Linear algebra and its applications

Syllabus

1 Course outline

- Matrix norms, Rayleigh quotient, conditioning of a problem, floating point arithmetic, backward and forward stability of an algorithm;
- Direct and iterative methods for solving a linear system of equations: Gaussian elimination, LU factorization, stability of GE, Cholesky method, QR factorization, Householder's matrices, Jacobi's method, Gauss-Seidel method, successive over-relaxation methods (SOR);
- Eigenvalue-eigenvector methods: conditioning of eigenvalue methods, methods based on reduction to Hessenberg or tridiagonal forms (Arnoldi, Gram-Schmidt), power iteration, inverse iteration, QR iteration, Rayleigh quotient iteration, Jacobi's method, bisection method, divide-and-conquer, Krylov subspace methods;
- Singular value problems: Computing the SVD, elements of PCA;
- Least squares problems: normal equations, QR, SVD, solving rank-deficit least squares problems using SVD and QR.

Texts and references:

1. Numerical linear algebra - Trefethen and Bau
2. Applied numerical linear algebra - James Demmel
3. Linear algebra and learning from data - Gilbert Strang
4. Matrix computations: Golub and Loan (the most authoritative reference on numerical linear algebra)

2 Grading scheme

40%	homework
15%	project and presentation
15%	3 quizzes (on 18th of each month, Feb-April)
30%	final exam