Linear Algebra (with theory) (Math 441/541)
Spring 2019

Meeting times:	Mon., Wed., and Fri. 12–12:50pm in 210 Deady
Instructor:	Ben Elias
Office:	Fenton 210
Office hours:	M 3-4 and T 1-2.
E-mail:	belias@uoregon.edu
Preferred Pronouns:	he/him/his.
Course website:	http://pages.uoregon.edu/∼belias/441-spring-2019/
Midterm:	In class, 50 minutes, Friday week 6.
Quizzes:	There will be weekly in class quizzes.
Final:	Monday June 10, 10:15AM, 2 hours, in 210 Deady.

Textbook: *Linear Algebra Done Right*, by Sheldon Axler. We will cover Chapters 1-6, 8, and 10, although this is subject to change.

In advanced math classes, one should expect that important concepts can be introduced in the lectures, in the book, and even in the homework.

Prerequisite: Math 342 and one of Math (307,262,232), or the instructor's permission.

Note to students on advanced math courses: Theory-based math courses are likely to be very different from previous math courses (like Calculus, Linear algebra, etcetera). I will not say that the material is harder than other courses, but it is certainly newer and in many ways weirder. Like any other new skill, it will take practice.

If you have not taken MAT316 or another proof-based course (rather than the bridge requirement, which is the actual prerequisite of this class) then you may find this course more difficult. Calculus is usually the first proof-based course for a reason: the material is more familiar, and many proofs can be repeated over and over again (e.g. proving this function is continuous, then that function, then that function). This lets you practice the form and style, and get used to the modifications that you might make in any given example. In Linear Algebra the proofs are more unique, and there aren't so many "practice tools."

The homeworks will feel different than those in lower level math courses. They are not drills, designed to internalize a specific technique. Mostly, they are thought experiments, and each is unique. Homework is meant to internalize the basic ideas and build intuition, and it is extremely important. I want you to spend more time on them. I strongly recommend rethinking how you approach homework for this class. The most efficient way to learn is to do regular exercises. Also, looking at problems early is very beneficial: often the homeworks are mental knots that need slow untying, and your brain will help you for free if you give it time.

Homework and Quizzes: Check the course website each week, where the problems will be posted. Late homework will not be accepted without *prior* permission.

I will take a vote in the first week of class to decide the homework routine. It will be one of two things.

My preference, and the method I use for graduate courses: Each class there is a very short assignment (15 minutes) due the following class. In addition, there is a weekly homework due on Wednesdays (first homework due W 4/10), assigned the previous Wednesday, and relying on the material up to the previous Friday. This weekly assignment will be a little shorter than it might normally be, to account for the extra time spent on the mini-assignments. I think this is the best way to learn. Moreover, I would grade the mini-assignments myself, giving me and you consistent feedback. A grader would grade the weekly homeworks.

Alternative: There is homework due each Wednesday by the start of class, and assigned the previous Wednesday (first homework due W 4/10), relying on the material up to the previous Friday. This gives a little more flexibility to your schedule, at the cost of not getting as much feedback.

Regardless of which method we choose, each Wednesday that homework is due, a very short quiz will be administered at the beginning of class, on the same topic as the homework.

Office hours: OFFICE HOURS ARE A VASTLY UNDERUSED RESOURCE. I am stuck in my office, waiting to answer your questions, so please use the opportunity!

Please, do not hesitate to ask questions in class. If you are confused, so are many of your colleagues, and they will thank you for speaking up. But you will surely have more questions, and office hours should be very helpful. If you can't make my office hours, email me to set up an appointment.

Attendance and Participation: If you miss a class, it is your responsibility to find out what happened from your colleagues, and to hand in homework on time. If your grade is borderline between one grade and another, then attendance and participation will be taken into account.

Homework policies In this course, you are strongly encouraged to work on the homework problems with your colleagues. Math is a collaborative activity, and one which is easier to learn as a team. However, when it comes time to write up your homework answers, this should be done individually, without reference to any common solution or the work of others. By writing it up individually, you can really isolate those things you thought you understood in the group, but which did not make sense later. For example:

Ok: a study group works a problem on the blackboard, gets the answer. Erases the answer, each member tries to write up the solution individually, asks questions of the group when something goes wrong, which it inevitably will.

Not Ok: a study group works a problem on the blackboard, gets the answer. Members copy the answer from the board to their homework sheet, or write up the solution while referencing the solution on the board.

Definitely not ok: Using solution guides, or asking for/finding answers on an online forum. Copying or modifying answers from external solutions is cheating, plagiarism, and counts as academic misconduct. Students caught cheating on homework will be reported. Students who cheat and are not caught may have higher scores on homework, but tend to do poorly on exams, and receive lower grades overall.

Calculators: Neither calculators nor other electronic devices will not be permitted on any of the exams.

Grading and Exams: There will be one midterm, a final exam, and very short weekly quizzes. The date of the midterm will be decided on in the first week of class. There will also be a practice quiz (not for credit) before each midterm. The final exam is worth 40% of your grade, the midterm 25%, homework 25%, quizzes 10%. Please bring your UO ID to all exams.

Learning Outcomes: The goal of this course is to understand the basic theory of linear algebra. Specific goals:

(1) Understand the definition of a field and a vector space.
(2) Understand subspaces, direct sums, and quotient spaces.
(3) Understand dimensions, bases, spans, and linear independence.
(4) Understand linear transformations, and how they are represented after choice of bases.
(5) Understand images and kernels of linear transformations.
(6) Understand inner product spaces and adjoint maps.
(7) Understand eigenvalues and eigenvectors of linear operators.
(8) Understand the Cayley-Hamilton theorem and Jordan normal form.
(9) Understand traces, determinants, and other invariants of linear operators.

Many of these ideas are familiar from basic linear algebra, but the goal of this class is to prove the fundamental properties of these concepts. Some of these specific goals are subject to change as I will be determining the curriculum for the later part of the class as we go along.

Learning Environment: The University of Oregon strives for inclusive learning environments. Please notify me if the instruction or design of this course results in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or `uoaec@uoregon.edu`. If you are entitled to extra time on exams, make sure to contact the AEC more than one week prior to the exam!

Academic Conduct: The code of student conduct and community standards is at:

`http://conduct.uoregon.edu`

It is not appropriate to help each other on exams, to look at other students exams, or to bring unauthorized material to exams. Any type of academic dishonesty will not be tolerated! Policies for homework were outlined above.