MATH 6020 — Scientific Computing
Fall 2023

Department of Mathematics and Statistics, University of Guelph

Web Site: University's CourseLink system, `http://www.courselink.uoguelph.ca/`.

Calendar Description

This course covers the fundamentals of algorithms and computer programming. This may include computer arithmetic, complexity, error analysis, linear and nonlinear equations, least squares, interpolation, numerical differentiation and integration, optimization, random number generators, Monte Carlo simulation; case studies will be undertaken using modern software.

Objectives

This course typically has students from a broad range of backgrounds. The objective is to teach students basic programming skills and introduce them to a number of different numerical algorithms for the solution of scientific programming problems. We are going to focus on problems in linear algebra, since these are fundamental and come up in other areas, for example in the solution of partial differential equations. We are going to be using the programming language Julia, which is a high-performance yet easy-to-use language with some similarities to MATLAB. Unlike MATLAB, it is free.

Topics

Julia language and programming. We will cover computer floating point numbers and error analysis. The linear algebra topics will include solving linear systems by LU factorization, QR factorization of a matrix, least squares minimization, computation of eigenvalues, the singular value decomposition, the eigenvalue decomposition, and classical and Krylov subspace iterative methods to solve large linear systems.

Resources

The following text is required.

- *Numerical Linear Algebra with Julia*, E. Darve and M. Wootters, SIAM, Philadelphia, 2021.

We will cover almost all of the material in this text. The course will be taught primarily in a "reading and question" mode. Students will be assigned readings and exercises from the text prior to lecture. During lecture we will discuss the readings, clarify concepts, and review the exercises. The library has a physical copy of the text, which will be on 4-hour reserve. The text is available from the SIAM web site. Students at the University of Guelph may apply for a free membership in SIAM. Members get a discounted price on textbooks. The University bookstore should also have some copies available.

An additional excellent text that is a good resource is

- *Numerical Linear Algebra*, L.N. Trefethen and D. Bau III, SIAM, Philadelphia, 1997.

This text is also on 4-hour reserve in the library.

A good source of information on the Julia language is the Julia documentation page https://docs.julialang.org/. The "manual" (left navigation bar) on that page particularly contains

helpful information.

Evaluation

There will be three assignments and a final take home exam. The take home exam will be the same format as the assignments. All of these will contain a significant programming component. You will be required to write and submit computer code written in Julia.

Assessment	date	weight
3 Assignments	(approximate dates) Oct. 4, Oct. 30, Nov. 22, in class.	75%
Take-home Final Exam	Issued Dec. 1, Due Dec. 15, 4:00 p.m.	25%

Collaboration and Use of Artificial Intelligence (AI)

For all of the assignments and the final take home exam, you are expected to hand in your own work. The only type of collaboration permissible is discussing with other members of the class or with the instructor how to approach a certain problem. This discussion should be high-level in nature. In particular:

1. You are *not* permitted to copy other people's material, whether that person is in the class or not.
2. You are *not* permitted to use AI in any manner to complete your assignments and the exam. This includes chatGPT and other AI chatbots.

Weekly Text Sections

Below is a table that provides the text sections we will be discussing each week. (Week 1 is Sept. 11 and Sept. 13.) Students are expected to have read these sections prior to class and come with questions and be prepared to discuss the material in these sections.

Note that Friday, Dec. 1 is a "Monday" schedule to compensate for Thanksgiving on Oct. 9. Thus there will be no class on Monday Oct. 9 (during Week 5), but there will be a class to compensate on Friday, Dec. 1 (during Week 12).

Week	2	3	4	5	6	7	8	9	10	11	12
Text Sections	2.1-2.6	3.1-3.3	3.4-4.3	4.4-5.1	5.2-5.3	5.4-6.1	6.2-7.2	7.3-7.6	8.1-8.3	8.4-9.1	9.2-9.

University Policies

E-mail Communication

As per university regulations, all students are required to check their uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for [Academic Consideration](#).

Drop Date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses. are available in the Graduate Calendar.

Copies of Out-Of-Class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: wellness.uoguelph.ca/accessibility/.

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is outlined in the Graduate Calendar:

Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless

further permission is granted.

Resources

The [Academic Calendars](#) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via Courselink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website ([(https://news.uoguelph.ca/2019-novel-coronavirus-information/)](https://news.uoguelph.ca/2019-novel-coronavirus-information/)) and circulated by email.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

COVID-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, that these guidelines may be updated as required in response to evolving University, Public Health or government directives.