Math 211 — Matrix Algebra I — Spring 2015

Course: MATH 211 Section A01 [CRN 22031]
Instructor: Jason Siefken (siefkenj@uvic.ca)
Class: TWF 10:30–11:20 in DTB A110
Webpge: http://web.uvic.ca/~siefkenj/math211

Office: DTB A555
Office Hours: TW 12:00–1:00 or by appointment
Textbook: *Introduction to Linear Algebra for Science and Engineering* Second Edition, by Norman and Wolczuk

Linear Algebra, sometimes called Matrix Algebra, is the study of vectors, "flat spaces" like lines and planes, and linear transformations like rotations and scalings. Vectors originated in the study of physics and the 3D world, but through the mathematical practice of *abstraction*, we now use vectors to represent non-spacial things like music in addition to computer graphics and physical forces.

Transformations are functions that move vectors around, and in this class we will focus on *linear transformations*. Why? Because although mankind has strived to understand the non-linear phenomena of the universe, we haven't gotten very far—the non-linear equations governing fluid flow still haven't been solved! However, we have a complete theory of linear equations and linear transformations. Our approach to answering general questions about the universe is often to convert the problem into a linear one—one that we can actually understand.

Learning Outcomes

After taking this course, you will be able to:

- Solve systems of linear equations and matrix equations, write vectors in different bases, use the geometry of subspaces like row spaces, column spaces, null spaces, and eigen spaces to solve problems, and switch between geometric and algebraic points of view to aid problem solving.
- Work independently to understand concepts and procedures that have not been previously explained to you.
- Clearly and correctly express the mathematical ideas of linear algebra to others.

Prerequisites

Linear algebra will be different from most math courses you've taken before, and it requires a level of mathematical maturity: you must be able to work problems carefully and diligently following rules you may not be familiar with (for example, if A and B are matrices, $AB \neq BA$, which is contrary to the way numbers work). You must also be familiar with the difference between an example and a proof (an example is a set of particular numbers that happens to work, a proof is a logical argument that works for any choice of numbers). Computationally, you must be able to factor polynomials (for example $x^3 - x^2 - 4x + 4$) and manipulate fractions and square-roots.

The formal requirements are an A in grade 12 math or 3.0 credits (2 courses) of university-level math.

To Succeed

Learning is hard! It is exercise for the mind, and like exercise, when you're doing it, it feels pretty uncomfortable (and if it doesn't, you're probably doing it wrong). Here are some tips to help you succeed academically (getting the grade you want) and intellectually (learning the most you can).

- Form a regularly-meeting study group of 3–4 people. Having others studying around you will help you study, and having someone to talk about confusing problems with will help you both productively struggle (struggling with others is how real-world problems are solved).

- Read the textbook *before* class. In class we will be working on problems that we haven't gone over before. If you expose yourself to the concepts prior to class, you'll get a lot more out of it.
- Visit the **Math & Stats Assistance Centre** where there are expert tutors, paid by the math department, to help you. For hours, see http://www.math.uvic.ca/~msassist/
- Know your definitions. Half of linear algebra is knowing the definitions (I'm not kidding). Knowing a definition means you can *write it down precisely*. If you "know it when you see it" but cannot write it down, you don't know the definition.

Assessment

Midterm 1 (15%) In-class midterm on Friday, February 6.

Midterm 2 (15%) In-class midterm on Friday, March 13.

Assignments (20%) There are two types of weekly assignments in this class: *4 typed assignments* and *4 written assignments*. All assignments are equally weighted, and your lowest two assignment marks will be dropped (because of this, there will be no makeup assignments). Assignments are to be turned in at the beginning of class the day they are due.

Typed Assignments: These assignments will consist of 2–3 problems and the focus is on clear communication. You may work in pairs, and if you do so, ensure both names are on the assignment and only turn in one copy. The goal of a typed assignment is to explain the problem, any necessary definitions, and a correct solution in a way that a student who hasn't taken this class could understand. The write-ups can be short, but they will be graded on clarity, completeness, and correctness.
I suggest you use the LaTeX typesetting software to do your write-ups. LaTeX is the industry-standard for scientific write-ups in math, physics, chemistry, computer science, and engineering. It has a learning curve but is well worth the effort. See the course webpage for details.

Written Assignments: These are individual assignments and will consist of 4–5 problems. You may, but are not required to, type these assignments.

Final (50%) A comprehensive 3 hour final exam will be scheduled by the Records Office for the April exam period.

Policies

I have carefully planned the midterm dates, so please ensure you are available for each midterm. If you miss a midterm for a justified reason (illness, family affliction, or other reason recognized by UVic's policies), I can excuse it for you by weighting other tests more heavily. However, *there will be no makeup exams*.
The final exam will be scheduled by the Records Office. **Students are strongly advised NOT to make final plans for travel or employment during the final examination period since special arrangements will NOT be made for examinations that may conflict with such plans**. Off-schedule Final Examinations are not given except in accordance with the regulations on *Illness, Accident, or Family Affliction* at Exam Time in the UVic Calendar. Deferred status is only granted for Final Examinations.
If you have a disability/health consideration that may require accommodations, please approach me and/or the Resource Centre for Students with a Disability (RCSD) as soon as possible. http://rcsd.uvic.ca
For the rest of the course and math department polices, please see http://www.uvic.ca/science/math-statistics/undergraduate/course-policies/index.php

Time Table

Below is a preliminary time table.

January	Week 1	6		**Chapter 1** (Vectors) (1.1) Linear Combinations (1.2) Vector space, subspace, span, linear independence/dependence, basis (1.3) Length, dot product, unit vector, normal vectors of lines and planes (1.4) Projections
		7		
		9		
	Week 2	13		
		14		
		16	Due: **Written Assignment 1**	
	Week 3	20		
		21		
		23	Due: **Written Assignment 2**	**Chapter 2** (Systems of Linear Equations) (2.1) Solving, consistency, matrix representation, row echelon form (2.2) Reduced row-echelon form, rank (2.3) Using rref to find linearly independent sets and spanning sets
	Week 4	27		
		28		
		30	Due: **Typed Assignment 1**	
February	Week 5	3		
		4		
		6	**Midterm 1**	
	Week 6	10	Reading Break (no class)	
		11		
		13		
	Week 7	17		**Chapter 3** (Linear Transformations) (3.1) Matrix operations/matrix multiplication (3.2, 3.3) Linear transformations (3.4) Null space/row space/column space (3.5, 3.6) Inverses and elementary matrices
		18		
		20	Due: **Typed Assignment 2**	
	Week 8	24		
		25		
		27	Due: **Written Assignment 3**	
March	Week 9	3		**Chapter 4** (Vector Spaces) (4.4) Change of basis **Chapter 5** (Determinants) (5.1, 5.2) Computing determinants (5.4) Area and volume and determinants
		4		
		6	Due: **Typed Assignment 3**	
	Week 10	10		
		11		
		13	**Midterm 2**	
	Week 11	17		**Chapter 6** (Eigenvectors) (6.1) Eigenvectors and eigenvalues (6.2) Diagonalization
		18		
		20	Due: **Written Assignment 4**	
	Week 12	24		
		25		**Chapter 7** (Orthogonality) (7.1) Orthogonal bases/orthogonal matrices (7.2) Gram-Schmidt
		27	Due: **Typed Assignment 4**	
April	Week 13	31		
		1	Last day of class	

Other important dates include January 18 (last day to drop a class for 100% reduction in fees) and February 28 (last day to drop a class). The exam period is April 7–22.