MATH223: Honours Linear Algebra
2024 Winter 1

Balázs Elek

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ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xʷməθkʷəy̓əm (Musqueam). The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on culture, history, and traditions from one generation to the next.

If you would like to know more about the joint history of UBC and Musqueam, one place to start is at UBC's Indigenous portal.

COURSE DESCRIPTION

This course is aimed at excellent students (typically honours students, though anyone may enroll). It is more abstract and covers more material than MATH 152 and MATH 221.

We will explore linearity, one of the most basic mathematical phenomena, and Linear algebra, a basic mathematical language which is used in every part of mathematics and generally within science to describe the world around us. We will focus on mathematical thinking with an emphasis on definitions and writing rigorous proofs. The following topics will be covered:

- Vector spaces over $\mathbb{R}$ and $\mathbb{C}$, subspaces.
- Span, linear independence, bases and dimension.
- Linear maps and matrices.
- Eigenvalues, eigenvectors and diagonalization.
- Inner product spaces, orthogonality and the Gram-Schmidt process.
- Generalized eigenvectors, characteristic polynomials, and the Jordan normal form.
- Trace and determinant.

INSTRUCTOR

Balázs Elek
e-mail: balazse@math.ubc.ca (please always include MATH223 in the subject line)
Please note: I am happy to be contacted via email, however I will not respond to emails with mathematical content questions, these questions should be posted to the course Piazza for everyone's benefit. Alternatively, you can ask me in person after class or during office hours.
Office hours: TBA

Class information

Time: MWF 10:00am-11:00am
Location: FSC-Floor 1-Room 1221
TA: TBA
Textbook: Linear Algebra Done Right, by Sheldon Axler, available for free here:
https://linear.axler.net/
Additional textbook: Interactive Linear Algebra, UBC edition, available for free here:
https://personal.math.ubc.ca/~tbjw/ila/
Course webpage: https://personal.math.ubc.ca/~balazse/math223.html

GENERAL SYLLABUS

You are expected to have read and be familiar with the policies and information contained in the general syllabus information.

CLASS NORMS

- This is a respectful and safe space for everyone to learn in.
- Everyone has something to contribute.
- Mistakes are an opportunity for learning.
- There is no shame in not understanding a concept or idea the first (or the twentieth!) time you encounter it.
- Mathematics is a collaborative effort.

GRADE BREAKDOWN

The final grade will be calculated as follows: 50% final exam, 30% midterms, 20% assignments.

HOMEWORK

There will be around ten homework assignments, due on certain Fridays during the semester at 11:59pm. The lowest score will be dropped when calculating the homework grade. You are encouraged to work on solving the problems together. However, each of you must write your solutions independently, in your own words. You may (and should) share your ideas but you may not share your written work.

EXAMS

There will be two (in-class) midterm exams and one final exam in the usual exam period. The first midterm will be on Oct/4 and the second one will be on Nov/8.

- If you need special accommodations when taking written exams, please contact the Centre for accessibility.
- If the midterm (or final) exam conflicts with a religious observance, or if you have any other legitimate conflict, please contact me **at least two weeks ahead of time** so we can make appropriate arrangements.

LEARNING GOALS

By the end of the course, you will be able to

- Write simple proofs.
- Solve challenging problems that require new ideas.
- Work with real and complex numbers, abstract vector spaces.
- Compute bases and understand the dimension of a vector space.
- Add, multiply and invert matrices.
- Relate linear transformations to matrices.
- Compute the inverse of a matrix.
- Recognize eigenvalue problems and compute the eigenvalues and corresponding eigenvectors.
- Compute in inner product spaces, find orthogonal complements and orthogonal projections.
- Describe and compute the characteristic polynomial and the Jordan normal form of a linear operator.
- Compute the trace and determinant of a linear operator.