MATH 2418 – FALL 2023: Linear Algebra

Last update: AUG/29, 2023

1 INSTRUCTORS AND OFFICE HOURS

In case you have questions or concerns about the course, grades, or assignments please contact **your instructor**, not the course coordinator.

Instructor: Dr. Anani Adabrah
Office: FN 3. 118B
Office hrs.: T/Th 12:00 pm to 1:00 pm and by appointment

Telephone: (972) 883 3959
E-mail: AnaniKomla.Adabrah@utdallas.edu

Instructor: Dr. Adrian Murza
Office: FN2.206
Office hrs.: Tuesday-Thursday 6:45-7:45 pm and by appointment

Telephone: 972-883-4778
E-mail: Adrian.Murza@utdallas.edu

Instructor: Dr. Felipe Pereira *(Coordinator)*
Office: FA 2.412
Office hrs.: T-Th.: 6:45 pm - 7:45 pm (my office) and by appointment (on MS Teams)

Telephone: (972) 883 6565
E-mail: luisfelipe.pereira@utdallas.edu

Instructor: Dr. Janos Turi
Office: Founders Building FO 2.408A
Office hrs.: Tue. & Th. 1:00 pm – 2:00 pm and by appointment

Telephone: (972) 883-2183
E-mail: Janos.Turi@utdallas.edu

Instructor: Dr. Cheyu Wu
Office: Founders Building FO 2.104
Office hrs.: T/Th 11:30 am - 12:30 pm and by appointment

Telephone: (972) 883-6688
E-mail: cheyu.wu@utdallas.edu

Information about Teaching Assistants (TAs) is available in eLearning, session MATH 2418.701.

2 PLTL (Peer led team learning)

This class is supported by PLTL. PLTL is a small group, weekly study session led by a peer leader that guides you through supplemental problems related to the course material. Registration is required. The registration process begins the first week of classes and fills up quickly. If you register, you are required to attend every PLTL session. To learn more about registration and the program, please visit:

https://studentsuccess.utdallas.edu/programs/peer-led-team-learning/

3 TEXTBOOK INFORMATION

- Required: Gilbert Strang *Introduction to Linear Algebra*, Sixth Edition. Wellesley Cambridge Press. ISBN: 978-1-7331466-7-8. Note that:

  i. All homework sets will have some suggested problems that will be discussed by TAs during problem sections. Answers for selected problems have been prepared by Dr. Strang and can be found at:

  `https://math.mit.edu/ gs/linearalgebra/ila6/indexila6.html`

  ii. Dr. Strang has prepared video lectures that can help you to understand the material of this course. You will find a link to these lectures in eLearning, session MATH 2418.701.

- Suggested for additional reading: Howard Anton, *Elementary Linear Algebra*, Wiley 11th Edition (The book and the student solutions manual are recommended).

- Earlier editions of Strang's book differ considerably from the sixth edition and are not recommended as a textbook.

4 PROBLEM SESSIONS AND ELEARNING

- Students must enroll in one of the problem sessions MATH 2418.3xx in addition to the lecture sessions MATH 2418.00x or MATH 2418.50x. Students **have to attend** the problem section they registered for; students may not attend a different problem section.

- The section MATH 2418.701 is the exam section for the entire MATH 2418 students.

- The instructors will post important announcements, homework, and exams on the MATH 2418.701 (the exam section) page of eLearning:

`https://elearning.utdallas.edu`

5 COURSE DESCRIPTION AND OBJECTIVES

Students will learn concepts and techniques of linear algebra that are important for applications in science (in particular in data science) and engineering. Course topics include systems of linear equations, determinants, vectors and vector spaces, eigenvalues and eigenvectors, and the singular value decomposition of a matrix.

1) Given a system of linear equations, students will be able to apply the Gauss-Jordon and Gaussian algorithms to determine all solutions and determine whether the system is consistent and whether the solution is unique.

2) Given a square matrix, students will be able to accurately calculate its determinant, and deduce whether the matrix is invertible or singular using elementary row operations; Basic properties of determinants and elementary matrices; Equivalent conditions of invertibility of a square matrix.

3) Given definitions of a set of objects with a well-defined addition and scalar multiplication, students will be able to evaluate whether this constitutes a real vector space. If valid, students will be able to demonstrate each axiom; if invalid, students will be able to present and verify an explicit counter-example to a vector space property.

4) Given a matrix, students will be able to determine its eigenvalues, and for each such eigenvalue students will be able to create a basis for the corresponding eigenspace; Diagonalizability of square matrices.

5) Given a matrix, students will be able to accurately determine basis vectors for its row space, column space, and their orthogonal complements.

6) Students will be able to use the Gram-Schmidt process to construct an orthogonal basis for an inner product space; Students will be able to find the least squares solutions of a linear system.

7) Students will be able to identify symmetric positive definite matrices.

8) Students will be able to find the singular value decomposition (SVD) of a given matrix.

6 COURSE POLICY & GRADING SCHEME

6.1 HOMEWORK

- A pdf file for assignment will be posted in MATH 2418.701 `weekly` to eLearning at

`https://elearning.utdallas.edu`

- The assignments will have information about the DEADLINE to be UPLOADED IN eLearning.
- The homework solutions need to the handwritten. You can write them on paper and scan your solutions or write directly on a tablet.
- NOT all the problems will be graded. Typically 6 to 9 homework problems will be collected each week.
- The lowest score will be dropped.
- **Important Remark:** The point of homework assignments is to increase the understanding of the material, not simply to prepare students for exams. The suggested problems listed in each homework set provide ample material to practice. It is highly recommended and is a very good learning habit that one works on these problems immediately after each lecture, without waiting for problem sessions or posting assignments. To be prepared for exams students should understand the theory and work through as many of the problems as one needs in order to become comfortable with the material.

6.2 QUIZZES

- It will be given at the end of your problem section.
- Duration: 20 min.
- Missed quizzes: possible justifications have to be sent to the INSTRUCTOR by email, copying (cc) the TA in it. The INSTRUCTOR will make a final decision if a make-up quiz will be given or not. (see late/missed coursework below)
- Each quiz will be one homework problem that is due in the week of the problem section.
- The lowest score will be dropped.

6.3 EXAMS

- Details of each exam will be posted to eLearning about a week before the exam.

6.4 LATE/MISSED COURSEWORK

- There is no make-up for late or missed assignments or exams, unless extreme circumstances with proper documentation is accepted by the INSTRUCTOR.
- In cases of extreme circumstances, one is expected to report to the instructor **before** the deadline of the coursework and resolve the problem within **one** week after the deadline.

6.5 CALCULATORS

Only basic or scientific calculators are allowed in exams of MATH 2418. Our definition of "basic or scientific calculators" is that:

i) it does NOT have any of the following features: programmability, matrix function, graphing function, wireless access to the Internet; and

ii) the height of its display screen is less than or equal to 1.25 inches (31.75 millimeters). For instance, some Casio brand scientific calculators are not allowed (FX-570ES, FX-570ES plus), among others.

6.6 ELETRONIC DEVICES

Electronic devices including smartphones, headphones, earphones, iPads, computers, laptops, etc., are NOT allowed to be used in exams and must be kept away from the desks of the examination rooms.

6.7 GRADING SCHEME

- – Two midterm exams: 25% each
  – Weekly assignments: 10%
  – Weekly quizzes: 15%
  – Final exam: 25%
- All letter grades will be assigned in accordance with the table of numeric to alphabetic conversions given below.

[90; 93) A-, [93; 97) A, [97; 100^{+}] A+
[80; 83) B-, [83; 87) B, [87;90) B+
[70; 73) C-, [73; 77) C, [77;80) C+
[60; 63) D-, [63; 67) D, [67;70) D+
[0, 60) F.

7 IMPORTANT DATES

- Classes begin; Monday, August 21, 2023
- Labor Day: Monday, September 04, 2023
- Last Day to Drop a Class without a "W" Full Term Session: Wed., Sept. 6
- **Midterm Exam I**: Wednesday, October 04, 7:30 – 8:45 pm
- Mid-Term Grades Viewable Online: Saturday, October 14, 2023
- **Midterm Exam II**: Wednesday, November 08, 7:30 – 8:45 pm

- No classes: Monday, Nov. 20 – Sunday, Nov. 26
- Last Day of Classes Full Term Session: Thursday, Dec. 07
- **Final Exam**: 12/12/2023, Tuesday - 7:00PM - 9:45PM

8 TENTATIVE SCHEDULE

TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Aug 22nd **1** Sec. 1.1	23rd **2** Problem section (1.1)	24th **3** Sec. 1.2	25th **4** Problem section (1.1)
29th **5** Sec. 1.3 HW 1 (1.1) Due	30th **6** Problem section (1.2, 1.3)	31st **7** Sec. 1.4	Sep 1st **8** Problem section (1.2, 1.3)
5th **9** Sec. 2.1 HW 2 (1.2, 1.3) Due	6th **10** Problem section (1.4, 2.1)	7th **11** Sec. 2.2	8th **12** Problem section (1.4, 2.1)
12th **13** Sec. 2.3 HW 3 (1.4, 2.1) Due	13th **14** Problem section (2.2, 2.3)	14th **15** Sec. 2.4	15th **16** Problem section (2.2, 2.3)
19th **17** Sec. 2.5 HW 4 (2.2, 2.3) Due	20th **18** Problem section (2.4, 2.5)	21st **19** Sec. 3.1	22nd **20** Problem section (2.4, 2.5)
26th **21** Sec. 3.1 HW 5 (2.4, 2.5) Due	27th **22** Problem section (3.1)	28th **23** Sec. 3.2	29th **24** Problem section (3.1)
Oct 3rd **25** Sec. 3.3 Exam week - no HW Due	4th **26** Problem section (3.2, 3.3)	5th **27** Sec. 3.4	6th **28** Problem section (3.2, 3.3)

Tuesday	Wednesday	Thursday	Friday
10th **29** Sec. 3.5 HW 6 (3.1, 3.2, 3.3) Due	11th **30** Problem section (3.4, 3.5)	12th **31** Sec 4.1	13th **32** Problem section (3.4, 3.5)
17th **33** Sec. 4.2 HW 7 (3.4, 3.5) Due	18th **34** Problem section (4.1, 4.2)	19th **35** Sec 4.3	20th **36** Problem section (4.1, 4.2)
24th **37** Sec. 4.4 HW 8 (4.2, 4.3) Due	25th **38** Problem section (4.3, 4.4)	26th **39** Sec 5.1	27th **40** Problem section (4.3, 4.4)
31st **41** Sec. 5.2, HW 9 (4.3, 4.4) Due	Nov 1st **42** Problem section (5.1, 5.2)	2nd **43** Sec 5.3	3rd **44** Problem section (5.1, 5.2)
7th **45** Sec. 6.1 Exam week - no HW	8th **46** Problem section (5.3, 6.1)	9th **47** Sec 6.2	10th **48** Problem section (5.3, 6.1)
14th **49** Sec. 6.3 HW 10 (5.1, 5.2, 5.3, 6.1) Due	15th **50** Problem section (6.2, 6.3)	16th **51** Additional lecture for Ch. 6	17th **52** Problem section (6.2, 6.3)
21st **53** Break	22nd **54** Break	23rd **55** Break	24th **56** Break
28th **57** Sec. 7.1 HW 11 (6.2, 6.3) Due	29th **58** Problem section (6.3, 7.1)	30th **59** Sec. 7.1	Dec 1st **60** Problem section (6.3, 7.1)

Tuesday	Wednesday	Thursday	Friday
	6th **62**	7th **63**	8th **64**
5th **61** Review HW 12 (6.3, 7.1) Due	Problem section (6.3, 7.1) - No quiz	Review	No class

The *UT Dallas Syllabus Policies and Procedures:*

`http://go.utdallas.edu/syllabus-policies`

Sharing Confidential Information

Students considering sharing personal information in email, in person, or within assignments or exams should be aware that faculty members and teaching/research assistants are required by UT Dallas policy to report information about sexual misconduct to the UT Dallas Title IX Coordinator. Per university policy, faculty have been informed that they must identify the student to the UT Dallas Title IX Coordinator. Students who wish to have confidential discussions of incidents related to sexual harassment or sexual misconduct should contact the Student Counseling Center (972-883-2527 or after hours 972-UTD-TALK or 972-883-8255), the Women's Center (972-883-8255), a health care provider in the Student Health Center (972-883-2747), the clergyperson (or other legally recognized religious advisor) of their choice, or an off-campus resource (i.e., rape crisis center, doctor, psychologist). Students who are sexually assaulted, harassed, or victims of sexual misconduct, domestic violence, or stalking, are encouraged to directly report these incidents to the UT Dallas Police Department at 972-883-2222 or to the Title IX Coordinator at 972-883-2218. Additional information and resources may be found at http://www.utdallas.edu/oiec/title-ix/resources.

Campus Carry

The University's concealed handgun policy is posted on the campus carry website: https://www.utdallas.edu

Technical Support

If you experience any problems with your UTD account you may send an email to:

`assist@utdallas.edu` or call the UTD Helpdesk at 972 883-2911.

Field Trip Policies, Off-Campus Instruction and Course Activities

Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at

`http://www.utdallas.edu/administration/risk/travel.php5`

Additional information is available from the office of the school dean.

Student Conduct & Discipline

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UT Dallas printed publication, A to Z Guide, which is available to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the Rules and Regulations, Series 50000, Board of Regents, The University of Texas System, and in Title V, Rules on Student Services and Activities of the university's Handbook of Operating Procedures. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391) and online at

`http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html`

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

[Added July 2010] Students are expected to be attentive during class and to participate actively in group activities. Students are expected to listen respectfully to faculty and to other students who are speaking. Racism, sexism, homophobia, classism, ageism, and other forms of bigotry are inappropriate to express in class. Classes may discuss issues that require sensitivity and maturity. Disruptive students will be asked to leave and may be subject to disciplinary action.

Academic integrity

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done

by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic Dishonesty: Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, submitting for credit any work or materials that are attributable in whole or in part to another person, taking an examination for another person, or any act designed to give unfair advantage to a student or the attempt to commit such acts.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source, is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of `turnitin.com`, which searches the web for possible plagiarism and is over 90% effective.

Copyright Notice

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted materials, including music and software. Copying, displaying, reproducing, or distributing copyrighted works may infringe upon the copyright owner's rights and such infringement is subject to appropriate disciplinary action as well as criminal penalties provided by federal law. Usage of such material is only appropriate when that usage constitutes "fair use" under the Copyright Act. As a UT Dallas student, you are required to follow the institution's copyright policy (UTDPP1043). For more information about the fair use exemption, see `http://copyright.lib.utexas.edu/copypol2.html`.

Email Use

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a students U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

Class Attendance

Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty. Attendance is strongly recommended.

Withdrawal from Class

The administration of this institution has set deadlines for withdrawal of any college level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

Student Grievance Procedures

Procedures for student grievances are found in university policy UTDSP5005

`http://policy.utdallas.edu/utdsp5005`

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originated.

Incomplete Grade Policy

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semesters end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of F.

Disability Services

It is the policy and practice of The University of Texas at Dallas to make reasonable accommodations for students with properly documented disabilities. However, written notification from the Office of Student AccessAbility (OSA) is required. If you are eligible to receive an accommodation and would like to request it for a course, please discuss it with an OSA staff member and allow at least one week's advanced notice. Students who have questions about receiving accommodations, or those who have, or think they may have, a disability (mobility, sensory, health, psychological, learning, etc.) are invited to contact the Office of Student AccessAbility for a confidential discussion.

The primary functions of the Office of Student AccessAbility are to provide:

1. academic accommodations for students with a documented permanent physical, mental or sensory disability
2. non-academic accommodations

3. resource and referral information and advocacy support as necessary and appropriate.

OSA is located in the Student Services Building, suite 3.200. They can be reached by phone at (972) 883-2098, or by email at `disabilityservice@utdallas.edu`.

Religious Holy Days

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

Avoiding Plagiarism

[Adapted from Duke University's guidelines for writers; added July 2010]

Take time to make careful choices among–and learn to use–the research tools available to you. You will probably find that your favorite web search engine is not adequate by itself for college-level research. Consult with your professor or a librarian. You may need to use specialized research tools, some of which may require learning new searching techniques.

Expect to make trips to the library. While you can access many of the library's resources from your home computer, you may find that you need to make several trips to use materials or research tools that are not accessible remotely. Of course, you will be seeking the best information, not settling for sources simply because they happen to be available online.

Allow time for gathering materials that are not available at UT Dallas. The InterLibrary Loan Office can borrow articles and books from other libraries, but this process takes additional time.

Allow time for reading, rereading, absorbing information, taking notes, synthesizing, and revising your research strategy or conducting additional research as new questions arise.

Sloppy note-taking increases the risk that you will unintentionally plagiarize. Unless you have taken note carefully, it may be hard to tell whether you copied certain passages exactly,

paraphrased them, or wrote them yourself. This is especially problematic when using electronic source materials, since they can so easily be copied and pasted into your own document.

Identify words that you copy directly from a source by placing quotation marks around them, typing them in a different color, or highlighting them. (Do this immediately as you are making your notes. Don't expect to remember days or weeks later what phrases you copied directly.) Make sure to indicate the exact beginning and end of the quoted passage. Copy the wording, punctuation and spelling exactly as it appears in the original.

Jot down the page number and author or title of the source each time you make a note, even if you are not quoting directly but are only paraphrasing.

Keep a working bibliography of your sources so that you can go back to them easily when it's time to double-check the accuracy of your notes. If you do this faithfully during the note-taking phase, you will have no trouble completing the "works cited" section of your paper later on.

Keep a research log. As you search databases and consult reference books, keep track of what search terms and databases you used and the call numbers and URLs of information sources. This will help if you need to refine your research strategy, locate a source a second time, or show your professor what works you consulted in the process of completing the project.

You must cite direct quotes.

You must cite paraphrases. Paraphrasing is rewriting a passage or block of text in your own words. If you paraphrase, you must still cite the original source of the idea.

You must cite ideas given to you in a conversation, in correspondence, or over email.

You must cite sayings or quotations that are not familiar, or facts that are not "common knowledge." However, it is not necessary to cite a source if you are repeating a well known quote or familiar proverb. Common knowledge is something that is widely known. For example, it is widely known that Bill Clinton served two terms as president; it would not be necessary to cite a source for this fact.

These types of sources should be cited as well. Printed sources: Books, parts of books, magazine or journal articles, newspaper articles, letters, diaries, public or private documents; Electronic sources: Web pages, articles from e-journals, newsgroup postings, graphics, email messages, software, databases; Images: Works of art, illustrations, cartoons, tables, charts, graphs; Recorded or spoken material: Course lectures, films, videos, TV or radio broadcasts, interviews, public speeches, conversations.

Resources to Help You Succeed

The **Student Success Center** offers a variety of services (PLTL, Peer Tutoring, etc) for Linear Algebra (Math 2418) students. The **Writing Center** offers a collaborative learning environment for one-to-one and small group assistance with general and advanced writing assignments and overall writing skills.

The **Peer Tutoring program** offers free tutoring assistance in multiple locations for many of the historically challenging undergraduate subjects at UT Dallas. Tutoring sessions, offered every weekday on a drop-in basis, are one-on-one or in a small group format.

The **Peer-Led Team Learning (PLTL)** program provides an active, engaged learning

experience for students who meet in small groups once a week with a Peer Leader who helps guide them through potentially difficult gateway course.

Supplemental Instruction (SI) provides free, peer-facilitated weekly study sessions for students taking historically difficult courses. SI sessions encourage active, collaborative learning based on critical thinking and transferable study skills.

The **Communication Lab (CommLab)** offers one-on-one and group consultations where you will gain practical feedback for improving oral and group presentations.

Success Coaching is available for individual student appointments to discuss study skills, time management, note taking, test taking and preparation, and other success strategies.

The Student Success Center's main office is located in the McDermott Library Building and can be contacted by calling 972-883-6707 or by sending an email to `ssc@utdallas.edu`.

These descriptions and timelines are subject to change at the discretion of the Professor.