territory in a pioneering way. Also it makes one realize where one would like to know more; thus, further reaching investigations will certainly be initiated by it.

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20[65F05, 65G05, 65F10, 65F35]—*Accuracy and stability of numerical algorithms*, by Nicholas J. Higham, SIAM, Philadelphia, PA, 1995, xxv + 688 pp., $23\frac{1}{2}$ cm, $39.00

Nick Higham is well-known for his contributions to error analysis and for his ability to communicate results that are necessarily full of intricate details. Only someone with his renowned writing skills could organize a work of this magnitude and still make it appealing. The book is close to 700 pages in length and is chock full of results, problems, and references.

Higham begins with four chapters that describe what life is like in the presence of roundoff error. A later chapter deals with software issues in floating point arithmetic and completes what I think is one of the best portrayals of finite precision arithmetic in the literature.

Chapters on polynomials, norms, and linear system perturbation theory set the stage for the analysis of $Ax = b$ algorithms, in many ways the real business of the book. Chapters on the LU, block LU, Cholesky, and QR factorizations are complemented by chapters that deal with related issues such as triangular system solving, iterative improvement, condition estimation, and matrix inversion.

Underdetermined systems and full rank least squares problems are also covered. By sticking to the full rank case, the singular value decomposition (SVD) can be avoided. Indeed, the SVD is relegated to a brief appendix and a few problems that are concerned with the pseudo-inverse. As Higham states in the preface, the treatment of singular value and eigenvalue computations requires a book in itself. I appreciate this point but still feel that the SVD should have been introduced as an analytical tool early in the book. It is just too powerful a decomposition to ignore in a major text like this that deals with numerical stability in matrix computations.

Other portions of the book reflect Higham's penchant for answering important stability questions. The reader interested in stationary iterative methods, matrix powers, the Sylvester equation, Vandermonde systems, and fast matrix multiplication will appreciate the author's treatment of these topics. A brief chapter on the FFT includes a nice proof of stability. New results for Newton interpolating polynomial evaluation, iterative refinement, Gauss-Jordan elimination, and the QR factorization are also included.

The overall style is perfect for the specialist who needs detail and rigor. But Higham's legendary expository skills also take care of the casual reader who needs intuition and a passing appreciation of the issues. Especially helpful in this regard are the "Notes and References" that appear at the end of each chapter. Higham is an extraordinary bibliophile and for every topic covered in this book you get the feeling that no stone is left unturned. There are over 1100 entries in the master bibliography and Higham's chapter-ending pointers into the literature are informative and impart a real historical sense.

Practitioners and experimentalists will enjoy several features of this book. There are many references to LAPACK, the software package of choice for solving most of the matrix problems given in the text. How to get software over the Internet and the author's MATLAB toolkit for test matrices are also discussed in the appendices.

There are over 200 problems in the volume and they resonate with the text very well. Except for the "research problems," solutions to the exercises can be found in a 50-page appendix. The book could be used as a text for advanced graduate-level courses in matrix computations. However, the main role that the book will assume in the coming years will be as a reference and as a companion text in the classroom. Wilkinson's *Algebraic Eigenvalue Problem* played a similar role in the 1970s and 1980s and I bet Higham's book will prove to be equally valuable in the long run.

The volume is laced with great quotations and my favorite is due to Beresford Parlett:

> One of the major difficulties in a practical [error] analysis is that of description. An ounce of analysis follows a pound of preparation.

No numerical analyst can change that ratio. But what Higham has shown is that this quote "scales up." With tons of preparation Higham has given us a hundred-weight of analysis—enough to keep the field on solid foundation for years to come.

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21[65N06, 65-04]—*Algorithms for elliptic problems: Efficient sequential and parallel solvers*, by Marián Vajteršic, Mathematics and Its Applications (East European Series), Vol. 58, Kluwer, Dordrecht, 1993, xviii + 292 pp., $24\frac{1}{2}$ cm, \$152.00/Dfl.240

This book presents a survey of fast numerical methods for elliptic partial differential equations. Chapters 1 and 2, forming the first of the two parts of the book, examine methods designed for sequential computers. Chapters 3 through 6, forming the second part of the book, consider extensions to parallel computers. While the title of the book implies a somewhat general treatment of the subject, the author deals mainly with the case of finite difference discretizations of linear second- and fourth-order elliptic equations with Dirichlet boundary conditions on the unit square in two dimensions. However, the treatment of this restricted set of topics is quite thorough. Each chapter begins with a resonably complete review of the related literature, as well as an entertaining historical overview. An extensive bibliography follows each chapter.

In Chapters 1 and 2, fast sequential methods for the Poisson and biharmonic equations are examined. Chapter 1 begins with direct methods based on the FFT, cyclic reduction, and marching algorithms. Suitable modifications for handling various boundary conditions are then discussed. The survey then moves to iterative methods, such as classical relaxation and multigrid methods. While the unit square domain is considered for most of the book, the first chapter ends with a discussion of the treatment of L-shaped, octagonal, and circular domains, again remaining in the finite-difference setting. Chapter 2 begins with direct methods for the biharmonic equation and concludes with methods for the biharmonic eigenvalue problem. The presentation in Chapter 2 includes direct methods (the Buzbee-Dorr