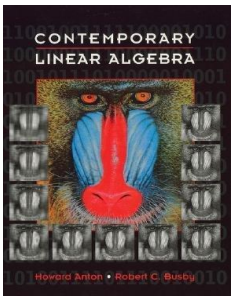
Math 211 :: Linear Algebra :: Winter 2013

This is the **syllabus** for Math 211 Linear Algebra. See the links to the right for updated information. Here you'll find information on prerequisites, grading policy, homework, study resources and a tentative course calender. See the box in the upper right for more links and information for the course.

Textbook

The (required) textbook we will use for this course is **Contemporary Linear Algebra by Anton & Busby** by Anton & Busby. It is available at the University Bookstore, and pictured below along with a link to places to buy it on the web.



Classroom

The class sessions will be active. On most days you will be asked to DO something other than listen to me lecture. This will especially be the case on Monday and Wednesday in the active classroom, LRC 108. On Friday, class will be in New Science 1209.

- Monday, Wednesday: LRC 108
- Friday: NSF 1209

Office Hours

I am often in my office **NSF 1211**, you are free to stop by and see if I am available, or email me to make an oppointment. My official office hours are :

- Wednesday: 3pm - 5pm
- Thursday: 1pm - 3pm
- Friday: 1pm - 2pm

Other Resources

There is a Student Solutions Manual for this textbook. The link on the right Linear Algebra Resources contains links to mostly free sites & documents that will help you get off on the right foot. Both free and paid tutoring is available, in the tutoring lab in NSF 3810.

Prerequisites

You need a B- or better in MA 161 or written permission from me, the instructor.

Quizzes

Group quizzes will be given on occasion. Groups may change each time.

Calculators

Calculators are allowed on all homework. The use of calculators on quizzes and

Links for Math 211

- Syllabus
- Homework
- Class Notes
- Writing Suggestions
- Computing Resources
- Some Fundamental Facts
- Tentative Class Schedule
- Linear Algebra Resources

Other Links

- Courses Previously Taught
- My Teaching Statement
- Important Dates
- NMU Home
- NMU Math
- MyNMU
- MyWeb
- EduCat

exams will be determined on a case by case basis. Unless otherwise notificed, you are **not allowed to have any information saved** in your calculators during quizzes and exams.

Laptops

We will use the software package MATLAB in this class. **Go to the HelpDesk to have MATLAB installed on your laptops ASAP!** In order to promote a positive classroom experience, **Do not use your laptop in class unless instructed to do so**.

Grading

- Homework 20%
- Group Quizzes 5%
- Exams 50% (2 @ 25% each)
- Final 25%

Exams

- Exam 1 - February, 15
- Exam 2 - April 5
- Final - Tuesday, April 30 :: 2 pm - 3:50 pm
- *Make sure that you will be able to attend the exams at the given dates and times. Exceptions can only be accepted in case of time conflicts with other courses, or serious illness with a physician's certification.*[Final Exam Schedule]

Outcomes & Assesment

Upon successful completion of this course students will be able to:

- Demonstrate fluency with the language of linear algebra.
- Solve a system linear equations.
- Find and use the inverse of a matrix to solve problems.
- Recognize and analyze linear transformations.
- Recognize and solve an eigenvalue problem.

Evaluation of these learning outcomes will be done through a mix of assignments, class exercises, projects, research papers, group work, written & oral quizzes and tests.

Topics will be chosen from the following areas.

Coverage of topics with an * will depend on time
In the first few weeks of course, we will cover basic material that will form the foundation for the remainder of the semester. It is important to keep up and not get behind these first few weeks.
Vectors, Matrices & Linear Equations
We will begin with the notion of a vector, and describe algebraic and geometric properties of spaces of vectors. This material will be the foundation of the course, and will lead us to develop linear equations. After seeing what linear equations can do for us, we will see how matrices are used to solve systems of linear equations. We'll see that solutions are usually not unique, but rather are members of an infinte family of solutions. This infinite family has inherits interesting geometrical properties from the larger space in which it lives, and we'll study how to describe and build these so-called *subspaces*. Finally, we learn how this abstract nonsense is the perfect way to describe how traffic flows around the Marquette Round-About.
Matrices & Linear Transformations
After learning the basic arithmetic of matrices, we'll see how some special matrices are used in cool applications such as Archaeology and Cryptography.

The fun will continue when we learn how to make shapes move, grow and deform using matrix transformations. We'll tie all of this together with applications to economics, population dynamics, sociology, fractals and computer graphics.
Determinants & Eigenvectors
We'll associate a special number, called the eterminant, to a matrix and then be amazed at how much information is contained in this one number. Concepts such as area and invertibility are just a few of the nuggets of knowledge hidden inside a matrix's determinant. We'll learn how another special number, an eigenvalue, determines the amoiunt ot stretching involved in a transformation. A special vector associated to this eigenvalue is called an eigenvector and we'll see how Google uses an eigenvector to sort web pages in a search.
Vector Spaces
We'll learn to see images and videos as vectors and discover some more general types of vector spaces, and explore ideas such as linear combinations, independence, bases and rank. We'll use special *orthonormal* bases to project images onto one another and learn how to transform one basis onto another.
Coordinate Representations
We'll learn how to think of a vector as a point in space, like a GPS. We can create objects in 3-D, and use matrix tranformations to move them, i.e., to change their coordinates. We can do so without changing the shape of the object *an isometry*, or we can deform it in a variety of ways. A discussion of diagonalization of matrices will allow us to seperate transformations into complementary mini-transformations. In this way, we can view any transformation as a combination of rotations, translations and dilations.
The Singular Value Decomposition*
We'll build on the ideas of diagonalization to constrct an important decomposition widely used in industry. This will allow us to peer into and through a matrix to learn things such as: its fundamental subspaces, directions of maximal and minimal energy of a point cloud and more.
Inner Product Spaces*
Just as there is more than one way to skin a cat, there is more than one way to do geometry. Just be changing your ruler, geometry can get exciting quickly. Such changes are not merely rescalings, but relativistic; the length of your ruler depends on where you are! This has surprising applications to function approximation and coding theory.
Non-Euclidean Geometry*
We'll explore a few special inner product spaces in depth. We'll learn how to construct hyperbolic geometry, spherical geometry and the geometry of special relativity. We'll learn how to measure distances, compute angles as well as the relevant isometries.
Applications to Video Processing*
We'll apply the SVD and most of what we've learned to tackle cool image processing problems like image segmentation and data clustering.

University Policies

Academic Honesty: Cheating is not only unethical and pathetic, but is a violation of the Northern Michigan University Student Code and University Policy and grounds for your dismissal from the University.

Discrimination & Harassment: Northern Michigan University does not unlawfully discriminate on the basis of race, color, religion, national origin, gender, age, height, weight, martial status, handicap/disability, sexual

orientation or veteran status. If you have a civil rights inquiry, contact the Affirmative Action Office at 906-227-2420.

Americans with Disabilities Act Statement: The University seeks to provide equal access to its programs, services and activities for people with disabilities. If you have a need for disability-related accommodations or services, please inform the Coordinator of Disability Services in the Dean of Students Office at 2001 C. B. Hedgcock Building (227-1700). at 906-227-1700 as soon as possible. Reasonable and effective accommodations and services will be provided to students if requests are made in a timely manner, with appropriate documentation, in accordance with federal, state, and University guidelines.

The Registrar: Withdrawing from any course or any matters relating to registration are the responsibility of the student. For more information regarding this topic, check out the Registrars Website.

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