2[46-01, 65-01]—*An introduction to functional analysis and computational mathematics*, by V. I. Lebedev, Birkhäuser, Boston, MA, 1977, x+255 pp., 24 cm, hardcover, $59.95

As the author writes in the Preface to the English Edition: "The book contains the methods and bases of functional analysis that are directly adjacent to the problems of numerical mathematics and its applications". The book reflects a course given by the author to students at the Moscow Institute for Physics and Technology over several years, and is readily accessible to anyone with a course in real analysis, in ODEs, and in numerical analysis.

The material is organized into just three chapters. Chapter 1 brings the basics of linear metric spaces, using best approximation (and some other extremal problems) to illustrate their use. Chapter 2 covers linear operators and linear functionals, bringing the standard functional analysis material (uniform boundedness principle, Hahn-Banach, though not open mapping/closed graph, but also eigenstructure and resolvent of an operator), and applying it to variational methods for the minimization of quadratic forms, and culminating in a discussion of generalized solutions to second-order elliptic equations. The final chapter deals with iterative methods for the solution of operator equations, including convergence acceleration, solving a corresponding variational problem, and, of course, Newton's method, all in a Banach or Hilbert space setting.

Although the book is based on a course, there are no problems. There are no references given for results which are stated but not proved, but the bibliography is rich enough to supply everything needed (largely from standard Russian books).

This book could easily be improved materially by having it copy-edited by someone wholly conversant with English and English mathematical terminology. While 'Minkowskii' and 'Boltsano' are still recognizable, 'quadrature functional' (for 'quadratic functional') is trickier, as is 'complement' (for 'completion') of a metric space, or 'reversible' (for 'invertible'), or 'diagram' (for 'graph') of a function, and 'Relay ratio' (for 'Rayleigh quotient') or 'Pyphagor' (for 'Pythagoras') is simply unacceptable. There is also the understandable, but often mathematically misleading, haphazard use of the articles 'the' and 'a'. In contrast, the preference for the standard Russian attribution of results, reflected in the names given them, might help to broaden the horizons of students not raised there.

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3[65-01, 65-04]—*Numerical recipes in Fortran* 90: *The art of parallel scientific computing, Volume* 2 *of Fortan numerical recipes, second edition*, by William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, Cambridge University Press, New York, NY, 1996, xx+551 pp., 25 cm, hardcover, $44.95, software diskette available separately, $39.95

The Numerical Recipes series of books and computer media began appearing in 1986. The media provide library software for general-purpose numerical computation using standard techniques, and the books describe the algorithms in some detail and list the programs in full. Thorough and quite different reviews were given by F. N. Fritsch, Reviews 3 and 4, Math. Comp. **50** (1988), pp. 346–349, and M. M. Gupta, Math. Rev. 87m:65001a,b,c. The original book, which emphasized Fortran, was reworked for C and Pascal in 1988 and 1989. A second edition, published in 1992 in separate volumes for Fortran 77 and C, considerably changed and expanded the algorithmic and software content; see W. Gautschi, Review 3a,b, Math. Comp. **62** (1994), pp. 433–434.

The book under current review is the first to focus attention on Fortran 90. It is a companion to the Fortran 77 volume. The authors see Fortran 90 as a major advance in programming language support for SIMD (single instruction multiple data) parallel computing, and they develop this theme by using the entire Numerical Recipes library as an example. They begin with a very good overview of the language. Next they introduce SIMD and MIMD (multiple instruction multiple data) computing, oriented toward Fortran 90 and anticipated future revisions of Fortran. The remainder of the book gives program listings with useful tips on Fortran 90 and parallel programming along the way.

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4[49N10, 65-01, 65F15, 93C05, 93B40]—*Algorithms for linear-quadratic optimization*, by Vasile Sima, (Pure & Applied Mathematics: A Series of Monographs and Textbooks/200), Marcel Dekker, Inc., Monticello, New York, 1996, vii+366 pp., $23\frac{1}{2}$ cm, hardcover, \$150.00

During the last 30 years, the linear-quadratic optimal control problems in both continuous-time and discrete-time have belonged to the most studied problems in systems and control theory. The theory is now very mature and it is well-known that the optimal control for these problems in case of an infinite-time interval under standard assumptions is obtained via particular solutions of certain algebraic Riccati equations (AREs). In case of continuous-time systems this is an equation of the form

$$0 = \mathcal{R}_c(X) = Q + A^TX + XA - XBR^{-1}B^TX \tag{1}$$

while for discrete-time systems we have

$$0 = \mathcal{R}_d(X) = Q + A^TXA - X - A^TXB(R + B^TXB)^{-1}B^TXA. \tag{2}$$

In both cases, $A, Q, X \in \mathbb{R}^{n\times n}, B \in \mathbb{R}^{n\times m}, R \in \mathbb{R}^{m\times m}$, and Q, R as well as the sought-after solution X are assumed to be symmetric. (Throughout the book it is also assumed that Q is positive semidefinite, and most of the time that R is positive definite.) Equation (1) is called the *continuous-time* ARE while (2) is referred to as *discrete-time* ARE. The required solutions X are usually *stabilizing* in the sense that for (1), $A - BR^{-1}B^TX$ has all its eigenvalues in the open left half plane while for (2), $A - (R + B^TXB)^{-1}B^TXA$ has all its eigenvalues in the open unit disk. Under certain assumptions on the underlying linear system, this solution exists, is unique and positive semidefinite.