

What is Linear Algebra?

Linear algebra is the study of how algebra can be used to understand flat geometrical shapes and their higher-dimensional analogues. Some examples of such geometrical shapes are lines and planes in the two and three dimensional spaces that you are familiar with. Linear algebra tells us how to use the power of algebra to think about higher-dimensional flat objects and how to use them to solve a vast range of problems. It underlies a great deal of applications in sciences and engineering, such as acoustics and sounds, computer graphics, machine learning, and robotics.

About the course

The purpose of this course is twofold. On the one hand, you will learn concepts, techniques and algorithms in elementary linear algebra. On the other, you will learn how to identify these concepts in real world problems, model them, and apply technology to solve them. We will start by learning how to solve systems of linear equations with the help of matrices. Then we will reinterpret matrices as linear transformations, these are functions which uniformly modify flat spaces. First we use our spatial intuition to guide our understanding of these functions, and then we let mathematics expand that intuition to higher dimensions. Linear transformations and their matrix representations will stay at the heart of the course throughout the semester.

XXX See the Course Calendar in this document for a detailed list of the topics we will discuss.

Approach to Teaching

MAT188 will be taught via research-based teaching and learning methods. In lectures and tutorials, you will engage with ideas through an active, student-centred teaching framework called Inquiry-Based Learning (IBL). Students, TAs, and instructors work together to make sense of mathematical definitions, concepts, and techniques. All the course components are designed to be student-centred, and instructors serve as guide.

Course Objectives

After taking this course, you will be able to:

1. Formulate problems using the language of linear algebra.
2. Identify applications of linear algebra in other contexts and situations.
3. Identify tools and employ technology to solve or understand problems.
4. Demonstrate computational fluency by hand and using technology.
5. Distinguish between numerical evidence and mathematical argument.
6. Translate between algebra and geometry to solve problems.
7. Apply mathematical knowledge to novel problems.

Course Components

Textbook

The textbook we will be using is ***Linear Algebra With Applications, Otto Bretscher, 5th edition.***

Course Website

The official course page is

<https://q.utoronto.ca/courses/411708>

Quercus is our main communication platform. All course material and information, including all the relevant deadlines, important dates and announcements are communicated through Quercus. Quercus will get updated frequently as the term progresses. It is your responsibility to check it regularly.

No Discussion Board. We will not have a discussion board for this course. Instead, we will have a wide range of drop-in hours throughout every week, including in-person and online drop-in hours.

- If you have a math question, you should go to drop-in hours.
- If you have a logistical question, you should check Quercus first, and if you can't find the answer, send an email to mat188h1f.a@course.utoronto.ca.

See the **Asking Questions** section in this document for more instructions.

Teaching Team

Instructors	Email	Section
Schinella D'Souza	schinella.dsouza@utoronto.ca	LECO101
Shai Cohen	sh.cohen@utoronto.ca	LECO102
Shai Cohen	sh.cohen@utoronto.ca	LECO103
Bernardo Galvão-Sousa (coord.)	mat188h1f.a@course.utoronto.ca	LECO104
Yulun Xu	tba	LECO105
Vardan Papyan	papyan@math.toronto.edu	LECO106
Narmada Varadarajan	narmada.varadarajan@mail.utoronto.ca	LECO107
TBD	tba	LECO108
Bernardo Galvão-Sousa (coord.)	mat188h1f.a@course.utoronto.ca	LECO109

How to learn?

Before class	Class	After class	Tutorial	Practical
READ textbook	ATTEND class	REVIEW what you learned	ATTEND class	ATTEND class
DO the pre-class essentials	PARTICIPATE in class	PRACTICE problems	APPLY	USE technology
	MAKE connections	ASK questions	COMMUNICATE	VISUALIZE
			WRITE quiz	

Pre-class essentials

A typical week in our course starts with a pre-class reading. These documents are specifically prepared to give you what you need to know before walking into your lectures for the coming week. Each pre-class reading has three sections: Introduce, Solidify and Expand.

We want you to come to lectures prepared. Although you can choose to read the corresponding sections of the textbook, or the entire pre-class reading document (and its complement, post-class reading) all at once before the first lecture of the week, typically the Introduce is essential to read before your first lecture of the week, the Solidify is essential before the second, and the expand before the last. This flow may occasionally change due to holidays or major assessments. There is also a short check-in in the form of a Quercus quiz before each lecture, which is designed to refresh your memory before you walk into the class.

The combination of the essential part of the pre-class reading and the check-in is referred to as Pre-Class Essentials (PCEs)

Class

You are assigned to a lecture section ranging between LEC0101 and LEC0109.

You will have three weekly lectures. Lectures assume that you have done the PCEs. A typical lecture is a series of activities guided by your instructor. You are expected to actively participate in all lectures, and in all activities prompted by your instructor.

Post-class

Your learning doesn't end with lectures, you are expected to spend some time each week studying course materials to deepen your understanding of concepts and prepare for quizzes, tutorials and exams.

To help with this, we have created a post-class reading document which complements each week's pre-class reading. Here, additional calculations, proofs, definitions and theorems are added to the pre-class document to help provide a more complete reference for the course. The additional material will appear colour-coded so you can easily spot what has been added. The pre- and post-class reading will be available at the same time on Quercus.

Tutorials

You will have weekly tutorials. During these, you will work with your classmates in small groups on Tutorial Worksheets.

The worksheets are designed to help you develop expertise on the more conceptual aspects of the course.

Tutorial sessions are facilitated by your TAs and are one of the most important components of the course, because they build up your mathematical communication skills.

Make the most out of these short sessions by actively explaining concepts to your group mates and ask them to do the same for you.

Every other week, there will be a tutorial quiz.

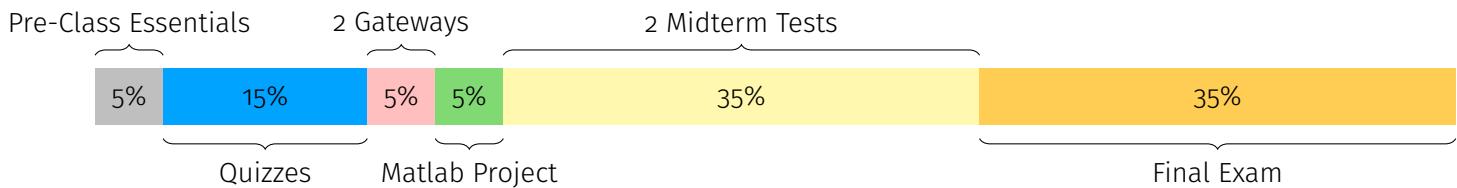
Practicals

You will have weekly Practical. These are computer labs supported by TAs, during which you will work on computational skills. Some of your time in Practical will be concentrated on working on the Practice WeBWorK questions and Gateway tests. Your TAs are present to give you feedback on your work. Some other Practical sessions focus on getting familiar with visual and computational software packages, and support assignments that require the use of those software packages.

Assessment

Grading Scheme

In this course, you will be assessed based on your mastery of the course's learning objectives, not against other students in the class. Therefore your grades will not be 'curved' up or down. Since we are measuring your performance against set criteria, we will not be releasing average grades or other information about how the class as a whole performs.



Pre-Class Essentials (PCEs)

Pre-class readings are posted on Quercus on a weekly basis. There is a short check-in in the form of a Quercus quiz before each lecture that is designed to refresh your memory before you walk in to the class. See our Quercus page for due dates. The lowest three PCEs grades will be dropped.

Tutorial Quizzes

There will be 5 tutorial quizzes and your grade for this component will be computed from the best 4 out of the 5 quizzes.

These quizzes will be assembled from the following sources:

- One computational question from the Practice WeBWorK problems
- One conceptual question from the Practice Quiz problems

Gateway Exams

Gateway Exams are timed, supervised tests that give you a chance to demonstrate your mastery in computational skills. They test foundational skills and concepts that are absolutely essential to success in this course, in your degree program, and in your future engineering career. The average student should aim to achieve near 100% on the Gateway Exam.

These tests will take place during your Practicals. See our Quercus page for dates. Practice Gateways will be available at least one week before each test, and you can take them as many times as you wish while they are open. You will have two opportunities to take each supervised Gateway.

You will get full marks if you successfully obtain 90% on both Gateways combined.

Matlab Project

Due in the first week of December, this assignment is your opportunity to put the concepts learned throughout MAT188 into practice on a real engineering problem. You will use MATLAB to work with data, perform linear algebra operations, create visualizations, and draw conclusions from your analysis.

This project is worth 5% of your final grade. The lab sessions in the second half of the course will be dedicated to learning MATLAB and getting help with the assignment.

Midterm Tests

There will be two midterms, currently, the midterms are scheduled for Tuesday, October 7 at 9am–11am and Thursday, November 13 at 7–9pm. The dates are subject to change.

Your grade for the tests will be calculated as follows:

- The **lowest test** will be worth **10%** of your course grade;
- The **highest test** will be worth **20%** of your course grade;
- After each test is graded and handed back, you will have the opportunity of submitting a **Test Reflection** consisting of a reflection on your studying for the test and a correction of your mistakes in the test. This will be worth **5%** of your course grade.

Missed Assessments

The petition policy of the Faculty of Applied Science and Engineering can be found at

<http://uoft.me/petitions>

Do not wait to read these rules until an issue (like illness) arises. Read them now so that if you need to use them, you already know how to proceed. It is an academic offence to feign illness to skip any coursework. TAs are not authorized to give any kind of accommodation. Here are course specific policies that are applied on top of the faculty's petition policy.

Missing PCEs. We are dropping your three lowest PCE marks. Therefore, you do not need to submit petitions unless you had a legitimate reason to miss more than three PCEs. However, in that case, you need to submit a petition for all occasions that you missed. Petitions for up to three missed PCEs will have no effect, since the lowest three scores – including zeros – are automatically dropped. If you receive a zero on a PCE due to having committed an academic offence, that zero will not be dropped under any circumstances.

If you miss more than three PCEs and have a valid petition for all occasions, the remaining PCEs will be re-weighted accordingly.

Missing Quizzes. If you have to miss a tutorial quiz, you should email your TA and your teammates to inform them that you will not be in the class.

Just like with the PCEs, the lowest quiz mark is dropped, so you only need to submit if you miss more than one quiz. If you miss more than one Quiz and have a valid petition for all occasions, the remaining Quizzes will be re-weighted accordingly.

Missing an Exam or a Gateway. If you miss a Test without a valid petition, you will receive a grade of zero.

If you miss a midterm and a petition for it was deemed valid, we will redistribute your marking scheme according to the course coordinator's discretion. There will NOT be a makeup midterm. If you miss a midterm, you will not be able to submit its associated reflection.

If you miss a Gateway due to a legitimate reason, you will be given a chance for a makeup Gateway. Regarding the final exam, there are dedicated faculty policies around petitions. Please refer to the faculty rules here:

<https://undergrad.engineering.utoronto.ca/petitions/term-work-petitions/>

Asking Questions

Our goal is to have all of your questions answered in a timely manner and to encourage you to ask more math questions.

If your situation is urgent, talk to your professor after class or during their drop-in hours, or come to your course coordinator's drop-in hours. You can find details about times and locations on Quercus.

In all other cases, if you have a question please follow the following procedure:

- Before asking administrative questions, check the course page on Quercus carefully. Most answers will be there already.
- If you do not get an answer to your posted question on Quercus or, if your question contains personal information that cannot be shared with the rest of the class (for instance, if you have a question regarding your grade), first consult your TA in tutorial or practical. If you still do not have an answer to your question, email `mat188h1f.a@course.utoronto.ca`, or directly to your professor.

The course admin team checks `mat188h1f.a@course.utoronto.ca` on a weekly basis.

- Once again, if your situation is urgent, talk to your professor after class or in their drop-in hours, or come to your course coordinator's drop-in hours.
- Note that `mat188h1f.a@course.utoronto.ca` is not suitable for urgent emails.

Emailing Etiquette.

- The University has a policy requiring that students have a U of T email address and that you check it regularly.
- If you have a question about the course policies, check the syllabus. Then check the FAQ on Quercus.
- When you communicate within the course (by email, in the discussion board, for regrade requests, in lecture or tutorial, etc), you are communicating with us in a professional context.
- When you email us from any address other than your `@mail.utoronto.ca` address, your email will be ignored. We would have no way to confirm your identity.
- Emails are not text messages or other social media interactions. Your email should start with a respectful greeting, have organized paragraphs and be signed with your name. We may not respond to emails that are written unprofessionally. All that said, don't worry too much about your grammar or spelling – we really do want to help you, however you write!

Mental Health and Wellness

As a university student, you may experience a range of issues regarding, for example your physical or mental health, your financial situation or your friends and family. These may result in significant barriers to achieving your personal and academic goals. The University of Toronto offers a wide range of free and confidential services and programs that may be able to assist you. We encourage you to seek out these resources early and often. You can find resources at <http://studentlife.utoronto.ca/hwc>.

If, at some point during the year, you find yourself in need of immediate support, visit the Feeling Distressed Webpage: <http://www.studentlife.utoronto.ca/feeling-distressed>, for more campus resources.

Immediate help is available 24/7 through U of T's My Student Support Program in 35 languages. You can call via phone or wifi or even chat using the app. Details can be found at <https://studentlife.utoronto.ca/service/myssp/>

All students in the Faculty of Engineering have an Academic Advisor who can advise on academic and personal matters. You can find your department's Academic Advisor here:

- <https://undergrad.engineering.utoronto.ca/contact/#first-year-team>
- <http://undergrad.engineering.utoronto.ca/advising-support-services/academic-advising/>

Accessibility and Accommodations

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code.

If you have a learning need requiring an accommodation, please contact Accessibility Services as soon as possible at

<https://www.studentlife.utoronto.ca/as>

Academic Integrity: Why It Matters

We at U of T want you to feel proud of what you accomplish as a student. Please respect all of the hard work you're doing this term by making sure that the work you do is your own.

We don't expect you to score perfectly on the assessments and there will be some things that you may not know. Using an unauthorized resource or asking someone else for the answer robs you of the chance to later feel proud of how well you did because you'll know that it wasn't really your work that got you there.

Success in university isn't about getting a certain mark, it's about becoming the very best person you can by enriching yourself with knowledge, strengthening yourself with skills, and building a healthy self-esteem based on how much you've grown and achieved. No single assessment captures that, but your conscience will stay with you forever. Make yourself and your loved ones proud of the student that you are by conducting yourself honestly at all times.

We know that the vast majority of students are honest.

If you are one of them, we want to say that we appreciate this and thank you for your commitment to learning! Honouring the achievements of hardworking students like you is one of the major reasons why we implement the policies below. Honesty always pays off in the long run! **If you are experiencing personal challenges that are having an impact on your academic work, please do NOT commit an academic offence. Instead, talk to us or your academic advisor. We are very understanding and happy to help if you are facing any issues. There is never a valid reason for committing an academic offence. Please talk to us!**

Academic Integrity: the fine print

Familiarize yourself with the University of Toronto's Code of Behaviour on Academic Matters, available at

<https://www.academicintegrity.utoronto.ca/>

You are expected to know the rules. Keep in mind that not being aware of a rule is not an acceptable excuse for not having followed it. If you have any questions about what is or is not permitted in this course, please do not hesitate to talk to your instructor or TA.

For components of the course when a certain number of the lowest marks are dropped, this does not apply to assessments in which an academic offence has been committed and a sanction of “zero on the assessment” was imposed – these assessments will always count.

Potential **offences** include, but are not limited to:

- Posting assessment questions on any kind of website/online forum to solicit help.
- Using someone else's ideas or words without appropriate acknowledgement.
- Looking at someone else's answers during an exam or test.
- Misrepresenting your identity.
- Obtaining or providing unauthorized assistance on any assignment.
- Falsifying or altering any documentation required by the University, including (but not limited to) forms related to a petition.

Both receiving and providing unauthorized assistance is an academic offence. It does not matter if you “helped” or “were helped”.

The following actions are **not offences** in this class:

- Discussing questions from PCEs or practice problems with classmates, building off of each others' ideas
- Using online resources to help you understand the content of the course
- Using online Desmos during a PCE assignment

Copyright Notice

You must not take audio recordings or video recordings of lectures or tutorials unless you received the written consent of the person whose work you are recording (consent will normally be given for accessibility reasons).

There are on-campus and off-campus enterprises out there that offer so called “course preparation” and that will ask you to provide course material to them, sometimes in exchange for money, sometimes in exchange for “free help”, sometimes without any direct benefit to you. You must not share the material of this course with such enterprises.