MATH 322 - Matrix Theory

Fall 2020

General information

Instructor:	Martin Frankland
Email:	Martin.Frankland@uregina.ca
Office:	CW 307.17
Office hours:	Monday 4-5 PM, Tuesday 4:30 - 5:30 PM, Wednesday 2-3 PM, or by appointment. The Zoom link is posted on UR Courses.
Lectures:	TR 2:30 - 3:45 PM on Zoom. The link is posted on UR Courses.
	There are no tutorials.
Textbook:	Roger Horn and Charles Johnson, *Matrix Analysis*, Second Edition. The book is available from the Bookstore.
Prerequisite:	MATH 222.
UR Courses:	`https://urcourses.uregina.ca/`
	This site will contain announcements, additional course material, and solutions to selected problems. The site is updated throughout the semester, so please check back regularly.

Course outline

An important topic from MATH 122 was to solve a system of linear equations $Ax = b$, where A is an $m \times n$ matrix. Row operations simplify the matrix into its reduced row echelon form, making the task much easier. Moving on to MATH 222, one important topic was diagonalization of a square matrix A. Changing to a basis of eigenvectors of A (if it exists) simplifies A into a diagonal matrix. This is useful for instance to compute high powers A^k, solve linear differential equations, or difference equations.

MATH 322 pursues this theme of simplifying matrices into certain canonical forms. By the end of the course, you will be able to find various decompositions of matrices, and use those decompositions to solve problems. You will also be familiar with special classes of matrices, their structure, and their applications.

The course covers the following topics:

- Inner product spaces and normed vector spaces.

- The Jordan canonical form.

- The singular value decomposition.

- Positive definite matrices.

- Non-negative matrices.

- Matrix norms and spectral radius.

- Selected applications of matrix analysis to other areas of mathematics and the sciences.

Grading scheme

- Readings: 10%

- Homework: 35%

- Midterm: 15%

- Final Exam: 15%

- Project: 25%

Course delivery and computer requirements

The course is taught **remotely**. At no point are you required to be physically in Regina. Here are the technology requirements.

- A computer, laptop, or similar device, with a reliable internet connection.

- A way of submitting work online, e.g., a smartphone camera or a scanner. Typing up your homework is another option.

- A video camera and microphone for the oral presentation. The rest of the semester, a camera and microphone are strongly recommended, in order to facilitate participation. Note: Most laptops have a built-in camera and microphone, which work fine for our purposes.

The course has both synchronous and asynchronous components.

- **Synchronous**: Lectures / problem sessions during the designated schedule.

- **Asynchronous**: Selected sections from the textbook, notes posted after each live session, additional notes and worked examples.

Readings

In preparation for each lecture, a section of the textbook will be assigned as reading. You will be asked to complete a mini-quiz on UR Courses **before** the lecture.

The **two lowest reading scores** will be dropped.

Exams

- Midterm: **Tuesday October 20**, take-home exam.

- Final Exam: **Tuesday December 15**, take-home exam.

Details for both exams will be confirmed.

The final exam covers the entire semester, with heavy emphasis on material after the midterm.

All exams will be **open book**: the textbook, notes, and class material are allowed. More details will be provided as to which resources are allowed and which are not.

Homework

Homework will be assigned more or less weekly and submitted on UR Courses. Selected problems from each assignment will be graded.

Late homework will not be accepted.

The **lowest homework score** will be dropped.

Project

You will work on a project on a topic of your choice related to the course. The project consists of two components:

- An expository written report, worth 15%.

- An oral presentation, worth 10%.

The project may be done in groups. In that case, however, duties will be individualized (e.g. writing different sections of the report) and grading will be individual.

Missed course work

Information about missed course work can be found in the *Academic Regulations*, section "Deferral of Final Exams or Course Work", available at:

https://www.uregina.ca/student/registrar/resources-for-students/academic-calendars-and-schedule/undergraduate-calendar/sections.html

See in particular the sections "Grounds for Deferral" and "Supporting Documentation".

Schedule conflicts: If you have a schedule conflict between an exam and another course or university sponsored activity (e.g. conference, sports tournament), please contact me in advance, **no later than a week before the exam** in question.

Illness: If you are unable to meet a course requirement due to illness or other serious circumstances, please contact me as soon as possible.

Homework: An excused missed assignment will be dropped. There will be no make-up homework.

Exams: In case of excused absence from an exam, the exam will be dropped, with the course grade computed out of the remaining 85 course points. There will be no make-up exam.

For administrative purposes, the Final Exam plays the role of a second midterm. In particular, the section "Deferral of Final Exam" in the *Academic Regulations* does not apply here.

Academic integrity

Working on homework with your peers is allowed. However, each student must write **their own** solutions. Handing in suspiciously similar solutions will be considered an instance of cheating.

Handing in any material copied from the internet or another source will likewise be considered cheating. **Cite sources** that you consult, for instance Wikipedia, Math Stack Exchange, or online course notes.

Scholastic offences are taken seriously and will not be tolerated. For more information, please consult the *Student Code of Conduct and Right to Appeal*, section "Academic Misconduct", available at:

https://www.uregina.ca/student/registrar/resources-for-students/academic-calendars-and-schedule/undergraduate-calendar/sections.html

as well as the *Faculty of Science Student Handbook*, section "Academic Integrity", available at:

https://www.uregina.ca/science/assets/docs/pdf/programpdf/new-student-manual.pdf

Accessibility

Any student with special needs who may need accommodation should contact the Centre for Student Accessibility at:

`https://www.uregina.ca/student/accessibility/`

After I receive the letter from the Centre for Student Accessibility, please contact me to discuss the accommodation.