Computing, 2nd ed., Cambridge Univ. Press, Cambridge, 1992, xxvi+994 pp., 25 cm. Price $49.95.

The first edition of these widely known volumes has been reviewed respectively in [2, 3]. Virtually every chapter in the present edition has undergone reorganization or expansion, in text as well as in computer routines, reflecting newer developments in methodology and omissions in the first edition. The major addition is a new chapter on integral equations, inverse problems, and regularization. (Surprisingly, there is no reference to [1].) All in all, more than 100 new routines have been added, almost all of the old ones still being there, though often with improved codes. To compensate for this substantial growth in material, many topics deemed "advanced" are now set in smaller type. Even so, the volumes have swelled to nearly 1000 pages, from the original 700–800 pages.

W. G.

1. C. T. H. Baker, *The numerical treatment of integral equations*, Clarendon Press, Oxford, 1977.
2. F. N. Fritsch, Review **3**, Math. Comp. **50** (1988), 346–348.
3. W. Gautschi, Review **6**, Math. Comp. **52** (1989), 253.

4[65–01].—Kendall Atkinson, *Elementary Numerical Analysis*, 2nd ed., Wiley, New York, 1993, xiv+425 pp., 24 cm. Price $61.95.

For a review of the first edition, see [1]. In the present edition, the outlay and character of the text have remained the same. Three paragraphs have been added, one on the general fixed-point method for a single equation, and one each on iterative methods for solving systems of linear, respectively nonlinear, equations. Some other parts of the text have been rewritten and supplied with new examples and problems.

W. G.

1. M. Minkoff, Review **36**, Math. Comp. **47** (1986), 749.

5[68–06, 68Q40, 68U99].—Andreas Griewank & George F. Corliss (Editors), *Automatic Differentiation of Algorithms: Theory, Implementation, and Application*, SIAM Proceedings Series, Society for Industrial and Applied Mathematics, Philadelphia, 1991, xiv+353 pp., 25 $\frac{1}{2}$ cm. Price: Softcover $48.50.

Since 1981, when L. Rall's Lecture Note Volume on Automatic Differentiation appeared, efforts directed toward the design and implementation of automatic differentiation software have multiplied. Nevertheless, the awareness among computational scientists of the availability and use of these tools is still rather restricted, even though their potential applicability is almost unlimited. This has been largely due to the fact that no comprehensive presentation of this subject has been available. The volume compiled and edited by A. Griewank and G. F. Corliss from papers presented at the SIAM Workshop on the Automatic Differentiation of Algorithms (held in January of 1991 in Breckenridge, Colorado) should finally fill this gap.

Naturally, a multiauthored volume cannot have the uniformity of a monograph. On the other hand, given the variety of viewpoints and orientations represented by the contributions, a more complete presentation of the state-of-the-art of the subject area has been achieved than could possibly have been realized by a single author. It is true that there are some duplications, and not all individual articles are equally to the point; but such a volume is not meant to be read from beginning to end. Altogether, the result of the editors' effort is remarkable and deserves high commendation.

Perhaps the two most valuable articles are the last two: a taxonomy of automatic differentiation tools by D. W. Juedes, and a bibliography of automatic differentiation compiled by G. F. Corliss. Altogether, 29 different products have been classified by Juedes and their similarities and distinctions described; information about their availability has also been included. The bibliography is the union of all quotations by authors in the volume and of previously compiled bibliographies by various people.

Before we enter into an assessment of other parts of the book, it may be advisable to clearly state the objectives of automatic differentiation: in today's understanding—and that of our volume—they consist in the computation of the *values* of derivatives (or of related quantities like a Jacobian times a vector) from an algorithmic description of the computation of the values of the underlying function. Thus, the mere transformation of the symbolic string for an arithmetic expression into that for its derivative with respect to some parameter (a capability present in virtually all computer algebra systems) is not automatic differentiation except if accompanied by the generation of efficient code for the derivative evaluation. The excellent introductory article by Masao Iri gives a concise description of the fundamentals of automatic differentiation, with a very transparent presentation of its two basic modes: forward or bottom-up, and backward or top-down. The juxtaposition and distinction of these two modes recurs in many of the following articles in ever varying forms, so that their relative advantages and disadvantages cannot escape the reader. Also, the mechanism of the (at first sight) not so intuitive reverse mode is illuminated.

It is clearly not possible to do justice to, and appraise, each one of the altogether 32 sections of the volume. Instead, the reviewer will only point to a few contributions which struck a particular chord in him; for the others, he can only summarize topics and directions.

The paper by Y. G. Evtushenko exposes the close analogy between the establishment of the data sensitivity of results in arithmetic expressions and in differential equations, which sheds yet another light on the reverse mode. Ch. Lawson draws attention to repeated automatic differentiation of the inverse function (for its Taylor expansion) and shows how this is feasible even in the multivariate case. The important problem of computing Newton corrections without an explicit computation of the elements of the Jacobian or Hessian is treated in several contributions. This is taken further by M. Berz who treats the evaluation of Lie derivatives in differential algebras. Two papers (Corliss, Layne) consider the combination of automatic differentiation with validation in the context of Taylor series expansions for solutions of systems of ordinary differential equations, which results in guaranteed inclusions, possibly under perturbations like in satellite computations.

A good number of papers deal with techniques which make implementations of automatic differentiation more efficient, special attention being given to concurrent architectures. Language aspects are also considered, and a group of papers describes particular aspects of particular software products. Another group of papers comments on the advantages which the authors have been able to derive from the use of automatic differentiation in their particular application areas, which range from weather prediction to distributed dynamical systems.

Altogether, this volume offers the opportunity to the computational scientist for a first, or in-depth, encounter with automatic differentiation, an experience which he is well advised to seek.

H. J. S.

6[41-06, 65Dxx].—E. W. CHENEY, C. K. CHUI & L. L. SCHUMAKER (Editors), *Approximation Theory* VII, Academic Press, Boston, xx+249 pp., $23\frac{1}{2}$ cm. Price $59.95.

During the last ten or fifteen years, *Approximation Theory* as a research subject has undergone remarkable changes and has turned up a variety of interesting new facets. Practical applications as well as theoretical questions, partly emerging from other mathematical subjects, have motivated new types of problems, which to a large extent have replaced classical issues like Jackson and Bernstein theorems. While this makes the field perhaps less coherent, it does enhance its pivotal position as a link between several different areas.

These trends are clearly reflected in this book. The Texas Symposium on Approximation Theory has long become a central and traditional event. This seventh volume of its proceedings has broken with tradition in that this time it only contains the contributions by the invited speakers. I am tempted to say, though, that the book is a good example of "less is more". In fact, all the articles are survey-type articles. They are all well, and some even exceptionally well, written. While they still address classical subjects like approximation by algebraic polynomials or rational functions, they emphasize important connections with potential theory, consider not only classical accuracy questions but also issues of shape preservation, and deal with algorithmic aspects such as recursive interpolation processes. The reader will learn of important principles for studying approximation orders and cardinal interpolation for shift-invariant spaces. This latter setting is also inherent in several contributions to the theory of wavelets and its applications, for instance, to signal processing. One important issue in this context is data compression, which is also the central theme of knot removal techniques for spline curves and surfaces motivated by applications in Computer Aided Geometric Design. Last but not least, the question of denseness of systems of ridge functions or sigmoidal functions is discussed and related to the theory of neural networks.

So the ideas and principles discussed in these articles, combined with the many references to the original papers, make this volume a valuable source of information on several recent interesting developments in approximation theory and beyond.