Linear Algebra 1 (E) Syllabus

Yilong Yang

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1 Admin Info

Class Name: Linear Algebra 1 (E)
Class Time: MW 19:20-20:55
Class Location: 6A211
Instructor: Yilong Yang (YMSC)
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Office: Jinchunyuan West 137
Office Hours: W 4PM-6PM
TA: Roby Simon
TA Email: roby@mail.tsinghua.edu.cn
TA Office: TBD
TA Office Hour: TBD
Discussion Session Time: TBD
Discussion Session Location: TBD
Class Wechat Group: TBD

2 Content of Class

Textbook:
[P] My past lecture notes, but now come in a book format somewhat....
Optional Textbook:
[LTY] Chinese textbook. I am one of the author, and it is designed with heavy engineering focus. (University bookstore)

[GS] Gilbert Strang, Introduction to Linear Algebra 5th edition. The linear algebra textbook used in MIT. Solid and very flavorful in its exposition. (University bookstore)

[ST] Sergei Treil, Linear Algebra Done Wrong. The linear algebra textbook used in Brown University for honor linear algebra class, and the one I used when I was a freshman. (Author made it free online)
Content Structure:
We shall mostly follow the book [P], chapter 1 through 7. However, I reserve the right to occasionally do things a bit different.
Important Resources:
Gilbert Strang has an online open course. This is a GREAT resource. But listening to all of them could be time consuming. If you are busy and you understand everything in class, you probably don't need to see this. If you have some free time, it is certainly nice to check this out.

Another fun thing to check out is 3Blue1Brown, a mathematical video content creator online. They have all kinds of videos on YouTube (and maybe bilibili?). They have a special series devoted just for linear algebra. Their stuff is always fun to check out.

I also HIGHLY recommend you to come to my office hour and/or the TA's office hour weekly or at least biweekly. I welcome you to come to even ask for hints about HW.

Discussion sessions should be important. Ideally the lectures should focus more on theories and ideas, and the discussion sessions should focus on computational techniques and details. Let me know if you find them to be uninteresting or if you have any suggestions for them.

Alternative Textbooks:

(We don't need any of this, but if you want to compare perspectives you can check them out.)

Sheldon Axler, Linear Algebra Done Right. (Classic book, great and insightful, but a bit too abstract for some people.)

David Lay, Steven Lay and Judi McDonald, Linear Algebra and Its Applications. (Standard linear algebra textbook in many US universities. Very standard. Not a bad book at all, but I prefer to read something with more personality.)

Yizhong Lan Textbook. (Peking University linear algebra textbook. A good textbook in Chinese.)

Linear Algebra Wikibook. (Surprisingly fun and informative sometimes, for something free and open online.)

3   Grading

30% Homework, 30% Midterm, 40% Final.

Homework: The homeworks should usually due weekly. Tries to write in english, but we do not really test your english ability, and it is totally fine if you let slide some Chinese if you are really struggling to express yourself.

All answers must be supplimented with proofs unless specifically told not to. Proofs need not to be rigiorous, but it is your job to make your reasoning clear to the grader. The grader should not be banging his/her head trying to decipher your logic. You are welcome to come to me or the TA for grading disputes.

As far as deadlines go, I'm usually easygoing, but I reserve the right to refuse any late submission.

Midterm: You take it home, you do it for one week or maybe two weeks (depending on the difficulty), and you hand them back. Sort of like a glorified homework, but you must hand them in on time. The problems will of course be very hard. You will likely lose some hair.

Final: The final is a traditional open-book in-class final exam. Sometimes the university do not assign standard final exam times for "special" classes such as ours. If the University do to assign us any dates, then we shall have the final on our last class, tentatively 7PM-10PM. It will be significantly easier and more standardized than the Midterm. I will try to imitate a traditional MIT style final. You may check MIT website for their many many past finals for practice.

Collaboration:

I think stress is detrimental to all learning endeavor, and competition is meaningless in a classroom setting since all of us have the same goal, to learn. As a general principle, I encourage collaboration of all sorts.

Ideally, I hope that you look at the problems as soon as I put them up, and think independently at first. You do NOT need to do them right away. Look them first, think a little bit, and maybe sleep on them for a day or two. As you can see from the grading policy, I tried my best to minimize your stress, so you can take your time and think them through. Some problems are DESIGNED so that you might need a few days to solve. After a day or two, if the answer still eludes you, feel free to ask your classmates for collaboration.

I encourage collaborations on homeworks, projects and even the takehome midterm. However, you must obey the following rule:

1. You MUST each hand in your own work individially in your own words.

2. You MUST understand everything you wrote. (Say you copied your friend's WRONG answer without thinking, and that will most likely be in violation of this rule.)

3. You need to write down the names of your collaborator.

4. Failure to comply rule 2 and rule 3 will be treated as plagiarism.

5. Collaboration with people not in this class (such as a math grad student) is not forbidden but not recommended. If you choose to, then write down their names as well.

4 Classroom Policy

1. You are allowed to sleep, eat, drink during class as long as no other classmate objects to it. (Unless a school official come to observe. Then please be on your best behavior wink wink wink.)

2. We do not record attendance, but coming to class is obviously highly recommended, especially since I do extra stuff all the time and they might be tested.

3. You may speak or interrupt me without raising your hand at all time during class. If my writing, speaking or explaining confuses you somehow, it is very admirable of you to speak up about it.

4. Respect your classmates. Which means turn your phone to vibrate in class; admire them rather than judge them when your classmates ask questions in class; and when asked to collaborate, assume that they are competent and want to learn, and explain and discuss patiently with them. Do not insult your classmate by just throwing your answers to them, as if they are not worthy of your time, or as if they are hopelessly stupid to figure things out.

5 Tentative Schedule

Preliminaries:
1 Introduction (1.1 and 1.2)
2 Maps, Projections, Dot products, Hyperplanes (2.1 and 2.2)
3 Row and Column View of a Linear System (2.3 and 2.4)

Matrices:
4 Uniqueness of RREF, Composition of Linear Maps (2.5 and 3.1.1)
5 Row Columns Entries of a matrix, Linear comb of matrices (3.1.2, 3.1.3 and 3.1.4)
6 Transpose, Elementary matrices, Inverse matrix (3.1.5, 3.2.1 and 3.2.2)
7 Block matrices (3.2.3, 3.3.1, 3.3.2, 3.3.3)
8 Wrap up LU decomposition (3.3.4, 3.3.5 and 3.3.6)

Vector Spaces:
9 Abstract Vector Space (4.1-4.3)
10 Basis and Entries (4.4, 4.5)
11 Rank-Nullity (4.6)

Inner Product Spaces:
12 FTLA (5.1)
13 Inner Product Space (5.2)
14 Gram Matrices (5.3)
15 Orthonormal Basis and Orthogonal Matrices (5.4)
16 Gram-Schmidt Orthogonalization and QR decomposition (5.6)
17 Projection and Applications (5.7)

Determinants
18 Definition of Determinants (6.1-6.3)
19 Big formula of Determinants (6.4)
20 Applications of Determinants (6.5)

Eigenstuff:
21 Eigen-algebra (7.1-7.3)
22 Eigen-geometry (7.5)
23 Applications of Eigenstuff (7.11)
24 Schur Decomposition (7.6-7.7)
25 Spectral Theorem (7.12)
26 Singular Value Decomposition (7.13.1=3)
27 Applications of SVD (7.13.4-5)

Symmetric bilinear maps
28 Bilinear Map and Law of Innertia (7.14)
29 Classification of quadratic surfaces (7.14)
30 Final Exam or Random Stuff