Course Syllabus
Randomized Numerical Linear Algebra (MATH6950)

Instructor: F. M. Faulstich (faulsfh@rpi.edu), Office: Amos Eaton 329

Office hours: Tuesday, 1-2 p.m. & Thursday 4-5 p.m.

Class web page: https://fabianfaulstich.github.io/MATH6950_2024/
RPI LMS page: https://lms.rpi.edu/ultra/institution-page

Course Content & Goals:
This course covers probabilistic algorithms for linear algebra computations, such as factorizing matrices and solving linear systems. It focuses on techniques that have a proven track record for real-world problems.

The course treats both the theoretical foundations of the subject and practical computational issues. Topics include norm estimation; matrix approximation by sampling; structured and unstructured random embeddings; linear regression problems; low-rank approximation; subspace iteration and Krylov methods; error estimation and adaptivity; interpolatory and CUR factorizations; Nyström approximation of positive semidefinite matrices; single-view ("streaming") algorithms; full rank-revealing factorizations; solvers for linear systems

Textbooks & References:

1. P.G. Martinsson and J. A. Tropp. "Randomized numerical linear algebra: Foundations and algorithms." Acta Numerica 29 (2020): 403-572.

Homework Assignments:

Homework assignments are to be uploaded on the due date until 11:59 pm. **No credit is given for homework turned in after the due date**. The lowest score for the homework will be dropped when counting towards the total score in the end.

Achieving all available points on a problem will generally require diligent analysis and clarity of presentation. Nontrivial steps in reasoning must be explained, particularly those involving the concepts and techniques covered in this course. Most problems will involve some amount of computing. Be sure to print out your code and provide snapshots of your session commands to receive credit for this work. Also, the logic of the scientific/mathematical part of the code should be explained by code comments or a separate narrative.

Students whose homework does not show clear positive evidence of representing their own thinking will be asked to take an oral exam prior to the final exam to confirm that their homework grade accurately represents their understanding of the course material. If a student fails to prove that their homework grade accurately represents their understanding of the course material, they will be assigned a course grade commensurate with their performance on this oral final.

The conversion of percentage grades to letter grades will be inspired by the following table:

C-=[50-55), C =[55-65), C+=[65-70),
B-=[70-75), B =[75-85), B+=[85-90),
A-=[90-93), A =[93-100],

Academic Integrity:

Student-teacher relationships are built on trust. For example, students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments that students turn in are their own. Acts that violate this trust undermine the educational process. The Rensselaer Handbook of Student Rights and Responsibilities and The Graduate Student Supplement defines various forms of Academic Dishonesty and you should make yourself familiar with these. In this class, all assignments that are turned in for a grade must represent the student's own work. In cases where help was received, or teamwork was allowed, a notation on the assignment should indicate your collaboration.

If you obtained assistance from anyone outside of the course or any written material beyond the lecture notes and the readings posted on LMS, you must explicitly acknowledge the source.

If the solutions of two or more students do not demonstrate sufficient independence of thought, but do not rise to the level of academic dishonesty, then I may split the points earned among all parties whose collective mind produced the solution. Additionally, oral final exams will be imposed on students whose homework shows a sustained lack of independence of thought. Flagrantly corrupt homework will earn no credit, and clear violations of academic integrity will also be reported to the Dean of graduate education. The distinction between "insufficient independence of thought" and "academic dishonesty" is primarily a matter of whether the work demonstrates an intent to misrepresent one's own work. If you are not clear on the concept of academic dishonesty, you might consult the Rensselaer Handbook of Students Rights and Responsibilities or ask me directly about my expectations for integrity.

If you have any questions concerning this policy before submitting an assignment, please ask for clarification.

You are encouraged to work in small groups on the homework assignments, indicating on your submitted homework those other students with whom you had significant interaction. Your actual solutions should be your own work. That is, you should feel free to discuss how to approach the problems, to consult on how to do certain calculations, or to check your results. But you should never be copying from other students. I will only give credit for work that demonstrates that you understand what you are doing. Therefore, be sure to explain all major steps, especially how you are setting up the calculations or computations.

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).

Course Learning Outcomes:

1. Upon successful completion of the course, students will develop a proficient skill set in programming numerical methods specifically designed for solving large linear systems using randomized techniques.
2. Upon successfully finishing the course, students will gain knowledge about contemporary methodologies in advanced numerical linear algebra, expanding their knowledge and skills in this field.