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REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 2000 Mathematics Subject Classification can be found in print starting with the 1999 annual index of *Mathematical Reviews*. The classifications are also accessible from `www.ams.org/msc/`.

5[35Q30, 65F10, 65M55, 65M60, 65N30, 65N55]—*Finite elements and fast iterative solvers: with applications in incompressible fluid dynamics*, by Howard Elman, David Silvester, and Andy Wathen, Numerical Mathematics and Scientific Computation, Oxford University Press, New York, 2005, xiii+400 pp., softcover, UK£35.00, ISBN 0-19-852868-X

The efficient numerical treatment of incompressible fluid dynamics is a formidable challenge in computational mathematics. To develop an efficient treatment, one needs to understand the basic equations of fluid dynamics; i.e., the Stokes and Navier–Stokes equations, together with the boundary conditions that give well-posedness. Next, for variational formulations, one needs a knowledge of finite element discretizations that are stable or finite element stabilization techniques, in order to generate accurate numerical solutions. Finally, one needs a grasp of fast iterative solution schemes, both linear and nonlinear, so that an overall efficient method can be constructed. To gain acquaintance with such a cutting-edge development, prior to the publication of this book, the main reference sources were technical journal articles on each of these treatment components. *Finite Elements and Fast Iterative Solvers: with Applications in Incompressible Fluid Dynamics*, by Elman, Silvester, and Wathen, now gives a thorough presentation of the state-of-the-art techniques in one volume.

The authors are acclaimed in this research field. Indeed, this book presents many of their own research results, but in a readable form accessible to a broad audience of both professionals and students of engineering, mathematics, and interdisciplinary computational science. The book is self-contained. Only basic knowledge of discretization methods for partial differential equations, fundamental functional analysis, and computational linear algebra are needed. Presentation of the basic partial differential equations underlying fluid dynamics, of finite element discretization, and of iterative linear system schemes start from the basics. The book then systematically progresses to more advanced theoretical and computational techniques for incompressible fluid dynamics. These advanced topics include continuous and discrete inf-sup stability and finite elements that satisfy them, stabilized finite element techniques and the patch-test to verify stability, Krylov iterative methods and the theory behind them, construction and justification of efficient preconditioners for the Stokes and Navier–Stokes equations, and a posteriori adaptive procedures. Even though these topics are often accessible only to experts in the field, the authors give a comprehendible yet thorough presentation, with concrete test-suite examples and appropriate analytical and computational exercises to give the reader a grasp of these concepts.

The book starts off with two chapters on the Poisson equation, the finite element discretization of it, and iterative linear system solvers for the discrete linear systems. The next two chapters then give a similar presentation for the convection-diffusion equations. With these two types of equations and the efficient numerical treatment of them, the book then turns to the Stokes equations. Stable and stabilized finite element techiques are described, and efficient preconditioners involving solutions of Poisson equations are justified. Finally, with all the necessary background from the earlier chapters, the last two chapters are directed to the Navier–Stokes equations. The authors acknowledge that research in the numerical treatment of these equations is still open, but describe cutting-edge methods. In particular, preconditioners based on the Poisson and convection-diffusion equations are described.

Each of the chapters ends with analytical and computational exercises, and the book ends with an exhaustive bibliography. Researchers and students alike will find this monograph very useful.

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6[60-01, 65C05, 68Qxx, 68W20]—*Probability and computing: randomized algorithms and probabilistic analysis*, by Michael Mitzenmacher and Eli Upfal, Cambridge University Press, Cambridge, 2005, xvi+352 pp., hardcover, US $55.00, ISBN 0-521-83540-2

Probabilistic algorithms are instrumental in dealing with hard problems arising in computer science and scientific computing. It is a subject to which advanced undergraduates and graduate students in computer science and applied mathematics should be exposed, and Mitzenmacher and Upfal are offering here a well-conceived textbook on which a suitable course on probabilistic algorithms can be based. The book assumes no prior familiarity with probability theory since all the necessary background from that area is developed *ab initio*, starting with the simple case of discrete probability spaces.

The book can be roughly divided into two parts, with the first seven chapters covering the core material that would suffice for a one-semester course. The remaining seven chapters present more advanced material that may also involve continuous probability and leads all the way to Markov chain Monte Carlo methods and martingales. Considerable emphasis is placed on bounds such as Chebyshev's inequality, Chernoff bounds, Hoeffding's inequality, and their applications to the analysis of probabilistic algorithms.

It is an attractive feature of the book that many concepts are motivated by examples and illustrated with probabilistic algorithms from computer science, among them packet routing, Quicksort, bucket sort, finding Hamiltonian cycles in random graphs, and algorithms in queueing theory. The analysis of these algorithms is carefully done and often accompanied by numerical examples. The book can be used for self-study since there are exercises in each chapter. However, one would have hoped for a more substantial bibliography. The list of references comprises only 15 items, all of them standard textbooks and monographs that were probably known to the reader before picking up this book.

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