

Spring 2024

Numerical Linear Algebra

MAD 5932

Details

- Time: 13:20 – 14:10, MWF
- Room: 107 LOV
- Instructor: K. A. Gallivan
- Office: 421 LOV
- Email: kgallivan@fsu.edu
- Homepage: <http://www.math.fsu.edu/~gallivan>
- Office Hours: 8:00 – 9:00, 12:00 - 13:00 MWF and by appointment
- For remote contact during office hours or other arranged meetings, use the Zoom meeting room link on my homepage.
- Prerequisites: three semesters of Calculus, programming proficiency, familiarity with finite dimensional vector spaces and basic linear algebra or consent of instructor
- Text : No textbook is required.
- The following reference texts are recommended:
 1. G. Golub and C. Van Loan, Matrix Computations, Johns Hopkins Press, Fourth Edition.
 2. Carl D. Meyer, Matrix Analysis and Applied Linear Algebra, SIAM, Philadelphia, 2023, Second Edition.
 3. Yousef Saad, Iterative Methods for Sparse Linear Systems, SIAM, Philadelphia, 2003, Second Edition.
 4. Yousef Saad, Numerical Methods for Large Scale Eigenvalue Problems, SIAM, Philadelphia, Revised Edition.
 5. A. Björck, Numerical Methods for Least Squares Problems, SIAM, Philadelphia, 1996.
 6. G. W. Stewart, Matrix Algorithms Vol. 1 Basic Decompositions, SIAM, Philadelphia, 1998
 7. G. W. Stewart, Matrix Algorithms Vol. 2 Eigenvalue Problems, SIAM, Philadelphia, 2000
 8. G. W. Stewart, Introduction to Matrix Computations, Academic Press, 1973
 9. M. A. Olshanskii and E. E. Tyrtyshnikov, Iterative Methods for Linear Systems, SIAM, 2014
 10. James W. Demmel, Applied Numerical Linear Algebra, SIAM, 1997

- Grades: You will be asked to do occasional homework assignments of written exercises and programming. You will also be asked to prepare a report on a mutually agreeable topic presented toward the end of the semester.
- Study Question Sets: Sets of problems and solutions will be posted during the semester. You are not required to submit solutions for these but are strongly encouraged to attempt them and consult the solutions provided. These are a key addendum to the slides and posted papers.
- Class Webpages:
 1. The class has a Canvas webpage that will be used for class emails, posting and submitting homework assignments, and some class documents such as the syllabus.
 2. The main class page is accessible from my departmental homepage www.math.fsu.edu/~gallivan by following the class link. Class notes, homework, programming assignment, study questions and announcements will be posted on the class website. The announcements will be duplicated on the Canvase webpage.
 3. You are expected to consult these websites in a timely and regular manner.
 4. The user and password information for the class website linked to my departmental homepage will be sent to those registered in an Canvas class email/announcement.
 5. Other books, papers, and software resources will be cited, posted or linked in the class notes, the homework, and on the class website linked to my departmental homepage. These are background material and suggested references. You will be expected to read a small subset identified in the lectures. The others are for your graduate academic development.
- Lectures will be in-person unless otherwise stated.
- Class Participation Policy: Participation in class by asking questions and responding to questions posed by the instructor is expected and strongly encouraged. The diverse background of the students implies several students will be unfamiliar with each topic and clarification by such questions and responses is vital to understanding. Students are expected to be prepared for class lectures and for any office visits. Students are encouraged to prepare carefully for class by reading relevant posted notes and sections of the textbook.
- Meetings with the instructor are also expected and encouraged especially for discussions that are too lengthy for class. It is particularly important to have such meetings early and often for material about which you are uncertain. Group meetings are encouraged.
- Electronic devices may be used to access class notes and related material during lectures. **Other uses of cell phones and similar devices are often disruptive to the lecture and are not permitted.**
- Plagiarism is a violation of the university honor code. With respect to the solutions of programming problems in the homework, it is not acceptable to engage in plagiarism. You may discuss the programming problems with each other **but any significant discussion must cited, i.e., it should be treated like the citation of any outside material**

used in your solutions. Such a citation must include names and the substance of the discussion. All students must design and implement their own code. All students must write individually the description of the code, its complexity, the experimental design, the empirical results and the interpretation of the results. **No student should provide any portion of their code to any other student in class.** If you find a library code (not written by a student in class) that performs a portion of the task **it must be cited – including the specific source of the code and its function.** You are still responsible for describing correctly its implementation and time/space complexity in your solutions. Credit for the program will be prorated based on the amount of functionality performed by a cited library code relative to the functionality required to solve the assigned problem. **Citations when writing solutions to the analytical problems included in a graded homework or programming assignment and applicable penalties for plagiarism are covered by these same policies.** The first offense of submitting a solution without the appropriate citation will result in 0 credit for the programming/experimental portion of the assignment or the particular solution to the analytical problem. Multiple offenses may result in referral to the university for discipline according to university regulations.

- University Attendance Policy: Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.
- Class Attendance Policy: With the exception of the first class meeting, attendance is not required but **it is strongly advised.** A student absent from class bears the full responsibility for all subject matter and procedural information discussed in class.

Content

This course covers the design and analysis of efficient and accurate algorithms for problems in numerical linear algebra with an emphasis on those of use in science, engineering, and statistics. Throughout the semester students will implement selected methods and investigate their performance.

Topics include the

- An introduction to the influence of architecture on the design of computational primitives and numerical algorithms that build upon them.
- Fundamental theorems, decompositions and transformations for numerical linear algebra and the design and analysis of efficient and robust numerical methods.
- Numerical methods for
 - linear systems of equations,
 - linear least squares problems,
 - eigenvalue problems,
 - the singular value decomposition,

- and selected topics such as matrix equations (Lyapunov and Sylvester), problems related to systems and control, and approximation problems.
- Methods will be considered for dense matrix problems, structured matrix problems and large sparse matrix problems.
- Factorization-based methods and iterative methods will be considered where appropriate.

Syllabus Changes

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.

Honor Code

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to “ ... be honest and truthful and ... [to] strive for personal and institutional integrity at Florida State University.” (Florida State University Academic Honor Policy, found at <https://dof.fsu.edu/honorpolicy.htm>.)

Americans with Disabilities Act

Students with disabilities needing academic accommodation should during the first week of class:

1. register with and provide documentation to the Student Disability Resource Center;
2. contact the instructor indicating the need for accommodation and what type.

This syllabus and other class materials are available in an alternative format upon request.

For more information about services available to FSU students with disabilities, contact the :

Student Disability Resource Center
874 Traditions Way
108 Student Services Building
Tallahassee FL, 32306-4167

644-9566 (voice), 644-8504 (TDD), sdrc@admin.fsu.edu, <http://www.disabilitycenter.fsu.edu>.