In The Name of God, The Merciful, The Compassionate

CE282: Linear Algebra
Department of Computer Engineering
Sharif University of Technology
Fall 2023

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, bio-informatics, 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 [3]. We are extremely grateful to the authors of [1, 2, 4, 5] 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] Nathaniel Johnston. *Advanced Linear and Matrix Algebra.* Springer Nature, 2021.

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

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

[5] 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 13:30 AM to 15:00 PM in Hall number 3. 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

TA classes will be held in person on Wednesdays from 17:00 PM to 18:00 PM approximately every other weeks. Schedule of TA classes is available in the appendix.

- Problem solving classes: Classes to solve additional questions will be held approximately every other week during the semester.

- 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.

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**: 1402/08/25 9:00 AM (From the topics of sessions 1 to 9)

- **Midterm 2**: 1402/09/23 9:00 AM (With focus on the topics of sessions 10 to 17, Preliminaries from sessions 1 to 9 required)

- **Final Exam**: 1402/11/03 9:00 AM (Comprehensive)

Homework Assignments

Five series of homework assignments will be released in this course. Each series of assignments include a theoretical part and a practical part with grades of 1.1 points and 0.5 points, respectively. Assignments will be released on Friday midnight every two weeks. Students will have 14 days for both theoretical and practical part to submit answers in the Quera. Regarding *the late submission policy*, students are allowed to submit answers of the theoretical part and practical part 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. It's obvious that *submission after related TA class to that assignment is forbidden.*

Grading

Please note that grades will be calculated out of 21.

- **Homework Assignments**: 8 points, 1.1 points for each theoretical and 0.5 point for each practical assignment

- **Midterm 1**: 3.5 points, 1402/08/25 9:00 AM

- **Midterm 2**: 3.5 points, 1402/09/23 9:00 AM

- **Final Exam**: 5 points, 1402/11/03 9:00 AM

- **Final Project**: 1 point

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/fhSHAzm69MS8ncpA7`) 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/14555/`, Password: `LA#1402#Fall`: 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	Home Work
1402/07/04	S01	MR	Course Overview and Introduction	
1402/07/09	S02	MR	Vector Space and complexity	HW1
1402/07/11	National Holiday			
1402/07/16	Add/Drop			
1402/07/16	S03	MR	Subspace	HW1
1402/07/18	S04	MR	Row Reduction and Echelon Forms	HW1
1402/07/23	S05	MR	Linear Equations, Matrices	HW1
1402/07/25	S06	MR	Independence (Linear and Affine)	HW2
1402/07/30	S07	MR	Bases, Dimension	HW2
1402/08/02	S08	MR	Inner Product Space	HW2
1402/08/07	S09	MR	Orthogonality	HW2
1402/08/09	S10	MR	Linear Transformation	HW3
1402/08/14	S11	MR	Change Basis	HW3
1402/08/16	S12	MR	Linear and Affine Functions	HW3
1402/08/21	S13	MR	Dimension and Rank	HW3
1402/08/23	S14	MR	Inverse	HW3
1402/08/25	Midterm 1			
1402/08/28	S15	MR	QR Decomposition and Pseudo inverse	HW3
1402/08/30	S16	MR	Determinant	HW3
1402/09/05	S17	MR	Determinant	HW3
1402/09/07	S18	MR	Norm Space	HW4
1402/09/12	S19	MR	Tensor Derivatives	HW4
1402/09/14	S20	MR	Tensor Derivatives & Least squares	HW4
1402/09/19	S21	HRR	Least squares	HW4
1402/09/21	S22	HRR	Eigenvectors and Eigenvalues	HW4
1402/09/23	Midterm 2			
1402/09/26	National Holiday			
1402/09/28	S23	HRR	Matrix Factorization	HW5
1402/10/02	Evaluations start			
1402/10/03	S24	HRR	Symmetric Matrices and Quadratic Forms	HW5
1402/10/05	S25	HRR	Diagonalization and Jordan form	HW5
1402/10/10	S26	HRR	Singular Values and Singular Vectors	HW5
1402/10/12	Withdraw Deadline			
1402/10/12	S27	HRR	PCA	HW5
1402/10/17	Makeup Session		Graph and Network	
1402/10/19	Makeup Session			
1402/11/03	Final Exam			
1402/11/18	Grade Sumbission			

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

TA Classes Schedule

Date	Title
1402/07/26	HW1
1402/08/17	HW2
1402/08/24	Midterm 1
1402/09/15	HW3
1402/09/22	Midterm 2
1402/09/29	HW4
1402/10/20	HW5
1402/11/02	Final

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Homework Assignments and the Final Project Schedule

Assignment	Release	Submission	Solution Release	
1	1402/07/18	1402/08/05	1402/08/08	2 Weeks
2	1402/08/05	1402/08/19	1402/08/22	2 Weeks
3	1402/08/26	1402/09/17	1402/09/20	3 Weeks
4	1402/09/17	1402/10/01	1402/10/04	2 Weeks
5	1402/10/08	1402/10/22	1402/10/25	2 Weeks
Final Project	1402/09/24	1402/11/11		

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