CE282: Linear Algebra

Department of Computer Engineering
Sharif University of Technology
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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 [2] We are extremely grateful to the authors of [1], [3], [4] 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] David C. Lay, Steven R. Lay, and Judi J. McDonald. *Linear Algebra and Its Applications*. Pearson, 2016.

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

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

Classes

Due to executive order of *Ministry of Science, Research and Technology*, The classes will be held in person on Sunday and Tuesday from 10:30 AM to 12:00 PM in Ibn Sina A12. In special circumstances, virtual classes will be held on `https://vc.sharif.edu/ch/rabiee`. Schedule of the classes is available in the appendix.

TA Classes

TA classes will be held on Sunday from 12:00 to 12:50. In person classes will be held in CE101 and virtual classes will be held in `https://vc.sharif.edu/ch/rabiee-ta`. We have four kind of TA classes.

- Assignment solving classes: For each assignment, a TA class will be held to solve question in that assignment.
- 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 learn Python, NumPy, visualization libraries, and PyTorch.

Schedule of TA classes is available in the appendix.

Homework Assignments

Six series of homework assignments will be released in this course. The first five series of assignments include a theoretical part and a practical part with grades of 1.4 points and 0.3 points, respectively. The last series only includes a theoretical part with grade of 1.5 points. Assignments will be released on Tuesday midnight every two weeks. Students will have 12 days for the theoretical part and 14 days for the 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 with 5 days of delay. 15 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. Consider that grading of the theoretical part and practical part of an assignment is separated and delay in each of them will be calculated separately. 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 15 days and subtracting that 0.5%. In other words, you can consider the theoretical and practical parts as two separate assignments in grading. Delays will be calculated on a scale of hours. It's obvious that *submission after related TA class to that assignment is forbidden.*

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 Exam**: 1401/09/17 9:00 AM
- **Final Exam**: 1401/11/02 9:00 AM (Comprehensive)

Grading

Please note that grades will be calculated out of 22.

- **Homework Assignments**: 10 points, first five series with 1.4 points for theoretical questions and 0.3 points for practical questions, last series with 1.5 for theoretical questions.
- **Final Project**: 1 point
- **Midterm Exam**: 5 points, 1401/09/17 9:00 AM
- **Final Exam**: 6 points, 1401/11/02 9:00 AM (Comprehensive)

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/ktngLcnxRSeKtV1z8`) 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/11826/`: 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.
- Google Sheet, `https://bit.ly/3Dgam9l`: Grading of parts of the lesson will be done through this Google sheet.

Class Schedule

Date	Session	Instructor	Topic	HW
1401/06/27	1	MR	Introduction	HW1
1401/06/29	2	MR	Vector Space	
1401/07/03	*Holiday*		*Nationwide Holiday*	
1401/07/05	*Holiday*		*Nationwide Holiday*	
1401/07/10	3	MR	Vector Space	
1401/07/12	4	MR	Vector Space	
1401/07/17	5	MR	Linear Equations	HW2
1401/07/19	6	MR	Scaler-valued Functions	
1401/07/24	7	HRR	Independence	
1401/07/26	8	HRR	Independence	
1401/08/01	9	MR	Combinations	HW3
1401/08/03	10	MR	Euclidean Norm	
1401/08/08	11	MR	Norm Space	
1401/08/10	12	MR	Inner Product and Orthogonality	
1401/08/15	13	MR	Matrix Properties	HW4
1401/08/17	14	MR	Transformations	
1401/08/22	15	MR	Transformations	
1401/08/24	16	MR	Dimention and Rank	
1401/08/29	17	MR	Dimention and Rank (and Inverse)	
1401/09/01	18	MR	Inverse	HW5
1401/09/06	19	MR	Eigenvalue, Eigenvector, Diagonalization	
1401/09/08	20	MR	Matrix Inner Product and Norm; Derivatives	
1401/09/13	21	HRR	Determinant	
1401/09/15	22	HRR	Decomposion and Matrix Factorization	
1401/09/17	Midterm		Midterm	
1401/09/20	23	HRR	Symmetric Matrices and Quaratic Form	HW6
1401/09/22	24	HRR	Least Squares	
1401/09/27	25	HRR	Least Squares	
1401/09/29	26	MR	Singular Value and Singular Vector	
1401/10/04	27	MR	Principal Components and the Best Low Rank Matrix	
1401/10/06	*Holiday*		*Nationwide Holiday*	
1401/10/07	28 (Optional)	HRR/MR	Graph and Network	
1401/11/02	Final Exam		Final Exam	

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

TA Classes Schedule

Date	Topic
1401/07/10	Python Workshop: Introduction to Python, installation and elementaries
1401/07/17	Python Workshop: Python elementaries and numerical computation using NumPy
1401/07/24	Python Workshop: Pandas and Visualization
1401/08/01	HW1
1401/08/08	Extra
1401/08/15	HW2
1401/08/22	Extra
1401/08/29	HW3
1401/09/06	Extra
1401/09/13	Midterm Exclusive
1401/09/20	HW4
1401/09/23	Python Workshop: PyTorch, will be held on Wednesday
1401/09/27	Extra
1401/10/04	HW5
1401/10/11	Extra
1401/10/18	HW6
1401/11/01	Final Exclusive

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

Homework Assignments and the Final Project Schedule

Assignment	Release Date	Theoretical Deadline	Practical Deadline	TA Class
HW1	1401/07/12	1401/07/23	1401/07/25	1401/08/01
HW2	1401/07/26	1401/08/07	1401/08/09	1401/08/15
HW3	1401/08/10	1401/08/21	1401/08/23	1401/08/29
HW4	1401/08/24	1401/09/05	1401/09/07	1401/09/20
HW5	1401/09/15	1401/09/26	1401/09/28	1401/10/04
HW6	1401/09/29	1401/10/10	1401/10/12	1401/10/18
Project	1401/09/29	–	1401/11/08	–

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