Math 416, Abstract Linear Algebra (Spring 2022)

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Logistics, or how will the course run:

We will use `active learning' which means that you will listen to the lecture before class time and we will spend the class time working on problems in groups.

I will provide lecture notes and videos of the lectures. You should also read the corresponding section of the textbook. After watching each video you will have a one question quiz to answer in Canvas. This quiz will expire at the time of the lecture.

There will be weekly homework that you will turn in using Canvas.

The class meetings may be online or in person. (The current plan is to have the first week online and the rest of the semester in person.)

When the class is online:

we will meet via Zoom and we will use Miro, a shared whiteboard app, to do the group work. You can find more information on the course Canvas page..

When the class is in person:

I**f you feel sick or if you might have Covid please do not come to class**.

Exams:

We will also have three midterms and a final. The midterms will be held on:

1. **February 21** (covering hws 1-3),
2. **March 23** (covering hws 4-7),
3. **April 18** (covering hws 8-10).

Discussions:

Please post your questions to the Discussions tab of the Canvas page. That way everybody can see the question and its answer.

Grading:

Quizzes (15%)
Homeworks (40%)
Midterms (25%)
Final (20%)
Everybody has something come up during the semester that can make it hard to keep up with the class. This is especially

true in the current crisis. **For this reason we will drop the three lowest quiz scores, three lowest homework scores, and the lowest midterm score.**

Text:

Meckes & Meckes, *Linear Algebra*.

Holidays:

Classes begin on January 18 and end on May 4. There will be no classes on March 12-20.

Brief course description:

(For a more detailed description of what the course is about, see Lecture 1.)

Linear systems of equations show up in all areas of science and mathematics. One reason is that if something (a map or a space) is not linear then one of our best tools for understanding it is to approximate it by a linear version. For this to be useful we need to have a good understanding of the linear versions. That's what we aim for in this course.

We will cover all sections of the textbook. The chapters are:
1) Linear systems and vector spaces
Solve linear systems of equations leads to the definition of general vector spaces over arbitrary fields.
2) Linear Maps and Matrices
It is a truism in math that to understand a structure you need to study the maps that preserve that structure. So having defined vector spaces we next study those maps between vector spaces that preserve their linear structure.
3)Linear independence, Bases, and Coordinates
Now we delve deeper into the structure of a vector space and learn how to recognize when two vectors spaces are really just different representations of the same space.
4) Inner Products
There are some vector spaces where it makes sense to say that two vectors are orthogonal to each other. This is extra structure so in keeping with our paradigm we also study the maps that preserve this structure.
5) Singular Value Decomposition and the Spectral Theorem
If the same vector space can present itself in ways that can look different, and we are studying a map between vector spaces, we can ask ourselves if one of these ways of describing the vector space(s) makes the map easier to understand. The answer is yes.
6) Determinants
The determinant is a single number that tells us whether or not a map is invertible. It's important to know about and a useful theoretical tool but, except for small matrices, we will usually prefer to use other tools.