works, the present book places somewhat more emphasis on computational aspects and practical error analysis.

Chapter 1, comprising about a quarter of the book, is an introduction to Hilbert and Banach spaces and the solution of linear operator equations, while a somewhat shorter Chapter 3 contains additional background material on differentiation of nonlinear operators. In between is a short (29 pages) chapter on the contraction mapping principle, and some of its variants, with an application to an integral equation.

The last and longest chapter (85 pages) is devoted to Newton's method and a few of its modifications. The author presents the now famous Kantorovich analysis and then discusses in some detail the implications of these results for practical programming. This discussion, together with the point of view put forth, is perhaps the strongest and most novel part of the book and concerns primarily the author's own research using interval arithmetic and similar ideas in order to obtain error bounds. Additional results relating to error estimation, as well as applications to various differential and integral equations, are also given.

Although the book makes a valuable contribution in those areas that it covers, its scope is rather limited. There is little or no mention of the important class of minimization methods nor of a large number of variants of Newton's method including, in particular, the secant methods and more recent "quasi-Newton" methods. Even within the confines of Newton's method, the author has restricted his analysis to the setting of normed linear spaces which precludes mention of the powerful results available in partially ordered linear spaces.

Nevertheless, the book will make useful supplementary reading in various graduate courses in both computer science and mathematics. Unfortunately, however, it seems to be overpriced, for its size, by a factor of almost two.

J. M. O.

**5[2.45, 12].**—JULIUS T. TOU, Editor, *Advances in Information Systems Science*, Vol. 1, Plenum Press, New York, 1969, xv + 303 pp., 23 cm. Price $14.00.

This volume is part of a proposed series which attempts "(1) to provide authoritative review articles on important topics which chart the field with some regularity and completeness, and (2) to organize the multidisciplinary core of knowledge needed to build a unified foundation." The articles in this volume do indicate some of the most prominent directions in the field of computer or information systems science. The series is aimed at "a wide audience, from graduate students to practicing engineers and active research workers." However, in order to avoid the learning of appropriate responses to the terminology of the field without learning the meanings of the terms, the prospective reader should have some familiarity with the field, especially the history and justification of the current lines of investigation.

The first article, "Theory of Algorithms and Discrete Processors," by V. M. Glushkov and A. A. Letichevskii (translated by Edwin S. Spiegelthal), is slightly out of place in this collection. In a modified form (even including its brief and incomplete excursion into the history of the development of automata theory) it might have been published as original research. Still, it is representative enough to serve as a description, by example, of one of the main directions of automata theory.

Having discussed "discrete processors" in an automata theory context, the authors develop a theory of "algorithmic algebras" aimed finally at studying various equivalence problems of automata theory. The references give the researcher a copious supply of entry points to the Russian literature on automata. The student should definitely be familiar with what the authors call "classical automata theory" before beginning this chapter.

The second article, "Programming Languages," by Alfonso Caracciolo de Forino, is to be commended for its attempt to integrate the theory of programming languages into a general philosophical framework. The philosophy is Carnap's Semeiotics, "the general theory of signs and of their significance." Unfortunately, the philosophical discussion cannot be taken literally. It requires an insight into what the author is trying to say rather than what he says when, for example, he refers to "the computation of a quantity not finitely representable, such as the number $\pi$." Except for trouble caused by Carnap's terminology and the continually strained insistence that the metaphorical references to the concepts of "language," "meaning," "knowledge," "understanding," etc. are not metaphorical, the article is easily accessible to anyone familiar with a higher-level programming language such as ALGOL. Aside from the philosophy, the article is a genuine survey of the field of programming languages emphasizing work on their formal definition. The references represent the current literature of the field well. Many problem areas are mentioned and the author's suggestions might be useful to those interested in entering the field.

The most accessible article of the volume is "Formula Manipulation—The User's Point of View," by M. E. Engeli. This article reviews its area by introducing a programming language SYMBAL as an example of the direction in which formula manipulation oriented programming languages should be moving. The language is a modification of ALGOL. The syntax is presented in Backus Normal Form; but the author does not get carried away by formalism. The study of SYMBAL in some depth complements the survey of the previous chapter with very little overlap. Again, this chapter provides areas of interest to those who are entering the field, at a level accessible to anyone who has been briefly acquainted with ALGOL. The references are so current as to include D. E. Knuth's *The Art of Computer Programming*, Vol. II.

The fourth article, "Engineering Principles of Pattern Recognition," by Julius T. Tou (the editor of the series) is another survey of pattern recognition methods: "Distance Functions," "Potential Functions," "Likelihood Functions," and "Entropy Functions." The chapter emphasizes adaptive methods and "training algorithms."

There is significant overlap between the fourth article and the fifth, "Learning Control Systems," by K. S. Fu. Fortunately, the notations are sufficiently similar that the reader can adjust to this situation. Both of these articles rely on the reader's familiarity with "statistical decision theory" and refer to information theory for many of the concepts discussed.

The volume, as a whole, is good as a descriptive work but short on justification. The interested reader should be warned against accepting certain problem areas as worthy of study merely because they are, as the book reports, being studied. If this

warning is heeded, the proposed series should serve as a good introduction to current research in "information systems science."

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**6[3, 13.15].**—RALPH A. WILLOUGHBY, Editor, *Proceedings of the Symposium on Sparse Matrices and Their Applications*, IBM Corporation, Thomas J. Watson Research Center, Yorktown Heights, New York 10598.

The symposium was held at the Thomas J. Watson Research Center on September 9 and 10, 1968, with 124 registered participants representing many fields of application. Included in this volume are summaries of the talks, usually of about eight or ten pages, together with an "edited version" of a panel discussion forming the closing session.

The eigenvalue problem came up only during the panel discussions and the contributions were meager. Otherwise, only inversion and the solution of linear systems were discussed. The treatment of large sparse systems is not yet to be found in the textbooks, and only occasionally in the periodicals concerned with numerical analysis. But special techniques have been devised for linear programming problems and for the analysis of power networks, in particular, and these are described in the literature dealing with these areas. This seems to be the first effort to bring together mathematicians and programmers, and specialists in their diverse areas, in order to coordinate and systematize their work. It is claimed that in some cases 100-fold reductions are achieved. This, and the range of applications, provide impressive evidence of the worthwhileness of the project.

The novice will not find in this an easy introduction to the subject in general or to any one technique in particular. But he can find indications of the various methods of approach and sometimes extensive lists of publications for further study. And the expert may well learn of other approaches he had not previously come across.

A. S. H.

**7[3].**—J. A. WILKINSON, *Rundungsfehler*, translated from English into German by G. Goos, Springer-Verlag, New York, 1969, x + 208 pp., 21 cm. Price $3.70 (paperbound).

This translation contains minor corrections of the earlier English version: *Rounding Errors in Algebraic Processes*. See review RMT **90**, vol. 18, no. 88, p. 675.

E. I.

**8[3].**—H. R. SCHWARZ, H. RUTISHAUSER & E. STIEFEL, *Numerik Symmetrischer Matrizen*, B. G. Teubner Verlag, Stuttgart, 1968, 243 pp., 22 cm. Price DM 34 —.

The names of the three authors should be sufficient to recommend this book to