Spring 2010

MA/CS 622 Matrix Theory and Numerical Linear Algebra II.

MWF 02:00-02:50

Instructor: Dr. Qiang Ye
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Syllabus: In this course, we study sparse matrix techniques and modern iterative methods and Krylov subspace projection methods for solving large sparse linear algebra problems such as linear systems of equations and matrix eigenvalue problems. The course emphasizes mathematical analysis of vector iterations and subspace projections with respect to convergence and speed of convergence. Among the topics to be covered are a model large matrix problem arising in finite difference discretization of partial differential equations, sparse matrix techniques, derivation and convergence analysis of both classical iterative methods and the Krylov subspace projection methods, and preconditioning techniques for accelerating convergence. The following is a detailed list of topics.

- Introduction to sparse matrix techniques;
- Iterative methods for large sparse systems of linear equations:
  - — Finite difference methods for PDE,
  - — Jacobi, Gauss-Seidel, SOR, Chebyshev iterations, conjugate gradient (CG), BiCGSTAB and GMRES methods for nonsymmetric matrices
  - — preconditioning and ILU factorization
- Iterative methods for large sparse eigenvalue problems
  - — Lanczos Algorithm
  - — Arnoldi Algorithm

The course will be based on Chapters 6 and 7 of *Applied Numerical Linear Algebra* by James Demmel (SIAM, 1997), with supplementary materials taken from various references.

Prerequisites: Good knowledge of linear algebra at the level of MA322 or equivalent, programming experience, numerical sophistication at the level of MA/CS 321 or equivalent.

Please see the instructor for more information.