Numerical Methods II

Review for Final Exam

Friday, May 21, 2004, 11:00–13:00 in the Research II Lecture Hall

1. Gradient and Conjugate Gradient methods for nonlinear problems. Understand the following issues:

   - Which method converges better for quadratic functions (i.e. when you are effectively solving a system of linear equations) when the system is ill-conditioned?
   - Why may you need to "restart" the CG method in the nonlinear case?

   Look, in particular, at the results from Projects 4/5 on Homework 6.

2. Basic stochastic differential equations. Be able to do problems like Question 2 on Homework 8, or compute $\mathbb{E}[\exp(\mu W(t))]$.

3. Stability of numerical methods for ordinary differential equations. Think about idea of absolute stability in the context of stochastic differential equations. (Where do the equations on p. 541 of Higham's article come from?)

4. Linear boundary value problems, in particular the computation of the local truncation error.

5. Matrix eigenvalue problems: Know the technical tools (plane rotation matrices, Householder reflections, Frobenius norm and its invariance under orthogonal transformations), Jacobi method, QR method, Gershgorin theorem, QR decomposition of a tridiagonal matrix by plane rotations, inverse iteration, elementary perturbation analysis.

   Revise, in particular, explicitly performing a Householder reflection, or one step of the QR algorithm. There are many good examples in the book by Süli and Mayers.

6. Penalty method for optimization with constraints. Questions like on Homework 7 are possible.

Note: This list of topics is only a selection of what we covered this semester. Don't completely ignore topics that are not listed, in particular if you are ambitious to solve the extra-credit questions.