

Numerical Analysis: Linear Algebra

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- (1). **Meeting times.** TTh 9.30 – 10.45, GDC 4.304.
- (2). **Office hours (instructor).** Tuesdays and Fridays, 13:00 – 13:50. Zoom link on canvas.
- (3). **Teaching assistant.** Yijun Dong, ydong51432@gmail.com
- (4). **Office hours (TA).** Office hours: Mondays 11am - noon, Tuesdays 2pm - 3pm. Zoom link on canvas.
- (5). **Website.** All course materials (lecture notes, homeworks, tutorial codes), and an up-to-date timeline will be posted at the following URL:

http://users.oden.utexas.edu/~pgm/Teaching/2021_NLA

(6). **Course objectives.** Fast algorithms for solving linear algebraic problems form one of the cornerstones of scientific and engineering computations, as well as in machine learning and data analysis. In all of these areas, tasks such as solving linear systems, computing eigenvectors and eigenvalues of large matrices, solving linear regression problems, 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 also discuss essential concepts of numerical analysis such as backwards and forwards error analysis, stability of numerical methods, and floating point arithmetic.

(7). **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.

(8). **Grading.** The final grade will be based on homeworks and two exams:

- 35% for homeworks (about 7 homeworks over the course of the semester).
- 25% for the midterm exam.
- 40% for the final exam.

(9). **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, 3rd Ed. Johns Hopkins Press, 1996.
- *Applied Numerical Linear Algebra* by James W. Demmel, SIAM, 1997.
- *Matlab Guide* by D. Higham and N. Higham, SIAM, 2005.

(10). **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.

Covid safety:

At the time of writing this syllabus, the course is scheduled to run as an in-person class on campus. Given the very high rate of community spread in Austin, we must however remain very focussed on safety.

Most importantly, while I will hold lectures in person, and anyone who is not at risk of spreading covid is very welcome to join, I will attempt to structure the course in such a way that you can attend remotely instead.

By law, I am not allowed to *require* masks or vaccines or even to inquire about your vaccination status. However, it is my understanding that I am allowed to share the following:

- I *strongly* encourage anyone who decides to attend class in person to wear a mask.
- If you are not vaccinated, then I *strongly* encourage you to get the shot; if you go to class, this is not only for your own sake, but also for the rest of us in the classroom. Vaccines offer good protection against infection, and very strong protection against serious illness. Vaccines are also safe; serious side effects are extremely rare. If you still choose to remain unvaccinated, then please consider taking the class remotely.
- I will do everything that I can to enable you to take the class remotely. I will post lecture notes for each lecture, and will do my best to stream and record the lectures.
- If feel sick, or have a cough, or a runny nose, then please do not come to class. Even if you have strong reason to believe that it is not due to covid, you will cause stress to anyone else in the room who have no idea what ails you.
- In the classroom, we will do what we can to keep physical distance. If possible, please do not sit in the front two rows, and keep at least one open seat between you. At the time of writing, the course is full, which in principle means we are at classroom capacity. However, my hope is that enough of you will choose the remote option that we will be able to space ourselves out.
- Under normal circumstances, I vigorously encourage students to attend lectures in person. This semester is different, however, and I encourage you to try the online option and see how it works for you. *In particular, if you are at all at risk of spreading the virus, then I encourage you in the strongest possible terms to not come to class!*
- The online course *Advanced Linear Algebra: Foundations to Frontiers* by R. van de Geijn and M. Myers covers much of the same material as this course. At the website, you will find complete lecture notes, and video lectures, available for free. Check it out at:
<https://www.cs.utexas.edu/users/flame/laff/alaff/>

Finally, remember that even though the risk of getting seriously ill is not high if you are vaccinated (and in particular if you are young and healthy as well), we all have a civic responsibility to do what we can to suppress the spread of the virus. There are many members of our community who *are* at great risk of getting seriously ill, and if you contribute to increasing the risk of them getting infected, then you are doing them grave harm.

University Policies:

Academic Integrity. Each student in the course is expected to abide by the University of Texas Honor Code: “As a student of The University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity.” Plagiarism is taken very seriously at UT. Therefore, if you use words or ideas that are not your own (or that you have used in previous class), you must cite your sources. Otherwise you will be guilty of plagiarism and subject to academic disciplinary action, including failure of the course. You are responsible for understanding UT’s Academic Honesty and the University Honor Code which can be found at the following web address: http://deanofstudents.utexas.edu/sjs/acint_student.php

Q Drop Policy. If you want to drop a class after the 12th class day, you’ll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester, but has been extended for the spring 2021 semester to May 11. Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution—however, for the fall 2020 and spring 2021 semesters, all Q-drops will be considered “non-academic,” which allows students to drop a class without counting toward the six-class limit. For more information about Q drops in general, see:

<http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop>

For information about fall 2020 and spring 2021 updates to the Q Drop Policy, see:

<https://t.e2ma.net/message/r3htee/j51jb0>

Pass/Fail or Credit/No Credit Grading Policy. For the spring 2021 semester, undergraduate students may choose to have a total of three (3) classes graded on a Pass/Fail or Credit/No Credit basis without penalty. These exceptions are new and apply only to the fall 2020 and spring 2021 semesters. For more information please visit UT’s policy on the Extended deadline for Q-drops and P/F Flexibility.

University Resources for Students. Your success in this class is important to me. We will all need accommodations because we all learn differently. If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. Together we’ll develop strategies to meet both your needs and the requirements of the course. There are also a range of resources on campus:

Services for Students with Disabilities: This class respects and welcomes students of all backgrounds, identities, and abilities. If there are circumstances that make our learning environment and activities difficult, if you have medical information that you need to share with me, or if you need specific arrangements in case the building needs to be evacuated, please let me know. I am committed to creating an effective learning environment for all students, but I can only do so if you discuss your needs with me as early as possible. I promise to maintain the confidentiality of these discussions. If appropriate, also contact Services for Students with Disabilities, 512-471-6259 (voice) or 1-866-329- 3986 (video phone).

<http://ddce.utexas.edu/disability/about/>

Counseling and Mental Health Center: Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support.

<http://www.cmhc.utexas.edu/individualcounseling.html>

Libraries: <http://www.lib.utexas.edu/>

ITS: <http://www.utexas.edu/its/>

Student Emergency Services: <http://deanofstudents.utexas.edu/emergency/>

BeVocal: BeVocal is a university-wide initiative to promote the idea that individual Longhorns have the power to prevent high-risk behavior and harm. At UT Austin all Longhorns have the power to intervene and reduce harm. To learn more about BeVocal and how you can help to build a culture of care on campus, go to:

<http://wellnessnetwork.utexas.edu/BeVocal>

Important Safety Information: If you have concerns about the safety or behavior of fellow students, TAs or Professors, call BCAL (the Behavior Concerns Advice Line): 512-232-5050. Your call can be anonymous. If something doesn't feel right — it probably isn't. Trust your instincts and share your concerns.

The following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, <http://www.utexas.edu/safety/> Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- Link to information regarding emergency evacuation routes and emergency procedures can be found at: www.utexas.edu/emergency

Title IX Reporting. Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, unprofessional or inappropriate conduct of a sexual nature, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When unprofessional or inappropriate conduct of a sexual nature occurs in our community, the university can:

- (1) Intervene to prevent harmful behavior from continuing or escalating.
- (2) Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
- (3) Investigate and discipline violations of the university's relevant policies.

Beginning January 1, 2020, Texas Senate Bill 212 requires all employees of Texas universities, including faculty, report any information to the Title IX Office regarding sexual harassment, sexual assault, dating violence and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be reported. *I am a Responsible Employee and must report any Title IX related incidents that are disclosed in writing, discussion, or one-on-one.* Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you would like to speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit <http://www.titleix.utexas.edu/>, contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419.

Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as unprofessional or inappropriate conduct of a sexual nature, including the types of conduct covered under Texas Senate Bill 212. The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.

Religious holidays. If you plan to miss class due to observance of a religious holiday, please let the instructor know *at least two weeks in advance*. You will not be penalized for this absence, although you will still be responsible for any work you will miss on that day if applicable. Check with instructor for details or arrangements.