

Numerical Analysis: Linear Algebra

Gunnar Martinsson

email: pgm@oden.utexas.edu, office: PMA 11.164

Meeting times. TTh 9.30 – 10.45, ECJ 1.308 .

Office hours (instructor). Mondays 13:00 – 13:50. Wednesdays 16:00 - 16:50. Zoom link on canvas.

Teaching assistant. Ziheng Zhang. Email: ziheng@utexas.edu

Office hours (TA). Tuesdays 13:00 - 14:00, Thursdays 14:00 - 15:00.

Website. All course materials (lecture notes, homeworks, tutorial codes), and an up-to-date timeline will be posted at the following URL:

http://users.odan.utexas.edu/~pgm/Teaching/2026_NLA

Course objectives. Accurate and efficient algorithms for solving linear algebraic problems form a cornerstone of scientific and engineering computations. They play an essential role in machine learning, data analysis, and computational statistics. In these areas, tasks such as solving linear systems, computing eigenvectors and eigenvalues of large matrices, solving linear regression problems, low-rank approximation, etc., often form the core of large scale computations. The class will describe efficient techniques for solving problems such as these. Both the theoretical foundations of the methods, and practical considerations for how to implement the methods efficiently, will be covered. The course will include both classical deterministic algorithms and more recent randomized techniques for large-scale linear algebra.

The course will also discuss essential concepts of numerical analysis such as backwards and forwards error analysis, stability of numerical methods, and floating point arithmetic. Particular attention will be paid to modern mixed precision computing, including how computations carried out partly in lower precision can nevertheless produce highly accurate results.

Prerequisites. Graduate standing or consent of instructor. Students should have a strong foundation in undergraduate linear algebra, and prior familiarity with numerical analysis. Knowledge of Matlab is required, as it will be used in the homework problems.

Grading. The final grade will be based on homeworks and four exams:

- 25% for homeworks (about 6 homeworks over the course of the semester).
- 17% for an in class section exam on Thursday September 24.
- 17% for an in class section exam on Thursday October 15.
- 17% for an in class section exam on Thursday November 19.
- 24% for the final exam, at 8:00am-10:00am, on Monday December 14.

The three section exams and the final exam will be “closed books” exams. You will be allowed to bring one page (letter size, single sided) of formulas if you like.

Text. The main text will be *Numerical Linear Algebra* by L.N. Trefethen and D. Bau (SIAM, 1997).

Recommended supplementary texts include:

- *Advanced Linear Algebra: Foundations to Frontiers* by R. van de Geijn and M. Myers:
<https://www.cs.utexas.edu/users/flame/laff/alaff/>
- *Matrix Computations* by G. Golub and C. Van Loan, 4th Ed. Johns Hopkins Press, 2013.
- *Applied Numerical Linear Algebra* by James W. Demmel, SIAM, 1997.
- *Matlab Guide* by D. Higham and N. Higham, SIAM, 2005.

Homeworks. There will be a homework assignment due roughly every two weeks. Exact due dates will be posted on the course website.

The homeworks should be completed individually. You are allowed, and even encouraged, to discuss homework problems with each other, but each student needs to hand in their own work.

Please carefully review the course policy on LLM assistance below.

Artificial intelligence. The creation of artificial intelligence tools for widespread use is an exciting innovation. These tools have both appropriate and inappropriate uses in class work. In this specific class, you are welcome to use LLMs responsibly to support your learning. If you find it helpful, you are very welcome to engage with LLMs to help you understand topics, and to tutor you on both the material presented, and on any prerequisites that you may have missed. In regards to the homeworks, you are strongly encouraged to work out the solutions by yourself; this is by far the most efficient way for you to master the topics covered. However, it is *not* forbidden to use LLMs to solve your homework problems. I would ideally like to forbid this, but I have no means of checking whether such a policy is followed. In order to avoid a situation where students are penalized for honesty, I have decided to allow LLMs in working homework problems. But please do remember that if you use them excessively, you will not gain a proper understanding of the material. Moreover, the section exams and the final exams will to a significant degree presume that you have worked out and understood the homeworks, and these account for 75% of your final grade. Please note that these are close book exams, and you are *strictly* forbidden from accessing AI tools to complete them.

Disability & access. The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Disability & Access (D&A). Please refer to the D&A website for more information: <http://diversity.utexas.edu/disability/>. If you are already registered with D&A, please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this cour

Concerns. If concerns of any kind arise during the course of the semester, I want to hear from you.

If you find that some aspects of the course delivery are not working well, it is more helpful for me (and you!) if you tell me early in the semester.

Make sure you are available during the exam times posted. If these conflict with any religious holidays or other foreseeable events, then please let me know at the start of the semester.

Importantly, if you fall behind, find it hard to follow along, or have any other issues arise that make it challenging for you to do well in the course, then let me know early! The later I find out, the harder it will be to help.

University policies and resources. For a list of important university policies and helpful resources that you may need as you engage with and navigate your courses and the university, see the University Policies and Resources Students Canvas page. The page includes the language of the University Honor Code, Title IX legal requirements for Texas employees, and information about how to receive support through the office of Disability & Access.

Getting help with technology. Students needing help with technology in this course should contact the ITS Service Desk: <https://its.utexas.edu/contact>

Classroom expectation.

Attendance: Expect to attend and actively participate in all class meetings. If you do have to miss class, please contact a classmate to get notes and information from the missed class. (In fact, it's a great idea to collaborate with one or more classmates throughout the semester!)

Behavior Expectations & Professional Standards: Please attend our in-person class meetings on time and be prepared to actively participate. Of course, we are all expected to uphold The University of Texas at Austin Honor Code (<https://deanofstudents.utexas.edu/conduct/standardsconduct.php>) in all settings, all modes of communication, and all interactions with each other (class meetings, all assignment submissions, all email communications, etc.).

Religious holy days. By UT Austin policy, you must notify me of your pending absence for a religious holy day as far in advance as possible of the date of observance. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Academic integrity expectations. Students who violate University rules on academic misconduct are subject to the student conduct process. A student found responsible for academic misconduct may be assigned both a status sanction and a grade impact for the course. The grade impact could range from a zero on the assignment in question up to a failing grade in the course. A status sanction can include a written warning, probation, deferred suspension or dismissal from the University. To learn more about academic integrity standards, tips for avoiding a potential academic misconduct violation, and the overall conduct process, please visit the Student Conduct and Academic Integrity website at: <http://deanofstudents.utexas.edu/conduct>

Important safety information.

Carrying of handguns on campus Students in this class should be aware of the following university policies related to Texas' Open Carry Law:

- Students in this class who hold a license to carry are asked to review the university policy regarding campus carry.
- Individuals who hold a license to carry are eligible to carry a concealed handgun on campus, including in most outdoor areas, buildings and spaces that are accessible to the public, and in classrooms.
- It is the responsibility of concealed-carry license holders to carry their handguns on or about their person at all times while on campus. Open carry is NOT permitted, meaning that a license holder may not carry a partially or wholly visible handgun on campus premises or on any university driveway, street, sidewalk or walkway, parking lot, parking garage, or other parking area.