MATH 253: Linear Algebra, Fall 2012

Instructor: Erin McNicholas  
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Office Hours: These will be set during the first two weeks of class. In the meantime, you can always make an appointment or just drop by my office.

Class Listserv: math-253-01@willamette.edu

Class Website: Course information, assignments, due dates, and policies are all available on the course website under WISE

Class Meetings: Class meets in Ford 204 every Tuesday and Thursday from 9:40-11:10 am. The Final Exam is Saturday December 15th from 8-11am

“A mathematician, like a painter or a poet, is a maker of patterns. If his patterns are more permanent than theirs, it is because they are made with ideas. The mathematician’s patterns, like the painter’s or the poet’s, must be beautiful; the ideas, like the colors or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics.” -G.H. Hardy

“It is my experience that proofs involving matrices can be shortened by 50% if one throws the matrices out.” - E. Artin

Class Objectives

The structures and theorems of linear algebra are among the most commonly applied concepts in modern mathematics. They appear in abstract algebra, functional analysis, analytic geometry, graph theory, game theory, physics, engineering, computer science, chemistry, economics, and host of other fields1. Like multivariable calculus, linear algebra captures the beauty and sublime utility of mathematics. It provides a framework in which some of the most abstract concepts can be made concrete, and in which modern science and technology have made great advances.

This course will be the study of how diverse perspectives can strengthen understanding and maximize the power of a mathematical concept. In particular, we will find that systems of linear equations, matrix algebras, and linear transformations are all shadows cast by the same central object. Through this course you will master these diverse perspectives, understanding their strengths and interconnections. At the same time, you will continue your progress towards increased abstraction. You will generalize your geometric intuition to higher dimensions and more abstract spaces; master matrix operations; and strengthen your proof-writing and logical reasoning skills. Your grade will be based on your level of achievement in each of the following student learning outcomes:

- Your content knowledge (including your geometric and algebraic reasoning skills)
  As demonstrated on in-class exams
- Your ability to independently research and apply the tools of linear algebra

1This link provides a list of interesting applications
As demonstrated through your project presentations
- Your technical writing and speaking ability

As demonstrated on exams and project presentations

Course Components

- **4 Group Exams (each worth 50 points)***

  Group Exams are done in groups of three, with each group member having a unique problem to work on. Group members proof-read each other’s work and offer suggestions. Of the 50 points possible for each group exam, 40 will be based on your work and 10 will be based on your work proof-reading your team members’ exams. Each team member is allowed one page, one-sided, of notes. For more information see the handout ‘Group Exams’, available from the class WISE site.

- **2 Midterms (each worth 100 points)***

- **1 Final Exam (worth 150 points)***

  The final exam is on **Saturday, December 15th, from 8-11am**. The final will be cumulative.

- **1 Project Presentation (worth 150 points)***

  For more information, see the Project link from the course WISE site.

- **2 Math Colloquium Talks (worth 30 points total)***

  Students are expected to attend two of the Math Colloquium Talks given throughout the semester. These talks will be announced in class and a schedule can be found on the Math Department web site www.willamette.edu/cla/math/colloquia/index.html. An excellent essay on how to approach math colloquium talks is available here: http://www.willamette.edu/~emcnicho/courses/Multi249/How_to_listen_to_a_Math_Lecture_Korner.pdf. The goal of this attendance requirement is to introduce students to the diversity and vitality of current mathematics research, and to include them in the Math Department culture.

**Homework:** Readings from the textbook and WISE site will be assigned to complement class lecture. Lecture format will assume students have completed the appropriate reading before class. Because of the accelerated pace of this course, it is essential that you start exploring the ideas before class and use lecture to strengthen and clarify your understanding. Problem sets for each covered section of the text will be assigned but not collected. I will post solutions to selected problems and expect you to check your work against these. Please discuss the problems with me and your fellow classmates, especially if there are any points you are unsure of. While I will not be collecting this homework, it is designed to help you master the course content. Your performance on in-class exams will be severely and negatively effected if you do not do the assigned homework.

**Grades:** Your grade will be based on the percentage of points you earn out of 730 total possible points. 90% and above guarantees you an A-, 80% and above guarantees you a B-, 70% and above guarantees you a C-, and 60% and above guarantees you a D.
Required Course Materials:

*Contemporary Linear Algebra*, by Anton and Busby

Student Responsibility:

Most of you already know this, but previous experience has shown that a friendly reminder is sometimes helpful. You are all adults and responsible for your own education. I will do everything in my power to help you learn. You should always feel free to stop by my office. In addition to the posted office hours, and I am always available by appointment. You should also feel free to ask me questions in class. Stop me if you are confused and ask me to explain things again. I welcome student questions! Although I will do everything in my power to help you through this class, you are ultimately responsible for your grade. The following is a list of things I expect from you.

- **READ THE TEXTBOOK.** This class is formatted under the assumption that you have completed the assigned reading before class. Class time will consist of lectures highlighting the main points of the section, Concept Tests, and in-class examples. It will be difficult to engage in the material during class if you have not looked over the content ahead of time.

- **DO THE ASSIGNMENTS.** Mathematics is not a spectator sport. You will only learn mathematics by practicing, that is what homework is for. I encourage you to work with your fellow students on homework assignments. Make it a social activity and you will not only learn a great deal, you will have fun doing it.

- **THINK CRITICALLY.** Your goal in this class should be to understand the concepts and strengthen your mathematical reasoning skills. Mimicking problem solving strategies, or working through processes you don’t understand is a waste of your time. Throughout the course you should be asking yourself “Why are we doing this? Why does this method work? How is this related to other topics I’ve learned?”

- **ASK QUESTIONS & SEEK HELP!** Ask questions in class, after class, during office hours, whenever! If you are confused or having problems with a certain section of the material see me AS SOON AS POSSIBLE. I am happy to help you but it is impossible to go over several weeks worth of material right before an exam.

- **STUDY & SHARE YOUR INTEREST.** The standard rule of thumb is that you should spend *three hours outside of class on course work for each hour spent in class*. To master the content of this course and to earn a good grade you will need to invest time and effort. Set aside time for both homework and studying. Linear Algebra contains some of the largest and most unifying theorems in mathematics. It would be wonderful if you discussed these concepts with your fellow classmates, your friends, and your family!

Cell Phone/Screen Policy:

No laptops, iPads, or other devices which take your eyes off your fellow classmates and the class discussion. Electronic devices such as cell phones, pagers, iPods, etc. must be turned off during class meetings. If your cell phone goes off during class, or it is clear that you are using one of these devices during class, you will be responsible for bringing treats for the entire class at the next class meeting. Papers should not be read during class, though I applaud your efforts to stay abreast of current events and tackle the latest crossword or sudoku puzzle.
**Academic Integrity:**

In accordance with Willamette University CLA catalog: “Plagiarism and cheating are offenses against the integrity of the courses in which they occur and against the College community as a whole... Ignorance of what constitutes plagiarism shall not be considered a valid defense. If students are uncertain as to what constitutes plagiarism for a particular assignment, they should consult the instructor for clarification.” Cheating is unethical and I take it very seriously. The Deans Office will be notified if anyone is found cheating and appropriate sanctions will be given. If you are unsure of what constitutes cheating, please ask me.

**Late Assignments and Missed Classes:**

I expect everyone to attend all classes and turn in all assignments. If for some reason you are unable to attend class or turn in an assignment, please let me know as soon as possible, preferably *before* the missed class or assignment.

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**From Previous Students To Future Students**

**Homework:**

“Don’t get behind on the homework. Just because it isn’t collected, doesn’t mean it’s not important and you can get overwhelmed if you put it off until right before the test.”

“Try to get a group together and schedule regular times to do the homework together, that way you won’t be as likely to put it off.”

**Group Exams:**

“Liked the ability to work with classmates to improve our understanding.”

“They were fun-ish, all with the exam buzz.”

“I like being able to work with others and get input on what I did before I turn it in.”

“Don’t blow them off! They may seem like they’ll be easier because you have people to help you, but they are harder questions than would be on the midterms.”

“Despite the fact that you work with others, you still are graded mostly on your own work. Don’t rely on your group to do it for you.”

“Prepare for a group exam just as you would for any other exam. The problems aren’t necessarily easier, but you have longer to do them; collaboration however can be difficult.”

“Do prepare and study for them, and prepare notes.”

“Be assertive - finish your problem before helping others. Don’t be scared to ask for extra quiet time.”

“Study and know theorems”

“Always prepare but don’t feel nervous. Group exams are a good way to learn.”

“Group exams help me learn during the exam while I do not need to be as nervous as taking a midterm.”
Projects:

“Practice presenting it before the day of the presentation. Think about questions people might ask about it.”

“Run your presentation by Prof. McNicholas ahead of time.”

“Fun way to express yourself and what you have learned.”

“Start planning early and leave yourself enough time to perfect your presentation.”

Midterms:

“Study everything! Go over all the homework again, even the proofs. Go over all the notes. Make notes when you are doing the homework on what seems important.”

Attending Math Colloquia:

“Between cookies, tea, and enough colloquium opportunities that it’s easy to find at least two you want to see, there’s no reason to view this as a chore! If anything, I’m jealous the computer science department doesn’t have anything like this.”

“Topics were very interesting, I’d just keep reminding people to do them earlier rather than the last two. It’s nice to choose your topics.”

“I really liked these. They got me really excited about upper-level math.”

“Enjoyable for sure. Helpful because it shows students what is being done with mathematics in the real world.”

“Topics are not easy to get into, but widen my view of math.”

“You get to taste some crazy mathematics.”

“They introduced me to new types of math I knew nothing about. Sometimes they were a little boring, but the cookies made up for that.”

ConcepTests:

“The discussion around these answers was way helpful, and it’s much easier to make a mistake anonymously then to admit confusion in front of the whole class.”

“Definitely helpful and enjoyable. They forced us to think about the material rather than just sitting there mindlessly taking notes. If we didn’t get the right answer, being able to get an immediate explanation of why the correct answer was correct was really helpful! I’d tell students to pay close attention when these come up because they are often very similar to homework and test problems.”

Writing Proofs:

“Justify, justify, justify! Don’t assume everyone knows what you are talking about.”

“Do scratch work, lay out the proof then attack. It may seem difficult or repetitive, but you can do it!”

“It’s like a board game; it’s easy to play if you know the rules... Learn the rules.”
“It’s a very interesting and unique process.”

“Little details are important. Often understanding comes in whether you know to put the small stuff into your proof.”

“It’s not all about math - there’s some flowery writing involved. Also make sure your terms are precise and concise.”

“Writing proofs is hard. Take advantage of office hours.”

“USE DEFINITIONS!!! That is how you do proofs. Always use whatever definitions exist to solve proofs. It makes life easier.”

“It takes a long time to write and make sure to leave a lot of time to do homework and spend a lot of time receiving help!”

“Think systematically, don’t just wing it. Map out what you need to know first, then solve.”

Using LaTeX & Beamer:

“It’s frustrating at first, but stick with it and you’ll figure it out. It actually doesn’t suck after a month or so.”

“It may seem new and mysterious at first, but you’ll be proud of the work you do once you finish the assignment.”

“Have fun! Learn to look for little errors.”

“Make sure you use the available resources and the website.”

“Learn the symbols for it quickly! Also, use Google to search for topics when unknown.”

“Enclose anything that looks remotely mathematical in dollar signs, but exclude any words.”

“It takes a long time! Leave yourself a good amount of time to type things up.”

“Not as hard as you think. Once you get used to it, you’ll be happy you have it as a tool.”
The following schedule is subject to change.

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