Syllabus
Math 232 - Linear Algebra
Spring 2018

Professor: Rafe Jones
Office Hours: Monday 10-11; Tuesday 10-11; Wednesday 9:15-10:15 and 3:30-4:30; Friday 10:30-11:30; or just stop by and see if I'm around (it helps to make an appointment, though it's not strictly necessary). I have a schedule posted on my office door that gives a general idea of my whereabouts.
Office: CMC 226
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Course meeting time:
MW 12:30-1:40, F 1:10-2:10 in Weitz 230

Course Web Site: http://www.people.carleton.edu/~rfjones/Math232spring18/index.html (there's a link to this site from Moodle).

Text: *Linear Algebra with applications, fifth edition* by Otto Bretscher.

Course Content and Goals: Your favorite functions in calculus may well have been the simplest ones: linear functions. Linear functions appear everywhere in mathematics and in many other disciplines precisely because they are simple enough to be analyzed mathematically, but sophisticated enough to give useful models to many real-world phenomena. Whether you choose to pursue pure math or any natural or social science, you will certainly use linear algebra.

The way we'll study linear functions this term probably differs dramatically from math courses you've had in the past, where the basic goal has been to solve particular problems: whats the derivative of this function, whats the area under this curve, how do you approximate $\sin(\sqrt{2})$? In this course, we are going to build a theory – it's "an adventure of the mind," to use the words of my colleague Steve Kennedy. The course is really about linear transformations, which are higher-dimensional versions of linear functions from calculus, and we'll develop an extensive theory of these functions. But the subject has roots in everyday problems that arose thousands of years ago in China and elsewhere, involving systems of linear equations. We will start with these problems, boil them down to their essence, and once and for all solve all possible problems of that particular type. Then we'll see how the notion of linear transformation in fact encompasses all the work done so far, and allows us to move still further outwards – towards transformations of spaces that don't have any obvious physical meaning.

The course works gradually upwards towards greater levels of abstraction. This means that there is some repetition of core ideas (such as linear independence and basis) in different contexts. This repetition isn't for nothing! Each time you see one of the ideas again in a new context, you should understand not just the new context better, but also the underlying idea – after all, seeing things repeatedly is perhaps the only way to truly learn them.

The abstraction that comes into this course in its latter part is a key component. It may be the first time you've seen abstraction of this sort, where statements must be established by rigorous logical proofs. We'll practice writing such proofs – I'll do many in class, and you'll be asked to so some in the homework. This mode of doing mathematics may take some getting used to, but don't worry – with enough practice you'll get the hang of it. Computations still play a primary role throughout the course, and overall most homework and exam problems will be computational.

Getting information and help: If you have questions about any organizational aspect of the course, the first place you should go is the course web page (URL given at the top of the page). It is a veritable treasure trove of course-related information, and will be updated frequently. Among the things you'll find there are this syllabus, homework assignments, class schedule, exam-related announcements, review tips, and links to practice exams.

If you can't find the information you need quickly on the webpage, or have a mathematical question, don't hesitate to contact me. I will read emails until about 7 pm each night, and will respond to any messages you send me within 24 hours, provided that I am not traveling. For face-to-face discussions, stop by any time during my office hours, listed above. Feel free also to stop by outside of office hours, and if my door is open, you can come on in. However, I may not be available (there is a schedule posted on my office door). To make sure I'll be around, send me an email to make an appointment; give me 24 hours notice if at all possible.

For additional help pretty much any time, you are encouraged to go to the Math Skills Center. It's an almost ridiculously welcoming place that provides drop-in peer tutoring, and it also functions as a place to study, to do homework, and to meet for one-on-one tutoring. Its hours are Monday-Friday: 8:30am-11pm, Saturday: 2-5pm, and Sunday: 2-5pm and 7-11pm. Your homework assignment for the first week of class is to spend 10 minutes checking out the Math Skills Center in person.

Finally, I may periodically need to contact the whole class via email, for instance to let you know that there are new materials on the website. I'll use your official Carleton email accounts (the ones that end in carleton.edu), so be sure that you check this account regularly.

Academic Integrity: Academic integrity is something I take very seriously, and I expect you to follow the College policy on academic integrity (a link can be found on the course website). Because I encourage collaboration in this course, it is of critical importance that you clearly understand the difference between collaboration and plagiarism. On homework assignments, you should feel free to discuss problems with me, classmates, and people you meet at the Math Skills Center. *This does not include using internet sources, which you should avoid – there are many resources on campus that are far superior.* Crucially, when it comes time to turn in your work, the answers you write ***must be in your own words and come from your own hand***.

Grading system: Below is how your course grade will be determined. Following this there are detailed discussions of each component.

Homework 16%
Projects 14%
Midterm Exams 21% each
Final Exam 28%

The grading system is as follows: 93 and up is an A, 90-93 an A-, 87-90 is a B+, 83-87 is a B, 80-83 is a B-, 77-80 is a C+, 73-77 is a C, 70-73 is a C-, 67-70 is a D+, 63-67 is a D, 60-63 is a D-, and lower than 60 is an F.

Exams: The exam schedule is given below; please note these dates and plan accordingly. Any conflicts must be legitimate and brought to my attention well before the exam is schedules. If you have any specific learning disabilities or special needs and require accommodations, please let me know early in the semester so that your learning needs may be appropriately met. You will need to contact Disability Services (Andy Christensen is the coordinator – anchrist@carleton.edu) to obtain documentation of your disability.

Exam 1: In class, Wednesday, April 25
Exam 2: In class, Monday, May 21
Final Exam: Monday, 6/4, 3:30-6:00 pm

Homework: The *only* way to learn and truly understand mathematics is by doing problems. So the homework is the most critical component of your leaning in this course, and as such it counts for a considerable portion of your grade (17%). Homework will be assigned and collected every other class period, with a few exceptions (see the course schedule on the webpage). I expect that each assignment will take you 5-8 hours to complete. One of the best strategies for doing well on the homework, and gaining solid knowledge from it, is to start it as soon as it's assigned. Studies have shown that learning occurs best when you allow ideas – even ones you don't fully understand at first – time to sink in. So starting on problems, working until you get stuck, and then coming back to them the next night is a good recipe for understanding.

Because of our limited time in class, it won't be possible to do examples of every kind of problem that will appear on the homework. So you should expect some problems that don't look immediately familiar; however, the underlying techniques you'll need to do the problems will have been covered in class.

The homework assignments are posted on the homework page of the course web site. Please staple your homework and write your name on the first page. If you want your homework graded, hand it in on time. If you hand in an assignment late due to some legitimate reason, then I will quickly check to make sure it is complete, and mark it down as such in the grade book. It won't count as part of your homework average (but it also won't count as a zero).

Learning often happens best when we are forced to explain our work or thinking to someone else. Sometimes just verbalizing your mathematical thoughts can deepen your understanding. So I encourage group work on the homework (groups of two or three tend to be most effective). However, you must still each write the problems up on your own, as mentioned in the academic integrity section.

Projects: There will be two collaborative projects, which will be assigned in the second half of the course, and will highlight applications of linear algebra. You'll work in groups

of two, and will turn in a paper describing your work on the project. The project is designed to help you develop your written communication and critical thinking skills. Youll be encouraged to be creative, and rewarded for pursuing extensions to the project questions.

Calculators: No calculators are necessary for this course. If you want to use one on the homework, you're welcome to, but keep in mind that calculator over reliance can get in the way of understanding the ideas. If you want to acquire a calculator, a model such as the TI-83 is sufficient. No calculators (or any other electronic devices) are allowed on exams. And they wouldn't help anyway, as the questions won't require any number crunching.

Attendance: Attendance is important to me and could make a difference in your final grade in borderline cases. The course moves quickly, and it is not easy to catch up missed material – so make the effort to come to class, and arrive on time, unless you have an outstandingly good reason (like being ill or a family emergency). If you contact me ahead of time and the absence is excused, then I will make every effort to provide you with the information that you missed. Otherwise, it is your responsibility to get notes from one of your peers and to make sure that you understand the material.

How to do well in this class:

- *Attend class, participate, and ask questions.* Class will significantly augment the material in the book (particularly in worked examples), and there will be lots of chances for you to participate. The more engaged you are in class, the better prepared you will be to understand the ideas and work problems.

- *Do all the homework, and do it well.* The best way to learn math is by doing math. The homework is your chance to do math, and you will gain the most understanding by doing it well. This means that after you finish each problem, you should be able to explain the idea to your classmates, your friends, or your mom.

- *Work with your classmates.* The knowledge and abilities of your classmates are great assets. Learn to explain mathematics to your classmates. Math can be fun and rewarding when there are people around you who enjoy figuring out problems as much as you do. Take advantage of this opportunity and organize study groups.

- *Get extra help when you need it.* You have lots of options for getting extra help (see the section "Getting information and help"). Don't hesitate to use them! In particular, please come talk to me if you're feeling stuck.