MATH 221: MATRIX ALGEBRA
2021, WINTER TERM 1

Before the start of term, a Canvas website for the course will be launched. A version of this syllabus will appear on that website. The version on the Canvas website takes priority, so if there is any disagreement between this document and the text on Canvas, the version on Canvas is correct.

DESCRIPTION

Math 221: Matrix Algebra is an introductory course in linear algebra.

Linear algebra is a fundamental and extremely important topic in mathematics. Many other branches of mathematics are concerned with reducing more complicated questions to problems in linear algebra. For instance, calculus tries to reduce questions about curves and surfaces (or higher dimensional shapes) to ones about their tangent lines or tangent planes. These lines and planes are concepts in linear algebra.

This course is a study of linear maps. We will learn what they are, how to manipulate them as well as tools (determinants, eigenvectors/eigenvalues, diagonalization) to visualize them better. Along the way we will also touch on various applications.

LECTURES, TIMES AND LOCATIONS

Table 1: Times, locations and instructors

Number	Time	Place	Instructor	Contact
101	Tu Th 9:30-11	GEOG 200	Dr Wenzhao Chen	
102	MWF 10-11	LSK 201	Dr Ben Williams	`tbjw@math.ubc.ca`
103	MWF 1-2	LSK 200	Dr Alexia Yavicoli	`yavicoli@math.ubc.ca`
104 (hybrid)	MWF 1-2	MATX 1100 & online	Dr Han Lu	`hanlu@math.ubc.ca`
106	MWF 3-4	LSK 201	Dr Alexia Yavicoli	`yavicoli@math.ubc.ca`

Instructors have no control over registration. For registration questions, refer to https://www.math.ubc.ca/undergraduate/advising-and-resources/registration-issues.

OFFICE HOURS

Office hours will be posted after term starts. They are subject to change. There will be a mix of in-person and online office hours at first.

You may also be able to make an appointment to meet your instructor at some other time.

TEXTBOOK

The textbook for this course is the online textbook Interactive Linear Algebra: UBC Edition.

Note that you can download a pdf version of the textbook from the linked website.

The textbook is based on Interactive Linear Algebra by Dan Margalit and Joe Rabinoff. Most of the chapters are the same, but the initial topics have been reordered and more material has been added to the UBC edition about discrete dynamical systems.

In previous years, this course was taught using Linear Algebra and Its Applications (4th edition) by David Lay. Most of the material is the same, so you might benefit from having a used copy of this book (or of the 5th edition) but it is not the official textbook for this version of Math 221.

ASSESSMENT AND GRADE

In this course, there will be weekly WeBWorK assignments and MATLAB assignments approximately every two weeks (precise times are specified on the Modules page). The homework will count for 15% of the course grade. There will be two midterms and a final exam.

The midterms and the final exam are in-person exams.

At the end of the term, we will calculate your score based on one of these three formulas:

- 15% for each midterm and 55% for the final,
- 15% for one midterm and 70% for the final,
- 85% for the final.

We will automatically use whichever calculation is best for you.

In the case of regular assignments, (MATLAB, WeBWorK) we will automatically drop one (MATLAB) or two (WeBWorK) of your lowest-scoring submissions. This is the default "first accommodation". If you have some problem (illness, bereavement, public health orders, family emergencies etc) that means you miss more homework than this, then contact your instructor as soon as possible.

Table 2: Overall grade calculation

Type	Number	Points each	Total points
WeBWorK homework	10 best of 12	1	10
MATLAB assignments	5 best of 6	1	5
Midterms	0,1 or 2 best of 2	15	0, 15 or 30
Final	1 best of 1	55, 70 or 85	55, 70 or 85
Total			**100**

HOMEWORK

WebWork. Homework assignments in this course will mostly take the form of automated WebWork assignments. These will be worth a total of 20% of the course grade. They will be posted online each week, and will be due on the Friday of the following week. Please note the following items:

(1) For most questions, you may attempt each question up to 5 times.

(2) The questions are generated randomly, and the numbers are different for each student.

(3) You are encouraged to discuss these problems with other students in this course, either on the Piazza website or independently.

(4) If you think there is a mistake in the question, contact the instructor on WeBWorK (but for math help, look on Piazza)

(5) The deadlines are enforced by the system, and it will shut down automatically when time is up, so give yourself plenty of extra time in case of difficulties.

(6) Your lowest two WebWork grade out of 12 will be dropped in the final course calculation. The other assignments will be worth 2% each, for a total of 20%.

MATLAB. There will be 6 MATLAB assignments. They will also be due on Fridays, starting on September, and then every two weeks. We will award 5% of the course grade for these, by making each one worth 1% and dropping the lowest score for each student.

MIDTERMS

There will be two midterms, in weeks 6 and 10 of the term. The midterms will be held during the regular class time.

If you cannot be present on campus for a midterm, don't panic. You do not have to take the midterms—the weight will be automatically be moved to the final.

If you cannot be present on campus for a midterm, but still want to test yourself to see how you are doing in Math 221, we will provide an option for you to submit answers to the midterm questions. These will be marked and returned just like any other midterm submission, but any remotely-taken midterm will not count towards your final grade.

FINAL

There will be a final exam, in the final exam period. We do not know when exactly it will be scheduled.

You can fail the final and still pass the course (although, since the final is a lot of points, this is hard to do).

Important information about the final: The final exam is an in-person exam. There is no online final. This applies to all sections. Students who cannot be present on campus for the final exam will have to apply for Deferred Standing (SD) in this course, and may be able to write a final in a subsequent term when they are able to be on campus.

Topics to be Covered

More detailed Learning Goals are on the website. Here is a list of the topics to be covered on a weekly basis.
Note: we may not exactly keep pace with this list of topics... we might end up one lecture ahead or behind.
This is especially true in Section 101, which meets on Tuesdays and Thursdays, so has different timing
from the other sections.

Table 3: Topics to be covered (provisional)

Week	Section	Titles	Notes
1 (7–10 Sep)	1.1, 1.2	Vectors, Vector Equations and Spans	
2 (13–17 Sep)	2.1, 2.2, 2.3	Systems of Linear Equations, Row reduction, Parametric Form	
3 (20–24 Sep)	2.4, 3.1, 3.2	Matrix Equations, Solution Sets, Linear Independence	MATLAB 1
4 (27 Sep–1 Oct)	3.3, 3.4, 3.5	Subspaces, Basis and Dimension, Bases as Coordinate Systems	
5 (4–8 Oct)	3.6, 4.1, 4.2	The Rank Theorem, Matrix Transformations, One-to-one Transformations	MATLAB 2
6 (11–15 Oct)	4.2(continued), 4.3	Onto Transformations, Linear Transformations	Midterm 1
7 (18–22 Oct)	4.4, 4.5, 4.6	Matrix Multiplication, Matrix Inverses, the Invertible Matrix Theorem	MATLAB 3
8 (25–29 Oct)	5.1, 5.2, 5.3	Determinants: Definition, Cofactor Expansions, Determinants and Volumes	
9 (1–5 Nov)	6.1, 6.2, 6.3, 6.4,	Eigenvalues and Eigenvectors, the Characteristic Polynomial, Similarity, Diagonalization	MATLAB 4
10 (9, 10 Nov)			Midterm 2
11 (15–19 Nov)	6.5, 6.6	Complex Eigenvalues, Discrete Dynamical Systems	MATLAB 5
12 (22–26 Nov)	7.1, 7.2, 7.3,	Dot Products and Orthogonality, Orthogonal Complements, Orthogonal Projection	
13 (29 Nov–3 Dec)	7.4, 7.5	Orthogonal Sets, the Method of Least Squares	MATLAB 6
14 (6,7 Dec)		Review	

Materials

The textbook is fully online (see link above).

You may wish to download a student edition of MATLAB (it takes about 3 GB of space on your computer),
but it is not necessary to do this, since you can use MATLAB in the cloud instead. Instructions are on the
MATLAB page.

There are no other required materials.

EXPECTATION AND LEARNING GOALS

A page describing learning goals, broken down by section, will appear on this website. In order to get a B-grade or better in this course, you should meet these goals and be able to apply what you have learned accurately in straightforward problems. To get an A-grade in the course, you should meet these goals, be able to apply what you have learned quickly and accurately and in more complicated problems.

WHERE TO LOOK FOR HELP, AND OTHER ADVICE

Come to office hours: all listed office hours in this course are open to students from any section.

Post on the course's Piazza page.

There is a special MATLAB TA to help you with technical MATLAB questions.

For enrollment problems, use the form here: `https://www.math.ubc.ca/undergraduate/advising-and-resources`

For all other problems, contact your instructor—via UBC email or through this Canvas website.

ACADEMIC INTEGRITY

The usual policy on Academic Honesty and Standards applies. Any kind of academic misconduct is prohibited. In Math 221, this chiefly applies to the midterms and the final, which are subject to the usual rules on misconduct as laid out in the academic calendar, and to the avoidance of plagiarism on homework assignments. Specifically, while you may freely discuss your assignments with other people in the class, you must submit your own answers, and not copy someone else's or pretend someone else's work is your own.

A NOTE ABOUT TIMES

All times on this website and in this course refer to Vancouver Time. This is Pacific Daylight Time (UTC -7) until 7 November 2021, at which point it changes to Pacific Standard Time (UTC -8).

University Values and Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence.

UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom.

UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances.

UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available here.