

Linear Algebra 2010 Fall Course Outline

Lecturer: Yung-Fu Fang 方永富

Office: Math Building room 210

Office Phone: (06)275-7575 ext 65131

Email Address: fang@math.ncku.edu.tw

URL: <http://www.math.ncku.edu.tw/~fang>

Lecture: Tue 09:10 -11:00, Fri 10:10 - 12:00

Classroom: Math Department 3172

Office Hours: Tue, Fri: 12:10 – 13:00, Plus Appointments

TextBook: Linear Algebra (4th edition) by S. Friedberg, A. Insel, and L. Spence

First Semester:

1: Vectors Spaces

2: Linear Transformations and Matrices

3: Elementary Matrix Operations and Systems of Linear Equations

4: Determinants

Second Semester:

5: Diagonalization

6: Inner Product Spaces

7: Canonical Forms

Grading: Homework: 27% (5n+1) Midterm : 30% Final: 40% TA: 3%

TA: 博士班 林宗澤, Discussion Hour: Thu ???, Office Hour: ???

Remarks: Homework will be collected periodically in the class. Knowledge of using Fortran, or MatLab, or Maple, or Mathematica will be useful. Wish you have a successful semester!

Introduction of Linear Algebra Course

The equations $Ax = b$ uses that language right away. The matrix A times any vector x is a combination of the columns of A . The equation is asking for a combination that produces b . Our solution comes at three levels and they are all important;

1. Direct solution, by forward elimination and back substitution.
2. Matrix solution, $x = A^{-1}b$ by inverting the matrix.
3. Vector space solution, by looking at the column space and nullspace of A .

There is another possibility: $Ax = b$ may have no solution. Elimination may lead to $0=1$. The matrix approach may fail to find A^{-1} . The vector space approach can look at all combinations Ax of the columns, but b might be outside that column space.

Another part is learning to visualize vectors. A vector v with two components is not hard. A second vector w may be perpendicular to v . If those vectors have six components, we can't draw them but our imagination keeps trying. In six dimensional space, we can test quickly for a right angle. It is easy to visualize $2v$ and $\frac{1}{2}w$. We can almost see a combination like $2v + \frac{1}{2}w$. Most important is the effort to imagine all the combinations $cv + dw$. They fill a "two-dimensional plane" inside the six-dimensional space. Linear algebra works easily with vectors and matrices of any size. If we have prices for six products, or just position and velocity of an airplane, we are dealing with six dimensions. For image processing or web searches (or the human genome), six might change to a million. It is still linear algebra, linear combinations still hold the key.