

MATH 2135 – Linear Algebra

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship



Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years

1 Instructor & Course Component Details

Instructor Dr. Dorette Pronk, Office: Chase 302, email: pronkd@dal.ca

Lectures MWF 8:35 - 9:25 AM in LSC 244

Lectures are in person and attendance is mandatory. However, if you are not able to attend due to illness or another valid reason, please contact me and I will run a livestream on the following Zoom link:

<https://us02web.zoom.us/j/87405907079?pwd=ZccCCMFr01FhjQkZdWYPmf8uum47bj.1>

(or meeting ID: 874 0590 7079 with Password: matrices)

Office Hours M 11:30 AM - 12:30 PM, T 4 - 5 PM, F 11:30 AM - 12:30 PM, or by appointment.

Office hours at the scheduled times are normally in person in my office, but all office hour appointments can also be scheduled on Zoom. The link for office hours is:

<https://us02web.zoom.us/j/81897694898?pwd=UF1WQ2JWbG5TQXl1adzU4dE10YVFKUT09>

(or meeting ID: 818 9769 4898 with Password: solutions)

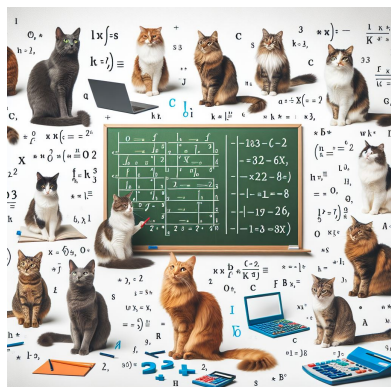
Important Note Please refrain from wearing any scented products to class or office hours. I am severely allergic to them – they cause me to get a migraine within a couple of minutes of exposure.

2 General Information

Course Description: This course is a continuation of MATH 1030 with an emphasis on foundations and the theory of vector spaces and linear transformations. Additional topics include inner product spaces, symmetric and orthogonal transformations, bilinear forms, similarity and diagonalization, the solution of linear differential equations, and various applications in mathematics, physics and computer science.

Course Prerequisites: MATH 1010 and MATH 1000. Exclusions: MATH 2040.

2.1 Learning Objectives

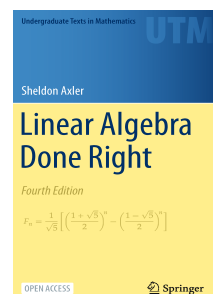


MATH 2135 is a proof-based course. Not only will proofs be given in class, but students will learn to write proofs themselves. The course is suitable for honours students and others with an interest in rigorous mathematics. Topics include:

- Complex numbers, fields, vector spaces, subspaces.
- Spans and linear independence, bases, dimension.
- Linear maps, null space and range, dimension theorem, isomorphism of vector spaces, products and quotients.
- Eigenvalues, eigenvectors, invariant subspaces, diagonalizability.
- Inner product spaces, orthogonality, orthonormal bases, Gram-Schmidt orthogonalization procedure.
- Unitary, self-adjoint, and normal operators; the spectral theorem.

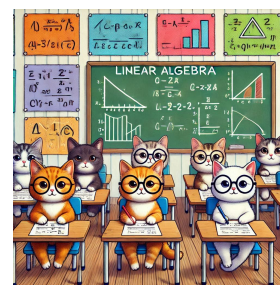
Course Materials: Textbook: “Linear Algebra Done Right”, 4th edition, by Sheldon Axler. The book is freely available from linear.axler.net. There is also a set of videos to accompany the book.

Course Topics: We will cover approximately the following textbook chapters: 1A-C, 2A-C, 3A-D, 5A, 5D, 6A-C, 7A-C.



3 Course Assessment

Participation	5%	Participation in class, office hours, and discussion forums.
Homework	25%	Assigned throughout the semester, to be handed in on Brightspace, as pdf-files.
Midterm	20%	Friday, February 28, in class.
Final Exam	50%	3 hours – Scheduled by the Registrar between April 9 and 26. <i>You must pass final exam to pass the course.</i>

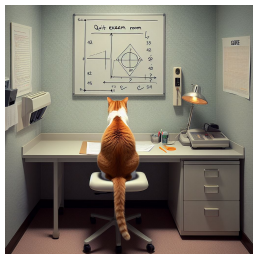


Note: Calculators, textbooks, and notes are not permitted for Midterm Tests or the Final Examination. The exams will consist of short answer questions and will require complete arguments and proofs.

The grading scheme for this course will follow the standard scale set by Dalhousie University.

A+	[90-100]	B+	[77-80]	C+	[65-70]	D	[50-55]
A	[85-90]	B	[73-77]	C	[60-65]	F	[0-50]
A-	[80-85]	B-	[70-73]	C-	[55-60]		

4 Student Accommodations



If there are aspects of the design, instruction, and/or experiences within this course that result in barriers to your inclusion please contact the Student Accessibility Centre da1.ca/access. Also, I welcome suggestions for changes in the way I deliver this course.

5 Course Policies - Working on Homework

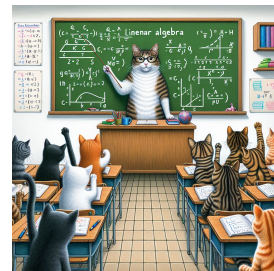
- The Mathematics Learning Centre, which is located in Room 119 on the 1st floor of the Chase Building, is a great study space. Although Math 2135 is not officially served by the Learning Centre, you can drop by if you have difficulties with fundamental concepts. Tutors are available Monday–Friday 11:30–4:30 and 6:30–7:30 on a first come, first served basis, free of charge.
- The Learning Centre also has large tables where you can work together. I strongly encourage you to form study groups and meet regularly to work together on homework problems. However, each student must complete their own individual homework and exams. Homework must be written in your own words.
- You are not permitted to copy answers from the internet or to ask anybody on the internet for help with your homework, including programming assignments. You may not use artificial intelligences to help with your homework. We may use plagiarism software and other technological means to detect academic integrity issues.



Algebra is but written geometry and geometry is but figured algebra.
–Sophie Germain (1776 – 1831)

6 Course Policies - Class Participation

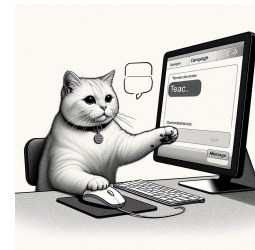
- 5% of your grade is for participation. There are at least three ways to participate: you can ask or answer a question in class; you can ask or answer a question in office hours; or you can ask or answer a question in the Brightspace discussion forum. Each time you do so, you receive 1 participation point, up to a maximum of 5 points. 5 points equals 5%. I reserve the right to not award points in case of frivolous activity (e.g.: don't ask what is $1+1$; don't ask questions you already know the answer to; don't answer your own question just to get a point; don't conspire to answer a friend's question just to get a point, etc. The point is participation).
- You are welcome to email me with questions or issues that are private or personal to you. When asking math-related questions, please use the discussion forum on Brightspace. This way, you can get participation points, and others can benefit from seeing your question and any answers that are already there. You are welcome and encouraged to answer each other's questions and be helpful, but obviously don't just post the full answers to the homework in the discussion forum.



7 Course Policies on missed or late academic requirements

- In the event that you are absent for three days or fewer resulting in missed or late academic requirements, you will be required to submit a Student Declaration of Absence Form to your instructor, see: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html
- I understand that circumstances can arise that can interfere with completing your work. I will drop your two lowest homework scores to function as a buffer for all.
- If you need to hand in your homework late, contact the instructor to alert the grader. If you do not do this, your work may not be marked at all. Unless you have a valid reason, the penalty for late homework is a 2 point deduction per day that it is late.

Midterm and Final exams: In the event that you are unable to attend the midterm or final exam, please notify the instructor via email **in advance** to determine what alternatives may be possible. If you do not contact the instructor in advance and don't have a valid excuse, you will receive 0 points for the missed assessment.



Note: all cat images in this syllabus were created with an AI image generator.

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: <https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html>

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.