Course Syllabus
Computational Linear Algebra (MATH6800 / CSCI6800)

Instructor: F. M. Faulstich (faulsf@rpi.edu), Office: Amos Eaton 406
Office hours: Monday/Thursday, 4-5 p.m.

Class webpage: https://fabianfaulstich.github.io/MATH6800_2025/
RPI LMS page: https://lms.rpi.edu/ultra/institution-page
Piazza webpage: https://piazza.com/rpi/fall2025/math6800csci6800
access code: q80bjxdfdem
Gradescope webpage: https://www.gradescope.com/courses/1105130
access code: PGEK7G

Course Content & Goals:

This course provides a rigorous treatment of the fundamental principles and algorithms used in numerical linear algebra. Emphasis is placed on methods that are both theoretically sound and practically effective, with a strong focus on state-of-the-art techniques and algorithms in modern applied mathematics and scientific computing.

Designed as the culminating course in the numerical linear algebra sequence, it builds upon the foundational material covered in Numerical Computing (MATH 4800/CSCI 4800), Linear Algebra (MATH 4100), and Numerical Linear Algebra (MATH 4840). As programming forms a central component of the curriculum, prior familiarity with Introduction to Computer Programming (CSCI 1010) and Data Structures (CSCI 1200) is assumed.

Students completing this course will be well-equipped to address real-world computational challenges that arise in engineering, data science, physics, and beyond. Topics include Cholesky, QR, Low-Rank factorization , Eigenproblems, Arnoldi, Lanczos, Iterative methods for linear systems, Krylov methods, Randomized Linear Algebra, multi-linear algebra, and tensor product approximations.

In Lieu of Textbooks

The course content will consist of selected chapters from the following resources:

1. Numerical Linear Algebra with Julia by E. Darve and M. Wootters
2. Numerical linear algebra by L. N. Trefethen and D. Bau, III
3. Matrix Algorithms Volume 1: Basic Decompositions by G. Stewart
4. Matrix Algorithms Volume 2: eigensystems by G. W. Stewart
5. Matrix computations by G. H. Golub and C. F. Van Loan
6. Matrix analysis by R. A. Horn and C. R. Johnson
7. Matrix analysis by R. Bhatia
8. Tensor Spaces and Numerical Tensor Calculus by Wolfgang Hackbusch
9. Tensor trains for high-dimensional problems by Mi-Song Dupuy
10. Randomized numerical linear algebra: Foundations and algorithms by P.G. Martinsson and J. A. Tropp

Logistical structure of the class:

- **Piazza**: Piazza will be the main forum for all communication outside of classroom and office hours, and this will include the announcements.
- **Questions in Addition to Office Hours**: If it is not class time or office hour and you want an answer more or less right away, please ask the question on Piazza. You can use the "private question" mode on Piazza if necessary. In case of an emergency (that does not include homework questions), we may be able to set up a WebEx appointment in my personal room.
- **Homework**: A few problems will be assigned and graded on a mostly weekly basis. This will be the only means of assessment of your work, so you should put a real effort into it. I encourage collaboration on the homework. However, copying is forbidden. In other words, you can exchange ideas as much as you want, but, in the end, you must write your work up on your own without looking at anybody else's work. Copying off the internet is also forbidden as is using AI helpers such as ChatGPT.
- **Gradescope**: Please submit your homework through Gradescope. You should submit a typeset .pdf file. Place different problems on different (sets of) pages, and connect the pages to the corresponding problems in Gradescope. Please submit the homework on time. Late homework will not be accepted.

Student Commitment and Expectations:

As a graduate-level course, students are expected to engage actively with the material both inside and outside the classroom. Mastery of the concepts requires independent study beyond the lectures, including reviewing references, experimenting with algorithms, and exploring connections to the students' research interests.

Homework assignments are designed to guide and support this process, but they represent only a portion of the necessary practice. To fully benefit from the course, students should plan to dedicate significant time outside of class each week to reading, problem solving, and programming exercises.

Ultimately, the student's success in this course will depend not only on participation during lectures but also on a sustained, self-directed effort to deepen the individual understanding of the subject.

Academic Integrity:

Copying the homework from anybody or anywhere is forbidden. This includes fellow students, the internet, recycled solutions from previous versions of the class, or ChatGPT. Violating this policy will result in a score of zero for the entire assignment and a referral to the dean of students. Penalties for repeat offenses can be quite harsh; you should check the

Academic Integrity Policy page provided by the Dean of Students Office for more information about this: https://info.rpi.edu/dean-students/05/29/2020/notice-student-rights-and-responsibilities

Grade Appeals:

All appeals must be made within one week of the date when the item was returned to the class. You can do this through a regrade request on Gradescope.

Disability Services:

Rensselaer Polytechnic Institute is committed to providing equal access to our educational programs and services for students with disabilities. If you anticipate or experience academic barriers due to a disability, please get in touch with the Office of Disability Services for Students (DSS) (dss@rpi.edu; 518-276-8197) to establish reasonable accommodations. Once you have been approved for accommodations, please provide me your Faculty Memorandum (a letter provided to students by DSS).