Math 471: Tentative Syllabus

Winter 2013

1. Convergence of algorithms.
    a. Rate of convergence.
    b. Order of convergence.
2. Nonlinear equations and root finding.
    a. Bisection method.
    b. Fixed point iterations and their convergence.
    c. Newton's method.
    d. Secant method.
    e. Accelerating convergence.
3. Linear systems of equations.
    a. Gaussian elimination: PALU decomposition.
    b. The Fast Fourier Transform.
    c. Classical iterative methods (Jacobi, Gauss-Seidel, SOR) and their convergence.
    d. Conjugate gradients.
    e. GMRES.
4. Eigenvalue problems.
    a. Power method.
    b. Inverse and shifted inverse iteration.
    c. Reduction to Hessenberg form.
    d. Simultaneous iteration.

5. Interpolation.
6. Numerical integration.
    a. Newton-Coates quadrature.
    b. Gaussian quadrature.
    c. Romberg integration.
7. Initial value problems for systems of ODEs.
    a. Euler's method.
    b. High order, one-step methods: Taylor methods.
    c. Runge-Kutta methods.
    d. Multistep methods.
    e. Convergence and stability analysis.
8. Two point boundary value problems: Finite differences.
9. The Poisson equation on rectangular domains.
10. Multigrid.