Linear Algebra Course Outline

Lecturer: Yung-Fu Fang  
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Lecture: Mon 09:10 -11:00, Wed 09:10 - 10:00  
Office Hours: Tue Wed Fri: 12:10 – 13:00  
Classroom: Math Department 3172  


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: ???, 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¡1b 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 ¡w. We can almost see a combination like 2v ¡ 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.