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Book Review

Procédures Algol en Analyse Numérique; 324 pages. (Published by Min. de l'Education Nationale, 35 F.)

This book, whose purpose is to provide useful ALGOL procedures for scientific computing, and to encourage the general use of ALGOL, is a combined effort by six French Universities organised by the National Centre for Scientific Research. There are seven chapters, with titles Linear Algebraic Equations (13 *procedures*), Algebraic Eigenvalue Problem (17), Algebraic and Non-linear Systems (11), Differential Systems, Integral and Integro-differential Equations (6), Definite Integrals (10), Approximation (13), Probability and Special Functions (8).

The two linear algebra chapters contain much standard material, such as variants of Gauss and Cholesky for solution of linear equations and matrix inversion, and methods for the eigenvalue problem associated with the names of Jacobi, Givens, Householder, Sturm, Rutishauser, Hessenberg, Wilkinson, Hyman, Laguerre and Newton. In addition there are processes for the termination of iterations based on consideration of a 'neighbouring' problem; least squares methods including that of Golub and Businger; the determination of pseudo inverses; power methods and deflation for eigenvalues; and Jacobi for complex Hermitian matrices. Chapter 3 includes for polynomials the methods of Newton (real and complex) and Laguerre, and those of Lin and Bairstow for finding quadratic factors. For more general functions the method of Muller is programmed, and 'bisection' and Newton iteration are used for single and simultaneous non-linear equations.

Chapters 5 and 6 include programs which probably exist in few other computer installations. The quadrature procedures determine matrices connected with polynomial and trigonometric interpolation, and tensor products of such matrices, and use them for quadrature along a line and over a rectangle, with error estimation based on the interpolating function. Romberg integration is also extended from the line to a rectangle and a parallelepiped. Chapter 7 relates only to initial-value problems, but covers systems of first and second order differential equations, Volterra integral equations and Volterra integro-differential equations of first and second orders. The main techniques are varieties of Runge-Kutta processes recently developed in France.

Chapter 7 also breaks new ground. Six procedures find good or best approximations, using the maximum norm, for continuous functions under a miscellany of conditions and constraints, both discrete and continuous. The Remes algorithm is the basic tool. Four procedures use a least squares norm, and four others produce spline approximations of general and particular orders. In the final miscellaneous chapter we find an additional Runge-Kutta error-minimising procedure, two sections on Mathien functions, one on the inversion of the error function, two on Markoff chains, and two on random sequence generators.

Each section comprises a 'Notice', with information about the program, method, and relevant literature; the '*Procedure*', containing the ALGOL instructions; and an 'Exemple d'utilisation', with problem, program and numerical results obtained. Each chapter also has an introduction, with some numerical analysis, a summary of the procedures and an evaluation thereof, and further references. Finally, each chapter and even each *procedure* have named responsible authors, to permit 'the establishment, of a fruitful dialogue between the authors and the readers (suggestions, criticisms, requests for clarification, etc').

Extreme accuracy, of course, is a necessity for a work of this kind, and the stated checks and methods of producing the printed pages give confidence that this has been achieved. This is undoubtedly an important and practically useful publication, and the team responsible for it deserve our congratulations and thanks for a good idea splendidly carried out.

L. Fox (Oxford)