

## **Numerical Linear Algebra**

Applied and Comp Math 920

Section: G200

Term: 2010 Fall

Instructor: Bob Russell

Discussion Topics:

### 1. FUNDAMENTALS

Matrix-Vector Multiplication  
Orthogonal Vectors and Matrices  
Norms  
The Singular Value Decomposition

### II. QR FACTORIZATION AND LEAST SQUARES

Projectors  
QR factorization  
Gram-Schmidt Orthogonalization

### III. CONDITIONING AND STABILITY

Conditioning and Condition Numbers  
Stability and Floating Point  
Arithmetic  
Backward Stability of QR  
Factorization  
Conditioning of Least Squares  
Problems  
Stability of Least Squares  
Algorithms

### IV. SYSTEMS OF EQUATIONS

Gaussian Elimination  
Pivoting  
Stability of Gaussian Elimination  
Cholesky Factorization

### V. EIGENVALUES

Eigenvalue Problem  
Overview of Eigenvalue Algorithms  
Reduction to Hessenberg/Tridiagonal  
Form  
Rayleigh Quotient, Power Iteration,

## **Numerical Linear Algebra**

Inverse Iteration  
QR Algorithm  
Other Eigenvalue Algorithms  
Computing the SVD

### VI. ITERATIVE METHODS

Overview of Iterative Methods  
The Arnoldi Iteration  
How Arnoldi Locates Eigenvalues  
GMRES  
The Lanczos Iteration  
Conjugate Gradients

Grading:

Homework 50%, Midterm 20%, Final  
Exam 30%

Required Texts:

D. Bau & L.N. Trefethen, Numerical Linear  
Algebra, SIAM (1997).

Recommended Texts:

Materials/Supplies:

Prerequisite/Corequisite:

## Numerical Linear Algebra

Graduate Student standing or permission  
of Instructor

Notes: \x09THE INSTRUCTOR RESERVES THE RIGHT TO CHANGE ANY OF THE ABOVE  
INFORMATION.

Students should be aware that they have certain rights to confidentiality concerning the return of course papers and the posting of marks. Please pay careful attention to the options discussed in class at the beginning of the semester.

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