on Lagrangian methods, as recent work has shown this approach to be more promising than the standard penalty function or barrier type of approaches.

Chapter 4 – *Second Derivative Methods,* authored by W. Murray, is exclusively concerned with Newton's method and modifications of it. After briefly describing methods proposed by several other authors, Murray devotes the rest of the chapter to a numerically stable method of his own based upon Cholesky factorization. This appears to be an excellent method if the time required for computing the matrix of second derivatives is not excessive.

Chapter 5 – *Conjugate Direction Methods,* authored by R. Fletcher is, in this reviewer's opinion, the best introductory discussion of these methods in print. Methods described include those developed by Powell, Smith, Fletcher and Reeves, and Zoutendijk and the Partan method.

Chapter 6 – *Quasi-Newton Methods,* authored by C. G. Broyden surveys all of the well-known quasi-Newton, (variable metric), updating methods and families of updating formulas. Theoretical properties of these methods are discussed, with the principal emphasis on convergence results. For some methods, statements are made about computational experience.

Chapter 7 – *Failure, the Causes and Cures,* authored by W. Murray, attempts to provide some helpful hints to the practical optimizer. Besides some general remarks on rounding errors and numerical stability, there is a good discussion of these aspects with regard to quasi-Newton algorithms. Here, recent work on implementing these algorithms using the Cholesky factorization of an approximate Hessian, rather than the inverse of that matrix, is described. There are also some remarks on computer input and interpretation of output.

Chapter 8 – *A Survey of Algorithms for Unconstrained Optimization,* authored by R. Fletcher, documents several fully available Fortran IV and ALGOL 60 codes which implement some of the better optimization methods. The information given should be of considerable interest to problem solvers.

Finally, there is an appendix which sets forth several definitions and results in linear algebra without proof with which the reader needs to be familiar. The common mistake of referring to the Sherman and Morrison modification rule as Householder's rule is made here.

Some obvious typographical errors that were noticed are: first line below (3.6.4): the first "infinity" should be "minus infinity"; p. 69, equation for g and (6.2.5): f omitted; (4.12.1): T_3 inside both sets of parentheses should be T_2; second line above (7.3.2): (1.6.1) should be (1.5.1); p. 133, line 4: (8) should be (7); p. 136, third reference: pollution should be solution.

D. G.

25 [3, 7, 8, 10].– JÜRG NIEVERGELT, J. CRAIG FARRAR & EDWARD M. REINGOLD, *Computer Approaches to Mathematical Problems*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1974, xiii + 257 pp., 24 cm. Price $8.95 (clothbound).

This is a delightful book. It introduces the student to a medley of techniques, algorithms, and facts, which would be known by a well-educated computer scientist with a mathematical bent. Yet he (or she) probably acquired this material haphazardly over the years from courses, colloquia, and technical conversations.

Is the book simply an introduction to formal languages, combinatorics, and graph theory? By no means, and yet all three subjects are introduced along with random number generation, game playing, and the computation of mathematical constants.

Part of the charm of the book stems from a lively style, but its character comes from the desire of the authors to show how problems are attacked with the aid of a computer. The mathematical maturity demanded is that of a junior or senior mathematics major. Consequently, it could serve as a text for a valuable course for first year graduate students in Computer Science, although such a course will be opposed on the grounds that it broadens rather than deepens.

Each of the six chapters is self-contained and ends with an annotated list of references and exercises of varying difficulty. For example, (i) find a method for generating random permutations from random numbers so that each permutation should have an equal probability of occurrence, (ii) estimate (by simulation) the probability that three points chosen at random in the plane form an obtuse triangle. Lewis Carroll posed the latter problem which has a nice theoretical solution. Historical comments are woven into the text. This book should appeal to many mathematicians who admit to very little interest in Computer Science, because the intellectual difficulties in the problems addressed are so clearly brought out.

B. P.

26 [4,5].—J. ALBRECHT & L. COLLATZ, Editors, *Numerische Methoden bei Differentialgleichungen und mit Funktionalanalytischen Hilfsmitteln,* Birkhäuser Verlag, Basel, Switzerland, 1974, 231 pp., 25 cm. Price sfr. 59.—.

This volume contains papers presented at two meetings organized by Y. Albrecht and L. Collatz. The first meeting took place at the Technical University at Clausthal-Zellerfeld, Germany, from May 31—June 2, 1972, the second meeting was held at the Mathematical Research Institute at Oberwolfach, Germany, from June 9—10, 1972.

J. B. & V. T.

27 [5].—ROGER TEMAN, *Numerical Analysis.* Reidel Publishing Co., Doordrecht, Holland, and Boston, Mass., 1973, viii + 167 pp., 19 cm. Price $17.50.

This book is an updated translation of a French text which appeared in 1970. Despite its title, it concentrates on the analysis of numerical procedures for elliptic problems. The main emphasis in this study is on the use of functional analysis. The book thus contains discussions of the Lax-Milgram theorem, the Galerkin method, approximation theory, etc., and applications of these tools to finite difference and finite element methods applied to a few linear and nonlinear model problems.

In this way, the author provides an accessible, fairly elementary introduction to some of the work on theoretical numerical analysis in France during the last ten years. What the book lacks, in the reviewer's opinion, is material on the more practical aspects of elliptic equation solving. The author does describe the fractional step approach, a method which however is rarely used in real life applications. Apart from this discussion, only a few sentences are spent on the very important and interesting problems of how to handle the large systems of linear and nonlinear equations which arise in these applications.

OLOF WIDLUND

Courant Institute of Mathematical Sciences
New York University
251 Mercer Street
New York, New York 10012