In The Name of God, The Merciful, The Compassionate

CE282: Linear Algebra
Department of Computer Engineering
Sharif University of Technology
Spring 2024

Instructors

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Objective

To make the undergraduate students acquainted with the fundamental concepts of linear algebra and its application in computer science and engineering.

Course Description

This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The concepts of linear algebra are extremely useful in image processing, computer vision, data science, machine learning, bioinformatics, social networks, and neuroscience. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics.

References

Our main reference which we recommend you to read is [4, 2]. We are extremely grateful to the authors of [1, 3, 5, 6] for the benefit we got from them in compiling the program of this lesson.

[1] Stephen Boyd and Lieven Vandenberghe. *Introduction to Applied Linear Algebra – Vectors, Matrices, and Least Squares*. Cambridge University Press, 2018.

[2] Kenneth Hoffman and Ray A. Kunze. *Linear Algebra*. PHI Learning, 2004.

[3] Nathaniel Johnston. *Advanced Linear and Matrix Algebra*. Springer Nature, 2021.

[4] David C. Lay, Steven R. Lay, and Judi J. McDonald. *Linear Algebra and Its Applications*. Pearson, 2016.

[5] Gilbert Strang. *Introduction to Linear Algebra*. Wellesley-Cambridge Press, 2016.

[6] Gilbert Strang. *Linear Algebra and Learning From Data*. Wellesley-Cambridge Press, 2019.

Classes

The classes will be held in person on Sunday and Tuesday from 15:00 AM to 16:30 PM in Hall number 1. In special circumstances, virtual classes will be held on `https://vc.sharif.edu/ch/rabiee`. Schedule of the classes is available in the appendix. If a class is canceled by students, that class may be considered as completed in the continuation of the curriculum.

TA Classes

- Exams Exclusive classes: In particular, for each of the midterm and the final exam, a TA class will be held so that students can prepare adequately for the exam.

- Python workshops: For those students who are not familiar with Python and its related libraries, four workshop classes will be held to cover Python, NumPy and visualization libraries.

Teaching Assistants

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Exams

Students' learning will be assessed by a midterm and a final exam. These exams will be held on the following dates and students are required to participate in them. Note that the final exam is comprehensive.

- **Midterm 1**: 1403/01/23 09:00 (From the topics of sessions 1 to 10)
- **Midterm 2**: 1403/02/27 09:00 (With focus on the topics of sessions 11 to 17, Preliminaries from sessions 1 to 10 required)
- **Final Exam**: 1403/03/31 15:30 (Comprehensive)

Homework Assignments

Eight series of theoretical and four series of practical homework assignments will be released in this course. Each theoretical and practical assignment is graded from 0.75 points and 0.5 points, respectively. Assignments will be released on midnight of the day the last topic of the homework has been lectured. Students will have 10 days for theoretical and almost 20 days for practical assignments to submit answers in the Quera. Regarding *the late submission policy*, students are allowed to submit answers of the theoretical and practical assignments each with 3 days of delay. 16 days of delay will be ignored in way to minimize your loss. After that, 0.5% of the assignment grade will be subtracted for each hour of delay. Total delay for each series of assignments is the combined delay of theoretical and practical part. For example, one day of delay in the practical part and two days of delay in the theoretical part of an assignment will be considered as three days in ignoring that 16 days and subtracting that 0.5%. Delays will be calculated on a scale of hours.

Grading

Please note that grades will be calculated out of 21.

- **Homework Assignments**: 9 points, 0.75 points with extra for each theoretical and 0.5 point for each practical assignment

- **Midterm 1**: 3.5 points, 1403/01/23 09:00

- **Midterm 2**: 3.5 points, 1403/02/27 09:00

- **Final Exam**: 5 points, 1403/03/31 15:30

Statement on Collaboration, Academic Honesty, and Plagiarism

We encourage working together whenever possible on homework, working problems in tutorials, and discussing and interpreting reading assignments. Talking about the course material is a great way to learn. Regarding homework, the following is a fruitful (and acceptable) form of collaboration; discuss with your classmates possible approaches to solving the problems, and then have each one fill in the details and write her/his own solution *independently*. At the top of each homework you turn in, we expect you to briefly list all sources of information you used, except known course materials like Text Book, Lectures, etc. A brief note such as "Did homework with ABC and ACB in study group" or "Looked at old solution for Problem 4" would be sufficient. Besides the morality issues, it will help TAs on grading your hand outs. There will be a zero tolerance policy for Cheating/Copying HW's. The first time you are caught, you will receive a -100% of grade for the task at hand. If you are caught for a second time, you will fail the course. Refer to the Education Committee's statement on homework etiquette.

Feedback

We would be grateful if you could send us your valuable feedback. You can contact instructors or even TAs via email. You can also use this google form (`https://forms.gle/FU9gjMXh65c6fyLr5`) to send your feedback anonymously to instructors.

Course Pages

- Jabrekh, `https://jabrekh.github.io/`: This is the main page of our course and all exercises, slides and course resources will be placed in it.

- Quera, `https://quera.org/course/16599/`, Password: `LA#1403#Spring`: Delivery of exercises and announcements will be done entirely through Quera. Make sure you enter an email on Quera that you check regularly. Your questions from the exercises will also be answered in Quera.

Class Schedule

Date	Title	Instructor	Description	Homework
1402/11/15	S01	HRR	Course Overview and Introduction	
1402/11/17	S02	HRR	Linear Equations, Matrices	HW1
1402/11/21	Add/Drop			
1402/11/22	Holiday			
1402/11/24	S03	HRR	Row Reduction and Echelon Forms	HW1
1402/11/29	S04	HRR	Vector Space	HW1
1402/12/01	S05	HRR	Subspace	HW1
1402/12/06	Holiday			
1402/12/08	S06	HRR	Independence (Linear and Affine)	HW2
1402/12/13	S07	HRR	Bases, Dimension	HW2
1402/12/15	S08	HRR	Inner Product Space	HW2
1402/12/20	S09	MR	Euclidian Norm, Inequalities and Angle	HW3
1402/12/22	S10	MR	Orthogonality (Gram–Schmidt, etc.)	HW3
1402/12/27	S11	MR	Linear Transformation	HW3
1403/01/14	S12	MR	Linear Transformation(cont.)	HW4
1403/01/19	S13	MR	Change Basis	HW4
1403/01/21	S14	MR	Dimension and Rank	HW4
1403/01/23	Midterm1			
1403/01/26	S15	MR	Inverse	HW5
1403/01/28	S16	MR	Determinant	HW5
1403/02/02	S17	MR	Determinant(cont.)	HW5
1403/02/04	S18	MR	Norm Space	HW6
1403/02/09	S19	MR	Derivatives	HW6
1403/02/11	S20	MR	Least squares	HW6
1403/02/16	S21	MR	Least squares	HW6
1403/02/18	S22	HRR	Eigenvectors and Eigenvalues	HW7
1403/02/23	S23	HRR	Eigenvectors and Eigenvalues(cont.)	HW7
1403/02/25	S24	HRR	Matrix Factorization	HW7
1403/02/27	Midterm 2			
1403/02/29	Withdraw/Survey			
1403/02/30	S25	MR	Matrix Factorization(cont.)	HW7
1403/03/01	S26	MR	Symmetric Matrices and Quadratic Forms	HW8
1403/03/06	S27	MR	Diagonalization and Jordan form	HW8
1403/03/08	S28	MR	Singular Values and Singular Vectors	HW8
1403/03/13	Makeup Session			
1403/03/31	Final Exam			
1403/04/14	Grade Sumbission			

Important: Note that this schedule is tentative and may be affected by unforeseen circumstances.

TA Classes Schedule

Date	Title
1403/01/22	Midterm 1 9:00 AM
1403/02/26	Midterm 2 3:00 PM
1403/03/30	Final 3:30 PM

Important: Note that this schedule is tentative and may be affected by unforeseen circumstances.

Homework Assignments and the Final Project Schedule

Assignment	Release	Submission	Solution Release	
TH1	1402/12/01	1402/12/11	1402/12/14	10 Days
TH2	1402/12/15	1402/12/25	1402/12/28	10 Days
TH3	1402/12/27	1403/01/17	1403/01/20	20 Days
TH4	1403/01/21	1403/01/31	1403/02/03	10 Days
TH5	1403/02/02	1403/02/12	1403/02/15	10 Days
TH6	1403/02/16	1403/02/26	1403/02/29	10 Days
TH7	1403/02/30	1403/03/09	1403/03/12	10 Days
TH8	1403/03/13	1403/03/23	1403/03/25	10 Days
PR1	1402/12/15	1403/01/31	1403/02/03	45 Days
PR2	1403/01/21	1403/02/12	1403/02/15	22 Days
PR3	1403/02/16	1403/03/09	1403/03/12	24 Days
PR4	1403/03/13	1403/04/03	1403/04/06	21 Days

Important: Note that this schedule is tentative and may be affected by unforeseen circumstances.