Edited by J. Legras, chapter five is concerned with numerical quadrature. Here some standard procedures using Newton-Cotes formulas of degrees one, three, and five are presented for use with functions of one and two variables. Procedures utilizing Romberg integration for rectangular regions in one, two and three dimensions are given.

Approximation is the subject of chapter six, under P. J. Laurent's editorship. It consists of two parts, the first dealing with approximation using the infinity norm, and the second dealing with approximation in the least squares sense. In the first section two versions of Remez' algorithm are provided as well as several procedures for finding uniform approximations on discrete sets of points. Procedures for obtaining least squares approximations (a direct method and one using orthogonal polynomials) appear. A procedure for generating approximations using spline functions ends the chapter.

The last chapter, edited by P. L. Hennequin, is entitled "Probability and Special Functions" and, as the editor states, deals with algorithms which could not logically be placed elsewhere in the book. They include one related to the decomposition of the set of states in a stationary Markov process into classes, an optimized Runge-Kutta procedure, two random number generators, a procedure to find the upper limit of integration of a Gaussian distribution when the cumulative probability is known, and two algorithms related to Mathieu functions.

Although the book contains a large number of very useful procedures, the reviewer feels that it should be approached with caution by the inexperienced computer. A few of the algorithms presented are of questionable reliability, and some of the limitations of the algorithms are not stated. For example, the inversion of a matrix using Schmidt orthogonalization can lead to severe round-off error and it is not generally regarded as a satisfactory numerical procedure. (By contrast, the same basic procedure using Householder transformation matrices to carry out the factorization enjoys good numerical stability.) Repeated use of Hotelling's deflation with the power method is suggested for finding all the eigenvalues of a given matrix when the eigenvalues are known to be distinct. It is often satisfactory only for a few iterations.

Despite these reservations, the authors deserve a great deal of credit for gathering together such a comprehensive set of algorithms. The procedures in the book would enable one to attack the majority of standard numerical computation problems. There are a few misprints in the book and sources for most of the methods are supplied.

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42[2.10, 7].—David Galant, *Gauss Quadrature Rules for the Evaluation of* $2\pi^{-1/2}\int_0^\infty \exp(-x^2)f(x)dx$, 6 pages of tables, reproduced on the microfiche card attached to this issue.

With $\{p_j(x)\}$ denoting the orthogonal polynomials associated with the weight function $\exp(-x^2)$ on $[0, \infty)$, the coefficients $\{b_j\}$ and $\{g_j\}$ in the recurrence relation $p_j(x) = (x - b_j)p_{j-1}(x) - g_jp_{j-2}(x)$ are given in Table I to 20S for $j = 1(1)20$.

Table II contains 20S values of the nodes $t_{j,n}$ and weights $w_{j,n}$ of the Gaussian quadrature rules $2\pi^{-1/2} \int_0^\infty \exp(-x^2)f(x)dx \doteq \sum_{j=1}^n w_{j,n}f(t_{j,n})$, $n = 1(1)20$. The recurrence coefficients were computed in 50S arithmetic from the moments of $\exp(-x^2)$ by means of the quotient-difference algorithm. The Gaussian nodes and weights were calculated in 30S arithmetic, using methods of Golub and Welsch (Gene H. Golub and John H. Welsch, "Calculation of Gauss quadrature rules," *Math. Comp.*, v. 23, 1969, pp. 221–230).

W. G.

43[2.20, 2.45, 5, 9, 11, 12, 13.20, 13.35, 13.50].—J. T. SCHWARTZ, Editor, *Mathematical Aspects of Computer Science*, Vol. 19, Proc. Sympos. Appl. Math., Amer. Math. Soc., Providence, R. I., 1967, v + 224 pp. Price $6.80.

This volume contains research and expository papers on computer science and its mathematical facets. The eleven contributions will now be briefly treated in turn.

"A review of automatic theorem proving": J. A. Robinson surveys the methods and results and observes that under very general conditions a theorem-proving problem can be solved automatically if it can be solved at all. This expository paper, which is of particular interest to logicians and computer scientists, records that some theorem-proving problems considered unfeasible five years ago, can now be treated on a computer with relative ease although other problems involving set-theoretic notions have computationally inefficient solutions.

"Assigning meanings to programs": Robert W. Floyd offers a basis for formal definitions of the meanings of computer programs by defining programming languages in a way so that a rigorous standard is established for proofs about computer programs, including proofs of corrections, equivalence, and termination. This research paper is of interest principally to computer scientists who have followed the work of J. McCarthy, A. Perlis, and S. Gorn.

"Correctness of a compiler for arithmetic expressions": John McCarthy and James Painter give a proof of the correctness of a simple algorithm for compiling arithmetic expressions into machine language. Their ultimate goal is to make it possible to use a computer to check proofs that compilers are correct. This research paper is the first one in which the correctness of a compiler is proved.

"Context-free languages and Turing machine computations": J. Hartmanis derives a result that establishes a close tie between complements or intersections of context-free languages and Turing machine computations. In addition he gives some new results about the complements, intersections, and quotients of context-free languages. This expository and research paper is of interest mainly to computer scientists active in automata theory.

"Computer analysis of natural languages": Susumu Kuno surveys a portion of the field of computational linguistics. In fact, his survey is confined only to algebraic (i.e., nonstatistical) studies concerning the syntax and semantics of natural languages. The reviewer agrees with the author that such studies are more prevalent, but regards his statement that they are also more interesting as being a matter of personal taste. Most of this thorough expository paper is devoted to a detailed analysis of parsing algorithms for generative and transformational grammars of N. Chomsky.