MATH 223/131: Honours Linear Algebra

Fall 2025

Instructor:	Kasia Jankiewicz (she/her)	**Time:**	MWF 10:00 - 10:50
Email:	through Canvas	**Place:**	Math Annex 1100
Office:	Math 212	**Canvas:**	link
Office hours:	M 15-16 & F 11-12		

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1 Acknowledgement

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

2 Course description

This linear algebra course is faster and more abstract than MATH 152 and MATH 221. We will focus on mathematical thinking with an emphasis on definitions and writing rigorous proofs. We will cover topics such as vector spaces, linear transformations, matrices, determinants, eigenvalues, eigenvectors, diagonalization, inner product spaces, orthogonality, the Gram-Schmidt process, the spectral theorem.

3 References

We will mostly follow Linear Algebra Done Right by Axler, which is freely accessible. At certain points we might use additional resources which will be made available. I will also share my lecture notes.

Other references and resources:

- [Interactive Linear Algebra (UBC Edition)](#) by Margalit, Rabinoff, and Williams - used in Math 221

- [Linear Algebra](#) by Friedberg, Insel, and Spence (older editions can be found online)

- [Math Learning Centre](#) - a space for undergraduate students to study math together, with friendly support from tutors. Located in Math 102.

4 Learning tools

Canvas

All the course information and assignment will be posted on Canvas. Please check it for announcements.

Piazza

All questions about the mathematical content of the course or the course logistics should be posted on Piazza for everyone's benefit. You are welcome to answer questions of your peers. Active participation on Piazza might result in a grade bump at the end of the term.

iClicker

We will use iClicker in class for anonymous polling. The answers are not graded. While there is no official participation grade, active participation might result in a grade bump at the end of the term.

The iClicker code for this class is AKHT.

5 Homework

Homework problem sets will be assigned on Wednesdays and due the following Tuesday at 11:59pm. The homework submission is through Canvas. Typesetting your solutions in LaTeX is strongly encouraged. A list of LaTeX resources is available on Canvas.

You are encouraged to work together on problem sets. However, your solutions must be written up independently. The use of generative AI is permitted, but needs to be acknowledged in your written solution of each problem where you use it.

The late homework is accepted with a 10% penalty per each 24 hour period that it is late. To accommodate for unforeseeable circumstances, two lowest problem set scores will be automatically dropped at the end of the term.

6 Quizzes

Short quizzes will be posted on Canvas after some classes. They will be short answer or multiple choice questions, and will be due before the next class. Unlimited attempts are allowed. The quizzes help you gauge your understanding of the course material and whether you should seek extra assistance.

7 Exams

There will be two in-class midterm exams on Monday, October 6 and Monday, November 17, and a final exam during the final exam period (the date and time will be announced by the university in October).

The lowest midterm exam score will be automatically replaced with the final exam score, if the final exam score is higher. In particular, if you miss one midterm, the final exam score will count for the missed midterm score. The exams will be closed-book. The final exam will be cumulative.

8 Grade breakdown

Homework: 25%
Quizzes: 5%
Midterm exams: 20% each
Final exam: 30%

The letter grades will be assigned at the end of the term using the standard UBC grading scale. Individual assignments will not be curved. The final grades might be curved up, if the instructor decides it is appropriate, but they will not be curved down.

9 Course topic schedule

Subject to change. The topics covered in class will be posted on Canvas each week.

Week 1: Introduction, Fields
Week 2: Vector spaces, Subspaces and span, Linear independence
Week 3: Bases, Dimension, Linear transformations
Week 4: Matrix representation of $F^k \to F^n$, Kernel and image, The rank nullity theorem
Week 5: Isomorphism, Matrix representation of $V \to W$
Week 6: *Midterm 1*, Change of basis, Linear Functionals
Week 7: Dual Spaces, Determinants
Week 8: Eigenvalues, Eigenvectors, Eigenspaces
Week 9: Diagonalizability, Inner products, norms
Week 10: Orthogonal and orthonormal sets, Gramm-Schmidt procedure
Week 11: Orthogonal complements
Week 12: *Midterm 2*, Functionals on inner product spaces, Adjoint operators
Week 13: The spectral theorem, Operators on complex vector spaces
Week 14: Jordan form, Multilinear forms

10 Learning goals

- Solve problems that require new ideas.

- Write simple proofs.

- Work with real and complex numbers, abstract vector spaces.

- Compute bases and understand the dimension of a vector space.

- Add, multiply, invert matrices and compute their determinants.

- Relate linear transformations to matrices.

- 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.

11   Accessibility

Students requiring support due to physical or learning disabilities may apply for accommodations through the Centre for Accessibility (CfA). Students must register with the CfA before requesting accommodation.

12   UBC resources to support student success

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 here.

13   UBC statement on respectful environment

The University expects courses to be respectful environments. This expectation extends to discussion forums associated with the course, where posts must be respectful and civil. The University's Statement on Respectful Environment highlights two central principles, *freedom of expression* and *promotion of free inquiry*, and an underlying requirement of *a vigorous commitment to recognition of and respect for the freedoms of others, and concern for the well-being of every member of the university community.*