Math 2040 Matrix Theory and Linear Algebra 2

Andrew Irwin

2024-01-09

Syllabus

Instructor: Andrew Irwin, Chase 225, `a.irwin@dal.ca`.

Office hours: TTh 14:30-15:30 or by appointment.

Class meeting times: TTh 13:05-14:25 in Chem 125.

Textbook: P Selinger et al. (2018) Matrix Theory and Linear Algebra.

This is a free, open-source textbook available as a PDF on Brightspace and the web. You can buy a printed copy from lulu.com. Allow about 3 weeks for printing and delivery.

I plan to cover topics from the Appendix and Chapters 9, 10, and 11.

Prerequisites

Linear Algebra (Math 1030/2030) and Calculus (Math 1000 or 1500 or 1215).

Course activities and evaluation scheme

- Lectures
- Assignments (9 in total, 20%)
- Tests (two, 20% each)
  - Test 1: Thu 15 Feb, in class
  - Test 2: Thu 21 March, in class
- Final exam (40%, scheduled by registrar)

Numerical grades will be converted to letter grades using the Dalhousie Common Grade Scale.

Course Overview and Learning outcomes

Students will learn advanced concepts of linear algebra, including real and complex vector spaces, inner product spaces, linear transformations, and orthogonality. We will discuss the use of vectors and linear algebra for representing and manipulating data for statistical analysis and data representing images and sounds. We will discuss several applications of the linear algebra theory in detail including least squares curve fitting, principle component analysis, error correcting codes, linear transformations of images, and the decomposition of sounds into component frequencies.

This course is a continuation of Math 1030.

Detailed learning outcomes are enumerated at the start of each section of the textbook.

At the end of the course, you should have expanded your knowledge of linear algebra and learned about several common applications of the theory. You should be able to describe the corresponding definitions and

algorithms studied, explain the connection between the ideas and the applications, and be able to perform computations related to the applications.

Course objectives can be completed with a pencil and paper – there is no need for a calculator or computer. Although computers are routinely used in applications of linear algebra, that is not our focus in this course.

Schedule of topics

This is a tentative course schedule. I will try to keep the schedule up-to-date with any changes that arise.

Week: Day	Date	Description	Textbook	Assignment
1: T	2024-01-09	Complex Numbers	A.1, A.2	Demo Homework
1: Th	2024-01-11	Fundamental theorem of algebra; Recurrence Equations	A.3, 8.11	HW 1
2: T	2024-01-16	Vector spaces	9.1	
2: Th	2024-01-18	Linear independence, span	9.2	HW 2
3: T	2024-01-23	Subspaces, basis	9.3	
3: Th	2024-01-25	Dimension	9.4	HW 3
4: T	2024-01-30	Error correcting codes	9.5	
4: Th	2024-02-01			HW 4
5: T	2024-02-06	Linear transformations	10.1, 10.2	
5: Th	2024-02-08	Vectors and transformations in Rn	10.3	
6: T	2024-02-13	Transformations as a matrix	10.4	HW 5
6: Th	2024-02-15	Test #1		
Break:	2024-02-19			
7: T	2024-02-27	Perspective rendering	11.1	
7: Th	2024-02-29	Inner product spaces, Orthogonality	11.2	HW 6
8: T	2024-03-05	Gram-Schmidt orthogonalization	11.3	
8: Th	2024-03-07	Orthogonal polynomials	11.4	HW 7
9: T	2024-03-12	Fourier series	11.4	
9: Th	2024-03-14	Least squares approximations	11.5	HW 8
10: T	2024-03-19	Orthogonal functions	11.6	
10: Th	2024-03-21	Test #2		
11: T	2024-03-26	Quadratic forms, diagonalization	11.7, 11.9	
11: Th	2024-03-28	Complex inner product spaces	11.10	HW 9
12: T	2024-04-02	Unitary and Hermitian matrices	11.11	
12: Th	2024-04-04	Principal component analysis	11.12	

Course policies

You can get help with this course in the Math Learning Centre (Chase building, 1st floor, room 119). See its Brightspace page for more information. Help is provided on a first-come first-served basis. You are encouraged to work in groups or individually at one of the large tables.

The work you submit for grading (homework, tests, exams) must be your own work.

Calculators, textbooks, and notes are not permitted for the mid-term tests or the final examination.

Late homework will not be accepted except with the instructor's prior permission. Please contact me by email if you anticipate a problem with a deadline and have a reasonable excuse.

There will be no opportunity to write the mid-term tests at another time. If you miss a test without permission

you will earn a 0. If you are excused from the test, the weight of the test will be added to the final exam or the other mid-term test.

If you anticipate missing any of the course work for any reason, please complete the 'Student declaration of absence' on BrightSpace. You can find this under Assignments. Please do not obtain doctor's notes.

University and Faculty of Science

Please see the supplement to this syllabus which describe resources, policies, and statements available to all students.