3.6: Cofactor expansion, minors and rank	**3/23**: 4.1, 4.2: Eigenvectors and diagonalization
3/38: Spring break	**3/30: Spring break**
4/4: 5.1, 5.2: Inner products spaces and orthogonality	**4/6**: 5.3: Orthogonal projection and Gram-Schmidt
4/11: 5.4, 5.5: Least squares, adjoints	**4/13**: 5.6: Isometries, unitary and orthogonal operators
4/18: 6.1, 6.2: Shur decomposition, spectral theorem	**4/20:** ***Exam 2***
4/25: 6.3, 6.4: Polar and singular value decompositions	**4/27**: 6.4: Applications of SVD
5/2: 6.5: Structure of orthogonal matrices	**5/4**: 9.1: Cayley-Hamilton Theorem
5/9: 9.2, 9.3: Spectral mapping, generalized eigenspaces	**5/11**: Structure of nilpotent operators
5/16: 9.5: Jordan decomposition theorem	