

Maths 1111: Linear Algebra I
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Office hours: Monday 10.00–11.00

1. Linear algebra in 2d and 3d. Vectors. Dot and cross products. Quaternions.
2. Systems of simultaneous linear equations. Gauss–Jordan elimination.
3. (Reduced) row echelon form for a rectangular matrix. Principal and free variables. Matrix product and row operations. Computing the inverse matrix using row operations.
4. Permutations. Odd and even permutations. Determinants. Row and column operations on determinants. $\det(A^T) = \det(A)$.
5. Minors. Cofactors. Adjoint matrix. Computing the inverse matrix using determinants. Cramer’s rule for systems with the same number of equations and unknowns.
6. Fredholm’s alternative. An application: the discrete Dirichlet’s problem.
7. Coordinate vector space. Linear independence and completeness.
8. Fields: rationals, reals, and complex. Abstract vector spaces. Linear independence and completeness in abstract vector spaces. Bases and dimensions. Subspaces.
9. Linear operators. Matrix of a linear operator relative to given bases. Change of basis. Transition matrices. Similar matrices define the same linear operator in different bases. Example: a closed formula for Fibonacci numbers.

Homework assignments

Homework assignments will be handed out in class every week. Besides just obtaining answers to questions, you are supposed to justify your answers (in particular, every “yes/no” question also assumes the “why” question). Homeworks are due to hand in after Tuesday’s classes; on the same evening solutions shall be posted on the course webpage, so late assignments are not accepted.

Assessment

Exam in the end of the year plus the continuous assessment.

The final mark is $100\% \times \text{final exam mark}$ or $80\% \times \text{final exam mark} + 20\% \times \text{continuous assessment mark}$, whichever is higher. This does not mean that you should hope to pass the final exam without investing time and effort in home assignments; home assignments are a primary source of training for the exam, and statistical data from previous years show a strong correlation between the continuous assessment and final exam results.

Reading suggestions

There will be no lecture notes for this course, so you are encouraged to take notes during the lectures — it takes effort but is really helpful. There are many books which you might find helpful, though they do not correspond exactly to the course content and the order of presentation of topics. The main textbook that will assist you with this half of the linear algebra course outside the classroom is *Elementary Linear Algebra (applications version)* by Anton and Rorres. Some topics closer to the end of the course are covered better by *Lectures on Linear Algebra* by Gelfand. You are also encouraged

to attempt problems from *Linear Algebra Problem Book* by Paul Halmos (but do realise that some of these problems are quite difficult, and often much more difficult than typical exam questions).

Online versions of Gelfand's and Halmos's books are available on Google Books via the links

<http://www.tinyurl.com/gelfand-linalg>

and

<http://www.tinyurl.com/halmos-linalg>

respectively. There are also several hard copies of the Gelfand's book owned by the School of Maths available to borrow from my office.

Web page

Homework assignments, selected solutions, various handouts and announcements will be posted on the course web page

<http://www.maths.tcd.ie/~vdots/indexLinearAlgebra.html>