

APPLIED LINEAR ALGEBRA
MAT 3341 – WINTER 2023

Instructor: Diane Guignard (STEM 651, dguignar@uottawa.ca)
Personal webpage: <https://mysite.science.uottawa.ca/dguignar/>
Course webpage: <https://uottawa.brightspace.com/d21/home> (Brightspace)
Classes: Mo 10:00am-11:20am in 65 University (MRT) 205
We 08:30am-09:50am in 65 University (MRT) 205
Office hours: Tu 12:00pm-13:30pm in STEM 651
or by appointment (on zoom or in person)

Course-related material, such as homework assignments, lecture notes, and topics covered per course, will be posted on Brightspace. Important information might also be sent by emails.

Textbook:

Peter J. Olver and Chehrzad Shakiban, *Applied Linear Algebra*, 2nd edition, Springer, 2018.

A free electronic version is available online and can be obtained via the library of the University (<https://biblio.uottawa.ca/en>). Moreover, lecture notes will be posted on Brightspace after each lecture.

Catalog Description:

Vector and matrix norms. Schur canonical form, QR , LU , Cholesky and singular value decomposition, generalized inverses, Jordan form, Cayley-Hamilton theorem, matrix analysis and exponentials of matrices, eigenvalue estimation and the Gershgorin Circle Theorem; quadratic forms, Rayleigh and minima principles. This course includes proofs and applications of computational methods.

Prerequisites:

(MAT 1322 or MAT 1325), (MAT 2141 or MAT 2342).

Course Outline (tentative):

This course will cover the following topics (exact topics and order subject to changes). The numbers in parentheses indicates the corresponding sections in the textbook.

1. **Chapter 1: Linear Algebraic Systems**
 - 1.1 Matrix arithmetic (1.3-1.6)
 - 1.2 Gaussian elimination (1.3)
 - 1.3 LU factorization and generalization (1.3-1.8)
2. **Chapter 2: Inner Products and Norms**
 - 2.1 Inner products and vector norms (3.1-3.3, 3.6)
 - 2.2 Matrix norms (3.3)
 - 2.3 Conditioning of a linear system
 - 2.4 Positive definite matrices and quadratic forms (3.4)
 - 2.5 Cholesky factorization (3.5)
3. **Chapter 3: Orthogonality**
 - 3.1 Orthogonal and orthonormal bases (4.1-4.2)
 - 3.2 Orthogonal matrices and QR factorization (4.3)
 - 3.3 Orthogonal projection (4.4)

4. **Chapter 4: Minimization and Least Squares** (5.1-5.5)
5. **Chapter 5: Eigenvalues and Singular Values**
 - 5.1 Computing eigenvalues (8.2, 9.5)
 - 5.2 Diagonalization (8.3, 8.5)
 - 5.3 Jordan canonical form (8.6)
 - 5.4 Singular value decomposition and pseudoinverse (8.7)

Homework:

Exercises will be posted weekly on Brightspace. Throughout the term, there will be 5 assignments to be turned in on the assigned due date directly on Brightspace. You are encouraged to work with others while solving homework problems, but you must write up your own solutions. Moreover, late homework will not be accepted except in the case of an excused absence.

Some problems will require the use of a computer. What software you use it up to you, but Matlab/Octave will be used for the solutions (as well as any given script/function that can be useful to solve some problems).

Exams:

There will be one midterm exam and one final *comprehensive* exam. The midterm will take place Monday, February 27, during the usual class time. The final exam will be held during the exam period (precise date to be determined). A detailed description of the material covered by each exam will be provided on Brightspace in due time.

Grading Policy:

The final grade will be based on the homework assignments, the midterm exam, and the *comprehensive* final exam. It will be computed according to the following distribution:

- Homework: 20% of your grade;
- Midterm: 30% of your grade;
- Final exam: 50% of your grade.

Out of the five assignments, the lowest grade will be dropped (so 4 assignments out of 5 will count for the homework part). Homework and exam scores will be posted on Brightspace so you can monitor your progress in the course. Your final letter grade will be computed according to the standard university scale:

A+ (90%-100%); A (85%-89%); A- (80%-84%); B+ (75%-79%); B (70%-74%); C+ (65%-69%); C (60%-64%); D+ (55%-59%); D (50%-54%); E (40%-49%); F (0%-39%).

Important Dates:

Below is a summary of the important dates for the Winter 2023 term. You will find more informations at the website

<https://www2.uottawa.ca/current-students/important-academic-dates-deadlines>

January 9	First day of the term and first day of this class
February 19-25	Reading week (no classes)
February 27	Midterm (10:00am-11:20am in MRT 205)
April 5	Last day of this class
April 12	Last day of the term (redefined day, Saturday course schedule)
April 14-27	Exam period (date to be determined)

Attendance Policy and Make-up Policy:

Attendance is STRONGLY recommended, but attendance will not be taken. There will be no make-up for the midterm. However, if you miss the midterm for a **valid reason**, then its weight will be transferred to the final exam.

Materials Copyright:

All materials generated for this class are protected by Copyright laws. Distributing copies or sale of any of these materials is strictly prohibited.

Academic Fraud:

Academic fraud is an act by a student that may result in a false evaluation. It is not tolerated by the University. Examples of academic fraud are: plagiarism, cheating of any kind or submit a work for which you are not the author, in whole or part. Any person found guilty of academic fraud will be subject to severe sanctions. Please consult the webpage <https://www.uottawa.ca/vice-president-academic/academic-integrity/resources-students> which contains regulations and tool to help you avoid plagiarism.

Bilingualism:

Except in programs and courses for which language is a requirement, all students have the right to produce their written work and to answer examination questions in the official language of their choice, regardless of the course's language of instruction.

Academic GPS:

The Academic GPS hub is a one-stop shop for academic support. Whether you're an experienced student or just starting out, you'll find some great resources to help you succeed.

With the Academic GPS, you can:

- chat with a mentor seven days a week;
- register for study groups;
- take part in study methods workshops (note taking, time management, exam preparation, stress management, etc.);
- book an appointment with a mentor.

For more information: <https://www.uOttawa.saea-tlss.ca/en/academic-gps>.

Health and Wellness:

Your wellness is an integral part of your success. If you don't feel well, it can be hard to focus on your studies. Dedicated professionals and fellow students who care about you are always ready to provide advice and support. Depending on your needs, many activities and services exist to accompany you during your academic journey.

Services include:

- opportunities to connect;
- counselling sessions;
- peer support;
- physical activity;
- wellness activities and workshops;
- spiritual guidance.

If you want to connect with a counsellor, you can book an appointment online or go to their walk-in clinic at 100 Marie-Curie, fourth floor. You can also drop-in to our wellness space, chat online with a peer helper, or access 24/7 professional help through the website.

For more information and to access these services, go to <https://www.uOttawa.ca/wellness>.

Academic Accommodations:

We try to make sure all students with disabilities have equal access to learning and research environments, the physical campus and University-related programs and activities. The Academic Accommodations service works with other campus services to create an accessible campus learning environment, where students with disabilities have an equal opportunity to flourish.

We offer a wide range of services and resources, provided with expertise, professionalism and confidentiality.

Services include:

- help for students with disabilities in making the transition;
- permanent and temporary accommodation measures;
- learning strategy development;
- adaptive exams;
- transcriptions of learning material;
- interpretation (ASL and LSQ);
- assistive technologies.

If you think that you might need any of our services or supports, email the Academic Accommodations service (adapt@uOttawa.ca).