

We recognize and acknowledge that McMaster University meets and learns on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the [Dish With One Spoon](#) wampum, an agreement amongst all allied Nations to peaceably share and care for the resources around the Great Lakes.

MATH 2LA3 – APPLICATIONS OF LINEAR ALGEBRA

2024 Summer Term

Section C01

Time: Monday and Wednesday 7:00—10:00pm

First class: June 24 | **Location:** See [Avenue to Learn](#) or [Mosaic](#)

Instructor: Mike Cummings | **E-mail:** cummim5@mcmaster.ca

COURSE OVERVIEW

Course calendar description

This course focuses on applications of linear algebra. Topics include linear programming, applications of matrix decomposition theorems, examples from data science, singular value decomposition, and applications to compression.

Prerequisites: One of MATH 1AA3, 1LT3, 1NN3, 1XX3, 1ZB3, ARTSSCI 1D06 A/B, ISCI 1A24 A/B; and one of MATH 1B03, 1ZC3, 1ZZ5

Objectives

- Understand core definitions, concepts, and theorems of linear algebra and how they relate to applications
- Carry out computational and geometric techniques to solve modelling and optimization problems (e.g., linear programming)
- Develop tools for representing matrices in ways that highlight their algebraic properties (e.g., QR Decomposition, Singular Value Decomposition) and their computational applications
- Apply both theory and techniques to real-world applications (e.g., image compression, facial recognition)

Topics

Here is a tentative overview of the topics we will cover, with corresponding textbook sections.

- (Chapter 9) Linear programming: geometric method and simplex method
- (Chapter 5) Dynamical systems: differential equations, eigenvalues, eigenvectors, and diagonalization
- (Chapter 6) Orthogonality: dot product, distance, projection, QR factorization, minimizing distance, least squares, and linear models
- (Chapter 7) Constrained optimization: diagonalization of symmetric matrices, Spectral Theorem, quadratic forms, singular value decomposition



- Other topics as time permits. Exact topics can be decided on during the term, but some options are image processing and statistics (Chapter 7.5), Markov chains (Chapter 5.9), and matrix games (Chapter 9.1)

Comparison with Math 2R03

This course's primary concern will be applications of linear algebra.

- Math 2R03 is a more theoretical development of linear algebra and is only offered once per academic year, usually during the Winter term, but for 2024—2025, it will only be offered in Fall 2024.
- At least one (you can take both) of Math 2LA3 or Math 2R03 is required for all Honours Math and Stats programs.
- Math 2R03 is **required** for Honours Math and Stats with a **Mathematics specialization**.
- Either linear algebra course is an allowable prerequisite for most third year Math and Stats courses. For Math 3B03, 3GR3, 3F03, 3FF3, and 3QC3, the requirement is Math 2R03 or a grade of at least a B in Math 2LA3.

WEBSITES

- [Avenue to Learn](#), for all course information
- [Crowdmark](#), for Assignments

REQUIRED MATERIALS & FEES

Textbook

David C. Lay, Stephen R. Lay, and Judi J. McDonald, Applications of Linear Algebra, 6th edition, 2022.

- Available for purchase through the [Campus Store](#)

There are no additional fees/access codes. You do **not** need to purchase access to MyLab.

EVALUATIONS

Evaluation	Weight Option A	Weight Option B
Assignments (6)	15%	15%
Participation	10%	10%
Term tests (2)	35% (17.5% each)	17.5% (best test)
Final exam	40%	57.5%

The lowest Assignment mark will each be dropped. Further descriptions of each category are below.

The instructor reserves the right to change the weight of any portion of this marking scheme. For students in good academic standing, other weights might be considered. In any case, the final mark will be the highest among all considered weightings.



Assignments

There will be 6 Assignments on [Crowdmark](#). The lowest Assignment score will be dropped. These Assignments will be a mixture of questions testing understanding of the material and computational techniques. There is a 24-hour grace period for each Assignment. Details and deadlines will be posted on Avenue.

Because the lowest Assignment score is dropped, Assignments are not eligible for an MSAF.

Participation

Each lecture will include Participation polls. These will be multiple choice questions based on the lecture material and will be designed to strengthen understanding of the course content.

Each question will be worth two points. One point will be given for an incorrect answer and two points will be given for a correct answer. If you attain 50% or more of the available points, you will receive full Participation marks. The following table lists the full conversions between participation points earned and final Participation grade.

Participation points earned	Participation grade
50% or more	10/10
Between 40% and 49%	7/10
Between 25% and 39%	5/10
Less than 25%	0/10

Because full Participation marks may be attained without needing full participation points, Participation polls are not eligible for an MSAF.

Term Tests

There will be two 50-minute term tests, which will take place in-person and during class time. Details (e.g., material that will be covered) will be announced on Avenue approximately one week before each test. Only standard McMaster calculators, Casio fx991MS or Casio fx991MS PLUS, may be used during tests.

Tentative test dates and times:

- Monday, July 8, 7:00—7:50pm
- Monday, July 22, 7:00—7:50pm

If an MSAF is used for a midterm, the weight will be transferred to the final exam. This is the same as Weight Option B in the course grading scheme.

Final Exam



There will be a cumulative, 2.5-hour in-person final exam **during class time on August 7**. Details (e.g., material that will be covered) will be announced on the course webpage approximately one week before the exam. Only standard McMaster calculators, Casio fx991MS or Casio fx991MS PLUS, may be used during the exam.

An MSAF cannot be used for the final exam.

COURSE DELIVERY

At this time, all lectures, tests, and the final exam have been scheduled to take place in person. Virtual alternatives will NOT be offered unless university and/or public health guidelines prohibit in-person meetings.

In the event that course activities are moved to a virtual setting,

- Lectures and office hours would take place on Zoom
- Tests and the final exam would take place on Childsmath and/or Crowdmark

To follow and participate in virtual classes it is expected that you have reliable access to the following:

- A computer that meets performance requirements [found here](#).
- An internet connection that is fast enough to stream video.
- Computer accessories that enable class participation, such as a microphone, speakers and webcam when needed.

If you think that you will not be able to meet these requirements, please contact uts@mcmaster.ca as soon as you can. Please visit the [Technology Resources for Students page](#) for detailed requirements. If you use assistive technology or believe that our platforms might be a barrier to participating, please contact [Student Accessibility Services](#), sas@mcmaster.ca, for support.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

[McMaster Student Absence Form \(MSAF\)](#): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”. For a missed term test, the weight of the test will be transferred to the final exam (equivalent to Option B). Assignments and Participation will not be eligible for MSAF as discussed above.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact [Student Accessibility Services \(SAS\)](#) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office



prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

It is the student's responsibility to understand what constitutes academic dishonesty.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in assessments, including soliciting aid from a third party.

Students are **not permitted to use generative AI** in this course. In alignment with McMaster academic integrity policy, it "shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source". This includes work created by generative AI tools. Also stated in the policy is the following, "Contract Cheating is the act of 'outsourcing of student work to third parties' (Lancaster & Clarke, 2016, p. 639) with or without payment." Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using



these elements, private information such as first and last names, usernames for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

ONLINE PROCTORING

This course may use proctoring software for tests/exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins. If you have questions about whether this software will be used, or concerns about the use of this software, please contact your instructor.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities \(the "Code"\)](#). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue2Learn, Webex or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Additional information about the Code and netiquette can be found [here](#).

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

RESEARCH ETHICS – NA

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

