MAT223 H1F 20221: Linear Algebra 1
Fall 2022, University of Toronto

Course Instructors

Section 101 Sebastian Olano, sebastian.olano@utoronto.ca
Tuesday 9:10 AM - 11:00 AM, Thursday 10:10 AM - 11:00 AM

Section 201 Alessandro Malusà, amalusa@math.toronto.edu
Tuesday 11:10 AM - 1:00 PM, Thursday 11:10 AM - 12:00 PM

Section 301 Soheil Homayouni Boroojeni, homayoun@math.utoronto.ca
Tuesday 1:10 PM - 3:00 PM, Thursday 2:10 PM - 3:00 PM

Section 401 Jason Siefken, siefkenj@math.toronto.edu
Tuesday 3:10 PM - 5:00 PM, Thursday 3:10 PM - 4:00 PM

Section 501 Gal Gross, g.gross@mail.utoronto.ca
Wednesday 9:10 AM - 11:00 AM, Friday 10:00 AM - 11:00 AM

Section 601 Stan Yoshinobu, stan.yoshinobu@utoronto.ca
Wednesday 11:10AM - 13:00 PM, Friday 11:10AM - 12:00 PM

Section 701 David Pechersky, david.pechersky@mail.utoronto.ca
Wednesday 1:10 PM - 3:00 PM, Friday 1:10 PM -2:00 PM

Section 5101 Vasiliki Liontou, vasiliki.liontou@mail.utoronto.ca
Tuesday 18:10PM - 20:00 PM, Thursday 18:10 - 19:00

Office Hours for instructors are posted on Quercus.

Teaching assistants (Emails for TAs are posted on Quercus)
Kyle Bower (Head TA), Noha ElGarem (Head TA), Leonard Afeke, Paula Arkhangorodsky, Mallory Bond, Quinn Fisher, Diba Heydary, Xinyu Huo, Matthew Koban, Friedemann Krannich, Belinda Kusuma, Junru Lin, Enrique Nunez Lon-wo, Nicholas Plati, Petros Ploumidis, Lucas Prates, Nischay Reddy, Aaron Tronsgard, Brinda Venkataramani, Chi Kam Wong, Jiyuan Yang, Shilong Yu, Clement Yung.

Course description
Linear algebra is the study of vectors, "flat spaces" (e.g. lines, planes, hyper planes), and linear transformations (e.g. rotations and scalings). Vectors originated in the study of physics, but have been useful in other areas, such as acoustics and sound, computer graphics, and the study of physical forces.

MAT 223 is an introductory course in linear algebra and will cover fundamental concepts and skills. We will ground our study in n-dimensional Euclidean Space, using spatial intuition to guide our understanding of linear algebra. Topics in MAT 223 include systems

of linear equations, matrix algebra, real vector spaces, subspaces, span, linear dependence and independence, bases, rank, dot products, orthogonality, linear transformations, determinants, eigenvalues, eigenvectors, eigenspaces, and diagonalization.

Prerequisites
To be prepared for this course, you need to have a solid understanding of high school mathematics. Specifically, students should understand functions, function notation, function composition, and solving systems of equations. Link to resource Entry Level Math Preparation

Course learning objectives
Learning Goals: By the end of the course you should be able to:

1. Use matrices, matrix arithmetic, matrix inverses, systems of linear equations, row reduction, determinants, eigenvalues, eigenvectors to solve problems.
2. Use multiple representations of linear algebra ideas (i.e. algebraic, numerical, graphical, and verbal).
3. Write mathematical explanations that use proper academic language and notation, appropriate for a first-year math course.
4. Work independently on problem solving and also collaborate effectively with classmates, TAs, and instructors.

Textbook
The textbook for the course is the free, open source workbook, "Linear Algebra, MAT 223 Workbook" by Prof J. Siefken. The textbook is available in hard copy in the bookstore and as a free pdf on Quercus.

How this course is organized
MAT223 will be taught via research-based teaching, learning, and assessment methods. In lectures and tutorials, students will engage in MAT 223 ideas through an active, student-centered teaching framework called inquiry-based learning (or IBL). In IBL courses students, TAs and instructors work together to make sense of mathematical definitions, theorems, and techniques to further our understanding of mathematical ideas and learn mathematical habits of mind. IBL courses are organized around student engagement in exercises in class and outside of class.

In **lectures**, class time is focused on nurturing student learning via carefully selected activities. Students and instructors will investigate core exercises (at the end of each module) and discuss the Linear Algebra skills, concepts, and big ideas. Lectures will be a mix of mini lectures, group work, and class discussion.

Each student must also be enrolled in a **tutorial section**, and students will be assigned into tutorial subsections of 45 students by TAs during the first week of classes. Tutorials are vital for student success, and students are asked to attend tutorials. TAs will lead active, student-centered lessons, where students practice basics, problem solve, and work on group reports.

Assessment Course marks are based on the following.

14% Reading assignments, submitted via Quercus
15% Online standards-based homework (via Mathematize)
30% Group reports (coordinated in tutorials, submitted via gradescope)
6% Individual reflective writing assignments
35% Standards based, in-person final exam or final project (depending on the pandemic situation). An in-person final exam is required by the Faculty of Arts and Sciences.

Comments: The assessment system for MAT223 is based on standards/mastery-based grading. Students have ample opportunities to demonstrate their learning. Online homework and group reports allow for resubmission without penalty, emphasizing learning and reducing incentives to cheat or look-up answers online (e.g. Chegg).

Reading assignments Students are required to read modules from the textbook before class, and respond to 3-5 general questions. Reading assignments are graded for completeness.

What is the purpose of reading assignments? The main purpose of pre-class reading assignments is for students to prepare before class and become familiar with the topics that we will work on in class. Students are asked to think and process the reading, and submit questions. Students are NOT expected to learn the materials all by themselves or fully understand everything in the unit before class. The point of reading assignments is for you to get familiar with the ideas. Think of reading assignments as a warm-up.

Students will be allowed to drop the **3 lowest** reading assignment scores from the term in order to accommodate student schedules and challenges. Because pre-class reading is vital for class, reading assignments have a set deadline.

Reading after class is also important. Like music or sports, revisiting ideas is vital for deep learning. Students are expected to read and reread modules to strengthen their understanding.

Online homework assignments focus on fundamental skills and conceptual understanding. One purpose of online homework is to support learning and give students immediate feedback. While students can look up or guess answers, homework is where students can try problems and check their understanding.

Online homework is implemented via MathMatize, and students are allowed **unlimited attempts** to complete assignments to support learning and minimize incentives to cheat. Cheating or looking up answers is not helpful for student learning, and students who do not practice well are more likely to be less successful on the final exam and more importantly does not prepare students for their lives. The best way to do online homework is to try problems honestly, and ask for help in class, tutorial, or drop-in office hours.

Suggested due dates will be posted weekly. The deadline to complete all of the online homework is **December 8, 2022, 11pm**. Since the deadline for online homework is the end of the semester, there will be no extensions. The lowest two (2) scores will be dropped.

Instructions for how to sign up for MathMatize will be posted on Quercus.

Group reports cover several levels of topics. Group reports cover basic computations, core concepts, analysis of ideas, and mathematical language. The specifics for each report will vary.

The primary class time for working on group reports is during tutorial. Time will be dedicated to students working on group reports, including giving and receiving feedback from TAs and classmates.

Group size is 2 or 3 students. Exceptions can be made in special circumstances. Please contact your TA. Students will be assigned in groups in tutorial subsections, and students are encouraged to form groups of 3. Students must be in the same tutorial subsection to be in the same group. Students are expected to contribute fairly and equitably to all aspects of group assignments, meaning that every student should work on each problem. The group then should meet to work on a draft of the group report.

Attending tutorials regularly and consistently is important for student success on group reports. Students are asked to attend tutorials every week to ensure they are making good progress and also to contribute to the class community, which helps everyone. In-person and zoom tutorials will be offered to accommodate all students.

How will group reports be graded? Group reports will be graded on a scale of 0 to 10 points. A subset of the problems will be graded and given feedback on mathematical correctness (5 points) and presentation/writing (5 points). Group will be able to resubmit each group report once without penalty. The higher of the original score and resubmitted score will be used for course marks.

Final Assessment: The final assessment is 35% of the course grade, and all of the other components of the course represent 65% of the course grade. Completing all of the term work ensures a student earns at least a 65% course mark or a "C." The final assessment can improve your grade to a "B" or "A."

A **final exam** is required by the Faculty of Arts and Sciences to be an in-person exam and will be scheduled during the final exam period at the end of the term. The final exam is scheduled by the registrar.

Public health measures may require us to switch to online. In the case that the final exam cannot be given in-person, then the final assessment will instead switch to a take-home **final project**.

The final exam is a standards based exam, and students will be provided with a list of standards and practice problems.

If we have an in-person final exam, it will be structured in two parts.

Final Exam Part 1 (25% of course grade) will cover the core standards in the course, requiring students to solve problems at a similar level to the ones done in class throughout the term. Basic computations and concepts will also be tested.

Final Exam Part 2 (10% of the course grade) will consist of challenging problems that require students to demonstrate the ability to problem solve, apply concepts, and use the mathematical language precisely and correctly. These problems are graded strictly and no partial credit will be given.

If MAT223's final assessment is a **final project** due to pandemic or other circumstances, then the final project will be structured with a portfolio for part 1 (25% of course grade) and an optional part 2 that requires students to do outstanding work, applying MAT223 ideas or analyzing concepts and theory (10% of the course grade) that will be graded strictly and with minimal partial credit. Part 1 Portfolios may include tasks such as (but not limited to) the following:

1. Writing expanded explanations about how to approach certain types of problems.
2. Synthesizing and analyzing MAT 223 core concepts
3. Writing about problems related to learning challenges and persistence (e.g. being stuck).
4. Selecting interesting problems and critiquing the solutions and finding ways to improve them.
5. Identifying strategies and personal strategic gaps.
6. Explaining why a mathematical idea from the course is beautiful to you.
7. Giving examples of expanding your own mathematical imagination.

In the event that the final assessment is a final project, additional information will be provided to students. Final projects are similar to "take-home" finals, meaning the students will not be sitting for an exam at a specific time.

A Note About Cheating: We know that there exists ways to cheat your way through college math courses using Chegg and paid test prep services. Students should avoid using these ways of gaming the system.

MAT223 uses standards-based grading aligned to learning and intellectual growth. Students should focus on learning, growth, and being a positive, honest member of our community.

At various points in your future, you will need to know how to think, problem solve, and manage intellectually and emotionally challenging situations. For all of the truly important issues you will face, there does not exist a Chegg-like thing to look up answers. For larger, societal-level problems, such as the climate crisis, there is no answer in the back of the book. You can Chegg your way past some of the MAT223 problems, but you'll learn less, feel

worse about your course mark, and be less prepared for life. Using Chegg or test prep companies is like taking a taxi to the finish line of a marathon. That finisher's medal doesn't have meaning, because it doesn't represent what you can actually do. Hence. MAT223 is an opportunity for you to learn to become a better person, and the grading system is set up to reward those who are honest and not give those who are dishonest and unfair advantage.

Policy On Late or Missed Work

- Late reading assignments will not be accepted. The marking scheme allows students to miss up to **three** assignments to accommodate missed or late work.
- Online homework assignments must be completed by December 8, 2022. Students however should complete the assignments during the week they are assigned in order to stay current with the material. The **lowest two online homework assignment scores will be dropped**. These are graded for completeness.
- Group reports turned in after the due date will receive up to 50% credit. For special circumstances, please contact your TA for accommodations.
- Students who miss deadlines due to illness or special circumstances can submit a "Petition Form " via Quercus to receive accommodations (e.g. extensions)

Missed In-Person Final Assessment

If you cannot show up for the in-class final assessment due to illness or other reason, please check Quercus for instructions about how to contact FAS to request an accommodation. http://www.illnessverification.utoronto.ca/index.php

Diversity Statement

At the University of Toronto we embrace diversity of age, background, beliefs, ethnicity, gender, gender expression, national origin, religious affiliation, sexual orientation, and other visible and non-visible categories. All students are welcome!

Names and Pronouns: You have a right to be addressed however you prefer. To ensure that you are addressed properly, you are welcome to let the teaching team know your pronoun(s) and/or preferred name at any time.

If you are discriminated against, please contact your TA, course instructor, or the course coordinator, Prof. Stan Yoshinobu.

Etiquette and expectations

Math Space Expectation: MAT223 will be taught using established, evidence-based best practices, called inquiry-based learning or IBL. Students should expect to spend significant portions of class time in lecture and tutorials working with classmates.

The expectation is that students will come prepared to think, work with classmates, and be patient with being stuck. Eventually our class will arrive at the solutions and learning objectives needed.

Students should also expect that this course leans toward conceptual understanding and problem solving, and less on rote skills and memorization. The value of

inquiry-based learning courses is that you practice what you need in life and work - you practice thinking creatively, problem solving, and working effectively and inclusively with other people.

Social Space Expectation: This is a friendly reminder to treat one another with empathy and respect. Inclusive learning spaces are essential for our institution to flourish, and every student, the TAs and the instructor are collectively responsible for creating an inclusive MAT223 class environment. All students are welcome and valued in MAT223.

Please wear a mask!

Please wear a mask in lectures, tutorials, and office hours to protect yourself, your classmates, and your community. We can create a safe community for all to learn and be healthy. Wearing a mask is one of the most significant things you can do for your own safety and the safety of our community. Masking significantly reduces forward transmission of COVID-19, which can cause serious illness and/or long-term disability even in young people and people who are vaccinated.

Colleges and universities are centers of **community** bringing together students, educators, and staff. Universities should be healthy, inclusive, and safe. Layered mitigation is most effective, and **mitigation supports mental health**. It is hard to learn, teach, work or be healthy, if you are worried about your health. COVID-19 policies are also equity and inclusion policies, because COVID disproportionally affects marginalized people. Reducing COVID cases reduces inequities.

It is recommended that students wear an N95/KN95/KF94 mask (or similar respirator or elastomeric). Respirators with a good fit and seal can filter out 95% or more of airborne particles that carry Covid-19.

Masking Side of Class is the Right Side: the right side of classrooms (from the perspective of a student sitting and facing the front of the class) is the masking side of class. Students who wear masks should sit on the right side of class, where they can benefit from 2-way masking.

Safe space to ask to mask: It is okay to ask someone sitting next to you to wear a mask without having to say why. In order to create a safe space, every member of the class community can say things like, *"Could you please put on a mask?"* when a person sits next to them.

Land Acknowledgement

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

Land acknowledgments are doorways, not endpoints. Everyone in MAT223 is encouraged to learn more about our relationship to indigenous peoples at https://indigenous.utoronto.ca/about/land-acknowledgement/

Schedule of Lectures and Tutorials
A schedule for the course is provided separately in quercus that will be updated regularly as the term progresses. Please read the "MAT 223 weekly guides."

Academic Integrity
All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019). If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to your Course Instructor. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the University of Toronto website on Academic Integrity http://academicintegrity.utoronto.ca/).

Turnitin
Turnitin may be used for detecting plagiarism in some of the written work submitted in this course. Normally, students will be required to submit written work to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

Email Policy and Discussion Boards
Please note that all communications with the Course Instructor or TA's must be sent from your official utoronto email address, with the course number included in the subject line. If these instructions are not followed, your email may not be responded to. Please check Quercus and Quercus Discussion Boards for information first.

Copyright
This course, including your participation, may be recorded on video and may be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

For questions about the recording and use of videos in which you appear, please contact your instructor.

Accessibility
The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs.

Technical Requirements
In order to participate in this course, students will be required to have:

- Reliable internet access. It is recommended that students have a high speed broadband connection with a minimum download speed of 5 Mbps.
- A computer satisfying the minimum technical requirements (https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/)

Other recommended items include headphones, microphone, webcam, and a tablet or printer.

If you have a disability that may require accommodations, please feel free to approach your Course Instructor and/or the Accessibility Services office as soon as possible. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Link to Accessibility Services website:
https://studentlife.utoronto.ca/department/accessibility-services/

Important Academic Dates & Deadlines
The academic dates include enrolment dates, drop deadlines, exam periods, petition deadlines and more.
https://www.artsci.utoronto.ca/current/dates-deadlines/academic-dates

Other Academic and Personal Supports

- Writing Centre https://writing.utoronto.ca/writing-centres/arts-and-science/
- Quercus guide for students https://q.utoronto.ca/courses/46670/pages/student-guide
- U of T Libraries https://onesearch.library.utoronto.ca/
- Feeling Distressed? https://studentlife.utoronto.ca/task/support-when-you-feel-distressed/
- Academic Success Centre https://studentlife.utoronto.ca/department/academic-success/
- College/Faculty Registrars https://future.utoronto.ca/current-students/registrars/
- **Student Mental Health** services are available at https://mentalhealth.utoronto.ca. Please take care of your mental health, and know that the university community cares and is equipped to help you when the need arises.

- If you are facing financial hardship, you are encouraged to contact your college or divisional registrar (https://future.utoronto.ca/current-students/registrars/) to apply for an emergency bursary.