MATH 220, Section 1

Linear Algebra, Spring 2024

Course specification

Laurence Barker, Bilkent University. Version: 6 March 2024.

Classes: Tuesdays 15:30 - 17:20, Fridays 10:30 - 11:20, room SA-Z01.

Office Hours: Fridays 11:30 - 12:20, my office, SA-129.

For all students, those doing well and aiming for an A, those doing badly and aiming for a C, Office Hours is an opportunity to come and ask questions.

Instructor: Laurence Barker, Office SA 129, barker at fen nokta bilkent nokta edu nokta tr.

Assistant: To be announced.

Course Texts: The primary course text is:

> Bernard Kolman, David R. Hill, "Elementary Linear Algebra with Applications",
> 9th Edition, New International Edition, (Pearson 2014).

Since there is no formally assessed homework, and since suggested exercises will be separate from the textbook, any other edition of the above will do, or indeed any similar kind of textbook on the subject.

In fact, the internet has a vast supply of text and videos on the material convered. If this course is only peripheral to your main interests, I can understand why you might wish to focus mainly on the textbook. But, of course, at a proficient level, full academic study does involve consultation of multiple sources, along with all the trouble which that entails: dealing with different notations, different terminology, different versions of the propositions and so on.

Supplementary material: Further texts supporting the course will be, from time to time, uploaded and updated on my university homepage (which is avaliable from the department webpages or, more quickly, by googling my name).

Syllabus: *Below is a tentative course schedule.* The format of the following details is *Week number: Monday date: Subtopics (Section numbers).*

1: 29 Jan: Systems of linear equations, matrices 1.1 - 1.5.

2: 5 Feb: Echelon form of a matrix, nonsingular matrices 2.1 - 2.3.

3: 12 Feb: Elementary matrices 2.3 - 2.4.

4: 19 Feb: Determinants 3.1 - 3.2.

5: 26 Feb: Inversion of matrices by Gauss–Jordan method and by method of minors and cofactors 3.3 - 3.5.

6: 4 Mar: *No class on Friday.* Vector spaces, subspaces 4.1 - 4.4.

7: 11 Mar: Linear independence, basis, dimension 4.5 - 4.6.

8: 18 Mar: Coordinates, homogenous systems 4.7 - 4.8.

9: 25 Mar: Rank of a matrix 4.9. Standard inner product 5.1 - 5.2.

10: 1 Apr: Inner product spaces, Gram–Schmidt process 5.3 - 5.4.

8 Apr: Feast of Ramadan.

11: 15 Apr: Orthogonal complement 5.5, Linear transfomrations 6.1.

12: 22 Apr: *No class on Tuesday.* Kernal and range of a matrix 6.2 - 6.3. Similarity 6.5.

13: 29 Apr: Diagonalization, eigenvalues and eigenvectors 7.1 - 7.3.

14: 6 May: Applications, catching up.

15: 13 May: Review.

Assessment:

• Midterm, 40%. Tuesday 12 March, 18:00 - 20:00, B-114.
• Final, 40%. Time and location to be announced.
• Quizzes, 20%.

A Midterm score of least 20% (of the available Midterm marks) is needed to qualify to take the Final Exam, otherwise an FZ grade will be awarded.

75% attendance is compulsory.

Asking questions in class is very helpful. It makes the classes come alive, and it often improves my sense of how to pitch the material. The rule for talking in class is: if you speak, then you must speak to everyone in the room.

Midterm syllabus:

• Systems of linear equations. Gaussian elimination and Gauss–Jordan elimination, expressed in terms of row operations on matrices. *Given, say,* 4 *particular linear equations in* 5 *variables, can you find all the solutions using those two methods?*

• Calculating determinants using row and column operations. Finding the inverse of a matrix by Gauss–Jordan elimination and by the method of minors and cofactors. *Given some particular* 3×3 *invertible matrix, can you find the inverse by both of those methods?*

• Vector spaces and subspaces. Spanning sets, linear independence, bases and dimension. The vector space P_n of polynomial functions $\mathbb{R} \to \mathbb{R}$ with degree at most n. *Do you understand why* $\dim(P_n) = n + 1$*? Given some abstractly defined subspace of* P_n*, can you find a basis for the subspace?*

• The image $\mathrm{im}(A)$ and kernel $\ker(A)$ of a matrix A. The rank $\mathrm{rank}(A) = \dim(\mathrm{im}(A))$ and the nullity $\mathrm{null}(A) = \dim(\mathrm{null}(A))$. *Given some particular* 4×4*-matrix, can you find a basis for the image and a basis for the null space? Can you find the rank and nullity?*