

# MATH 221 921 2023S1 Matrix Algebra

## Overview

MATH 221 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.

## Lecture

- Time and Location:
  - Mon Thu Fri 2:00 PM -- 4:00 PM in Hennings 202
  - Wed 2:00 PM -- 3:00 PM in Buchanan A103
- Instructor: Wenzhao Chen
- Email: [chenwzhao@math.ubc.ca](mailto:chenwzhao@math.ubc.ca)
- Textbook: Online textbook [Interactive Linear Algebra: UBC Edition](#) by Dan Margalit, Joe Rabinoff, and Ben Williams
- Lecture notes will be posted after each lecture

## Office hours

During the term (May 15 to June 22), office hours are provided on Zoom at the following time:  
Tuesday 4 pm -- 5 pm & Friday 10 am -- 11 am  
Note that office hour schedules are subject to change.

## Assessment and Grade

The assessment of this course consists of homework (best 5 out of 6 WeBWork assignments), two midterms, and a final exam. (Details of WeBWork assignments and exams can be found below.)

Your final grade will be the maximum of the scores computed using the following two methods:

- WebWork 15%, midterms 15% + 15%, final 55%
- WebWork 15%, best midterm 15%, final 70%

## WeBWork

There are 6 WebWork assignments, one each week starting from Week 1. Each WebWork assignment is due on the Sunday of the corresponding week. When computing your final score, we will use your best 5 WebWork grades, each contributing 3%. Please note the following items:

- 1) You may attempt each question more than once. There is no penalty for a wrong answer. This is to help you correct your own mistakes and to get instant feedback on your attempts.
- 2) The questions are generated randomly, and the numbers are different for each student.
- 3) Please try to do the problems by yourself, and without the use of other calculators or software. Since calculators and software are not allowed in the exams, you should practice working without them.
- 4) You are encouraged to discuss these problems with other students in this course, either on the Piazza website or independently.
- 5) In general, it's a good idea to start the assignments early rather than waiting till the last minute. 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 problems.

## Exams

There are two midterms and a final. If you miss one of the midterms, don't panic. The weight will automatically be moved to the final. We will not provide alternate midterms.

- Format: closed book, in-person, calculators not allowed.
- Midterms are 50-min long and are held during class hours on the following dates:
  - Wednesday, May 31
  - Wednesday, June 14
- The final exam will be scheduled by the university.

## Concessions

UBC's general policy on Academic Concessions can be found here:

<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3.329.0.0>

Our course already incorporates certain flexibility. More specifically,

- Lecture notes will be provided
- You can miss one WeBWork assignment without losing marks
- If you miss a midterm, the weight will be automatically relocated to the final

If you need more concessions, please follow the guidance here:

<https://www.math.ubc.ca/general-syllabus-information>.

## Course Schedule

The following is a provisional schedule of the class.

- Week 1 (15-19 May).
  - 1.1-1.2, 2.1-2.4: Vectors, Vector Equations and Spans, System of Linear Equations, Row reduction, Parametric Form, Matrix Equations

- Week 2 (24-26 May).
  - No class on Monday, May 22
  - 3.1-3.5: Solution Sets, Linear Independence, Subspaces, Basis and Dimension, Bases as Coordinate Systems
- Week 3 (29-31 May and 1-2 June).
  - Midterm 1 on Wednesday
  - 3.6, 4.1-4.5: The rank theorem, Matrix Transformations, One-to-one Transformations, Onto Transformations, Linear Transformations, Matrix Multiplication, Matrix Inverses
- Week 4 (5-9 June).
  - 4.6, 5.1-5.3, 6.1-6.3: The Invertible Matrix Theorem, Determinants: Definition, Cofactor Expansions, Determinants and Volumes, Eigenvalues and Eigenvectors, The Characteristic Polynomial, Similarity
- Week 5 (12-16 June).
  - Midterm 2 on Wednesday
  - 6.4-6.6, 7.1-7.2: Diagonalization, Complex Eigenvalues, Discrete Dynamical systems, Dot Products and Orthogonality, Orthogonal Complements
- Week 6 (19-22 June).
  - 7.3-7.5: Orthogonal Projection, Orthogonal Sets, The Method of Least Squares

## 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 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 on the [UBC Senate website](#).