MA 571: Numerical Solution of Differential Equations

Spring 2007

MW 4:00—5:15 pm, SC 340

Instructor

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Office Hours

MWF 2:00—3:00 pm or by appointment

Textbook

John C. Strikwerda, Finite Difference Schemes and Partial Differential Equations
SIAM, 2004, ISBN 0898715679 (second edition)

Prerequisites

Undergraduate numerical methods course (such as MA 377) or the instructor's consent.
Some knowledge of differential equations and linear algebra together with basic computer programming skills will be required.

Course Outline

This course is an introduction to finite difference methods for solving partial differential equations. We begin by considering hyperbolic PDEs and introducing the fundamental concepts of stability, consistency and convergence and the related theory. Further, we discuss the order of accuracy and analyze some multistep finite difference schemes. Then we continue with discussion of parabolic PDEs, parabolic systems in higher dimensions and ADI methods. The last part of the course will focus on elliptic PDEs, regularity and maximum principle and efficient solving of the linear systems resulting from the finite difference discretizatons. Different linear iterative methods will be covered, as well as the optimal multigrid method. Additional topics, if time permits, may include introduction to finite element methods and domain decomposition.

Grading

The final grades will be determined by a weighted average score of the homework (50%), two hourly exams (15% each) and a final project (20%).

Homework

Homework problems will be assigned regularly in class. Some will be theoretical exercises from the text, others will include computer experimentation using e.g. Matlab. The computer projects' grading will be based not only on the numerical results but on your clearly presented analysis and conclusions.

Exams

There will be two hour-long exams, held during the regular lecture time, tentatively scheduled for February 19 and April 2.

Final Project

The final project will be computer-based and will be due by April 23. You may be asked to present your project results in class.