The authors' writing style is clear and crisp. There is an abundance of quotations, many of them from Leibnitz, but also from sources ranging from Aristotle to Hank Williams. While interesting and amusing, not all of them seem particularly relevant.

Although the authors' stated goal is to fuse mathematical modeling, analysis and computation, the emphasis is clearly on computation. The authors' experience in computation gives them a perspective on the subject that allows them to stress the important issues. Rather than offer simply a collection of methods, they have chosen to unify the text by focusing on a single method—the Galerkin method. However, this comes at a cost because some other very effective techniques, particularly for ordinary differential equations, are not even mentioned.

Interesting problems are inserted throughout the text instead of being gathered together at the end of sections. They are often smaller steps in the proofs of larger propositions. In addition there are many computational projects which may be done with a collection of finite element codes developed at Chalmers University of Technology, Sweden. They are available at no charge at the Chalmers website. The web address that worked for me, different from the one given in the book, is `http://www.md.chalmers.se/Math/Research/Femlab/`.

The text would be suitable for a student having had the usual three semesters of calculus, linear algebra, a course in ordinary differential equations, and some experience with numerical analysis. The first two parts of the book could be used for an advanced undergraduate course, but Part III is graduate level material.

Because of its very definite point of view, this book does not fit the mold of the standard numerical analysis text or of the standard numerical analysis course. However, it is provocative and should be taken seriously by all faculty, not just those in applied mathematics. It takes a fresh look at some of the standard topics in undergraduate analysis, and the ideas of the text could be used in many courses in analysis and computation. While not without its limitations, this book provides a vision of computation and analysis that may become a model for the future.

Jeffery Cooper
Department of Mathematics
University of Maryland
College Park, Maryland 20742

18[65-01, 65FXX]—*Applied numerical linear algebra*, by James W. Demmel, SIAM, Philadelphia, PA, 1997, xi+419 pp., $25\frac{1}{2}$ cm, softcover, \$45.00

This book is intended as a textbook in numerical linear algebra for first-year graduate students in a variety of engineering and scientific disciplines. In the preface the author gives a list of goals he was trying to meet. After stating his target audience, he goes on to write, "2. It should be self-contained, assuming only a good undergraduate backgound in linear algebra. 3. The students should learn the mathematical basis of the field, as well as how to build or find good numerical software. 4. Students should acquire a practical knowledge for solving real problems efficiently. In particular they should know what the state-of-the-art techniques are in each area...". Finally he writes, "5. It should all fit in one semester...".

This is a difficult undertaking. In my opinion the author has fallen short in certain ways, but the book is excellent nevertheless. It is clearly written, though somewhat demanding, and it is well organized.

All of the standard topics are there, including linear equation solving, linear least squares problems, nonsymmetric and symmetric eigenvalue problems, and the singular value decomposition. The perturbation theory associated with each of these topics is discussed. The basic computational tools are developed, and the algorithms are derived. Convergence and backward error analyses are supplied where needed. Sometimes rigorous convergence proofs are provided, but in other cases informal arguments are given instead.

A serious effort has been made to discuss every state-of-the-art algorithm in the core areas of numerical linear algebra. Not surprisingly, emphasis has been placed on those that have been included in LAPACK, to which Demmel has been a major contributor. Numerous pointers to LAPACK (and to Matlab and Templates) are included. Wherever two or more algorithms for the same problem are given, advice on which is best in which situations is also given.

A long chapter on iterative methods includes not only the standard SOR and conjugate gradient theories, but also material on fast Poisson solvers, multigrid, and domain decomposition.

The final chapter is on iterative methods for eigenvalue problems. The focus is on the Lanczos algorithm for symmetric matrices, but there is also a brief discussion of the nonsymmetric problem.

Several other features are worth mentioning. Interesting and illuminating applications are sprinkled throughout the text. The impact of modern cache-based computer architectures on algorithm design is discussed. Relative perturbation theory and high-accuracy algorithms are included. The author maintains a homepage for the book (`http://www.siam.org/books/demmel/demmel_class`), at which one finds a list of errata, Matlab source code for examples and problems, and numerous links to software libraries and various information sources.

The book contains a huge amount of information within 400 pages. It follows that the presentation must be fairly steep. Indeed, many details are left to the reader, usually with scant hints. Most students will find this book to be tough sledding.

It is also fair to say that the book contains much more than could be covered in a single semester. In the preface the author gives advice on what to include in a one-semester course. The amount of material listed there is far more than I would undertake.

One apsect of the book's organization displeased me. It is difficult to find one's way from the problems back to the appropriate place in the text. For example, Question 6.7 on page 358 asks the student to prove Lemma 6.7. The way the numbering scheme is set up, Lemma 6.7 could be anywhere in Chapter 6, which is 96 pages long. I located Figure 6.7, Theorem 6.7, Example 6.7, and Definition 6.7 before finally finding Lemma 6.7, which turns out to be a list of fundamental properties of Chebyshev polynomials on page 296. Looking further, I found an Algorithm 6.7 and a displayed equation (6.7). There are several things that could have been done to make navigation easier. The questions could have been placed at the ends of sections rather than gathered at the end of each chapter. There could have been fewer independent numbering schemes. For example, there could have been a common numbering scheme for definitions, theorems, lemmas, propositions, and algorithms. Also, items could have been numbered by chapter.section, not just by chapter.

On the positive side, the book has a detailed table of contents and an extensive index, so it should be easy to use as a reference book.

I can recommend this book as a text for a class of outstanding, well-prepared students. It is also an excellent, up-to-date reference for experts.

DAVID S. WATKINS
DEPARTMENT OF PURE AND APPLIED MATHEMATICS
WASHINGTON STATE UNIVERSITY
POLMAN, WASHINGTON 99164-3113

19[65D25]— *Computational differentiation techniques, applicatitons, and tools*, Martin Berg, Christian Bischof, George Corliss, and Andreas Griewank (editors), SIAM, Philadelphia, PA, 1996, xv+421 pp., 25 cm, softcover, $65.00

This is one of the most interesting mathematical books that I have had in my hands for a long time. Its editors have strived to illuminate the ideas and the potential of computational differentiation by assembling a total of 36 contributions from nearly as many authors: each of them points a beam of light on the subject from a special direction, and the fascinating result is the appearance of a rather comprehensive image of this fast-growing, important area of scientific computing. Naturally, this also testifies to the skill of the organizers of the workshop in inviting the right people.

It is impossible to give credit to the individual contributions. Someone having a basic acquaintance with computational differentiation (this slightly wider notion has replaced the original term "automatic differentiation") may pick articles to his or her liking in any order, and will find many which offer interesting and relevant reading. Someone without prior knowledge of the subject should start with an introductory survey article (several of these papers have the appropriate flavor) and then will at least be able to gather an impression of the potential of computational differentiation for his or her own work. Gnerally, the articles maintain a nice balance between readability and technicality.

The volume should greatly help in advertising the important benefits that may be derived from computational differentiation in many areas of scientific computing, and it may help to attract a number of scientists into developping the subject further.

HANS J. STETTER

20[65K10, 90C26]—*Numerica: A modelling language for global optimization*, by Pascal Van Hentenryck, Laurent Michel, and Yves Deville, The MIT Press, Cambridge, MA, 1997, xvii+210 pp., 23 cm, softcover, $25.00

The overall subject area encompassing this book is the numerical solution of nonlinear systems of equations and constrained and unconstrained optimization. More precisely, the book describes certain techniques for finding *all* solutions to nonlinear systems of equations and to finding *global* optima. Until recently unrecognised by many researchers in the field, such computational methods both provide mathematical rigor and are applicable to many practical problems. The authors have a commercial implementation, ILOG Numerica, that embodies both their own variants of these methods and a modeling language to interface well with the methods