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BOOK REVIEWS

BERESFORD N. PARLETT, *The Symmetric Eigenvalue Problem*, Classics in Applied Mathematics 20, SIAM, Philadelphia, 1998, XXIV+398 pp., ISBN 0-89871-402-8.

The first edition of this book was published in 1980; with some improvements included, this second edition has appeared in the "Classics in Applied Mathematics" series. The structure of the book is briefly the following.

The prerequisites are introduced and discussed in the first two chapters, *Basic facts about self-adjoint matrices*, resp. *Tasks, obstacles and aids.* In Ch. 3 – *Counting eigenvalues* – there are discussed the triangular factorization, an error analysis, and the slicing of the spectrum. Ch. 4 – *Simple vector iteration* – analyzes the power method, the inverse iteration and the Rayleigh quotient iteration. Ch. 5 deals with deflation. Some useful matrices (permutations, rotations, reflections, etc.) are presented in the next chapter, together with some algorithms connected to them. Ch. 7 contains a thorough discussion of the tridiagonal form. The QL and QR algorithms are analyzed in Ch. 8, while the Jacobi methods are analyzed in the following chapter. Ch. 10 – *Eigenvalue bounds* – contains the classical results on this topic, and also refined results needed for the case of large matrices, discussed in the rest of the book. Ch. 11 – *Approximations from a subspace* – deals with the Rayleigh-Ritz procedure. The Krylov subspaces are discussed in Ch. 12, the following one treating the Lanczos algorithms. Ch. 14 deals with subspace iterations, and finally, the last chapter discusses the general linear eigenvalue problem. The book ends with two appendices (*Rank-One and Elementary Matrices* and *Chebyshev Polynomials*), an annotated bibliography, and the bibliography.

Though a lot of progress has been made in the field since the first edition was published in 1980, this book remains as major reference for specialists and nonspecialists; it contains essential results, clear proofs, elaborated notations, accompanying exercises, and notes and references at the end of each chapter.

All the expectations of a pretentious reader are fulfilled, the place of such work in such prestigious series being well deserved.

E. Cătinaş

STEPHAN KAUFMAN, *A Crash Course in Mathematica,* Birkhäuser Verlag, Basel-Boston-Berlin 1999, 200 pp., ISBN 3-7643-6127-1 and 0-8176-6127-1.

The program *Mathematica*, widely used in mathematics and applications, allows to solve quickly, symbolically or numerically, a variety of problems like calculating integrals and differentials, solving equations (algebraic, differential etc), doing graphics or plotting

functions. The amount of literature on *Mathematica* (over than one hundred books) is growing quickly, an up-to-date List of published books is available on the Web site of the Wolfram Research, the company behind *Mathematica*, at the address `http://www.wolfram.com`.

The present book is aimed at beginners, so that the examples are kept at a simple mathematical level, at a large extent independent of special technical and scientific applications. The emphasis is on standard problems of solving equations (algebraic, differential), and on graphics.

The first two parts of the book, 1. *The basics* and 2. *Graphics*, are sufficient for a newcommer to be acquainted with the basic tools of *Mathematica*, to solve his own problems and to find additional help in the online documentation.

The third part, 3. *Lists and graphics programming*, is more technical containing a discussion on lists, which are used to manipulate vectors and matrices. The lists allow also to assemble graphics elements and to animate sequences of graphics.

The last part of the book, 4. *Introduction to programming*, is for people desiring to go deeper with *Mathematica* and to construct more complicated programs. Based on the study of structure and evaluation of *Mathematica* expressions, several possible programming methodologies are discussed.

The book contains also a lot of exercises, kept again at an elementary level, in order to help the reader to master the program, without getting bogged with complicated mathematics.

The CD-ROM, accompanying the book is essentially the *Mathematica* notebooks from which the book was printed. Some things, like colors, animation of graphics and hyperlinks within the notebooks and the online documentation of *Mathematica*. and to Web sites, are available only on the CD-ROM. The CD-ROM can be viewed without a complete installation of *Mathematica*.

A German version of this book has been published by Birkhäuser in 1998, the English translation being done by Katrin Gygax.

The book is a valuable tool for all people wanting to learn or to teach *Mathematica*, a powerful tool in applying or teaching mathematics.

S. Cobzaş

The Maz'ya Anniversary Collection, J. Rossmann, P. Takáč, G. Wildenhaim (Editors), Vol. 1, *On Maz'ya's Work in Functional Analysis, Partial Differential Equations and Applications*, XII+364 pp., ISBN 3-7643-6201-4; Vol.2, *Rostock Conference on Functional Analysis, Partial Differential Equations and Applications*, XVI+352 pp., ISBN 3-7643-6202-2; Birkhäuser Verlag, Boston-Basel-Berlin 1999

These two volumes are partially based on talks given at the Conference Functional Analysis, Partial Differential Equations, and Applications", a satellite conference of the ICM-Berlin 1998, held at the University of Rostock from August 31 to September 4, 1998, and dedicated to the 60th birthday of Professor Vladimir Maz'ya. The conference was attended by 109 mathematicians from 21 countries and the program included 21 invited lectures and 63 short communications. Besides these, there were also survey lectures on the outstanding contributions of V. Maz'ya to various areas of mathematics-potential theory

and function spaces (L. I. Hedberg), linear theory of water waves (N. G. Kuznetsov and B. R. Vainberg), integral and pseudo-differential operators (J. Elschner), boundary value problems in non- smooth domains (J. Rossmann) singularly perturbed boundary value problems (A. Movchan), inequalities for convolution operators (S. Eilertsen). V. Maz'ya and his wife T. Shaposhnikova wrote the book Jacques Hadamard, a universal mathematician, 578 pp., published in 1998 jointly by AMS and London Math. Soc., which in the opinion of R. Cooke, expressed in this volume, will probably be the definitive biography of J. Hadamard. This simple listing of domains to which V. Maz'ya made essential contributions, illustrates his broad field of investigation, his enormous productivity and the large variety of his work. Two introductory papers, by R. Wildenhaim and I. Gohberg, put in evidence, besides mathematical ideas and results of V. Maz'ya, his charming and fascinating personality, with interests in other fields of life, as art, especially music and literature. The first volume contains also articles having their origins in joint work with V. Maz'ya, a Curriculum vitae of V. Mazy'a and the impressive list of his publications – 16 books and 335 papers.

The second volume contains most of the invited lectures of the conference, as well as a few contributed papers.

Containing surveys as well as contributed papers related to Mazy'ya work and reflecting his creativity, influence and worldwide recognition, the present volumes will attract a large audience, mainly researchers interested in potential theory, function spaces, partial differential equations, and their applications, including applications in physics and fluid mechanics.

S. Cobzaş

NICHOLAS J. HIGHAM, *Handbook of Writing for the Mathematical Sciences*, Second Ed., Philadelphia, 1998, XV+302 pp., ISBN 0-89871-420-6.

The book starts with the brief chapter 1, *General Principles*. Some complementary reading is given in the second chapter, concerning dictionaries, thesauruses, usage and style guide for the English language, as well as technical and mathematical writing guides. Ch. 3 contains an interesting discussion on the mathematical elements (theorems, proofs, examples, definitions, notations, symbols, etc.). The English usage in the mathematical texts is treated in Ch. 4, while the following chapter contains additional topics for the non-native writers of English. Ch. 6 contains useful advises, examples, and counterexamples for writing a paper, starting with the title and ending with the reference list. Ch. 7 presents many examples of how to revise and improve a draft. Ch. 8 is entitled *Publishing a Paper*; it describes the refereeing process and also useful recommendations before and after submitting a manuscript. The following three chapters are dealing with the preparation and presenting (or defending) the theses, talks and posters. Ch. 13 deals with many useful aspects of TeX and LaTeX. The last chapter describes some aids and resources for writing and research. Finally, there are five appendices (A. *The Greek Alphabet*, B. *Summary of TeX and LaTeX*, C. *GNU Emacs – The Sixty + Most Useful Commands*, D. *Mathematical and Other Organizations*, E. *Winners of Prizes for Expository Writing*), a bibliography, a name index and a subject index.

The author realizes a lively presentation of the many facets of the mathematical writing, either deep or just informative, from do's and don'ts when writing a paper, to the five most cited papers in mathematics.

The recommendations and advises made throughout the book are pertinent and the situations presented may occur in the practice of every active mathematician. It is a real benefit to find all of them gathered in a single place.

We believe the book should be read not only by all the young mathematicians (not to mention the non-native writers of English) but also by the experienced ones.

E. Cătinaş

SIDNEY I. RESNICK, *A Probability Path*, Birkhäuser, Boston-Basel-Berlin, 1998, XII+453pp., ISBN: 0-8176-4055-X, 3-7643-4055-X.

This book is designed to be used as a textbook in probability theory for beginning graduate students from variety of disciplines whose primary focus is not necessarily mathematics, but interested in the applying of mathematics, particularly probability theory and statistics, to their research fields. To this aim the book treats the basics of advanced probability theory including measure and integration theory, guiding the readers to a deep understanding of modern probability theory for research statistics, applied probability, biology, operations research, mathematical finances, and engineering.

The material of the book is organized into ten chapters. Each chapter ends with a large number of carefully graded problems given as exercise sets. Hints are given for some of them. The book also contains a short bibliography especially consisting of the most representative and well-known books in probability theory, and ends with a subject index.

Chapter 1 introduces the basics of set theory, and these are chosen to fit the needs of probability theory as best as possible. Chapter 2 presents definitions, properties, constructions of probability spaces, and a short view to the construction of probability measure on $\mathbb{R}$. Chapter 3 considers random variables as measurable functions, induced probability measures and σ-fields generated by measurable maps. Chapter 4 deals with independence of events and random variables and focuses especially on Borel-Cantelli lemma and zero-one laws. Chapter 5 begins with the definitions of expectation, variance covariance as the Lebesgue integrals of random variables, and their basics properties. There then the construction of probability measures on product spaces, the independence and Fubini theorem follows. In Chapter 6 almost sure convergence, convergence in probability and Lp convergence are considered. Connections between these types of convergence are presented, and also a regard in respect to statistical terminology and a statistical application of convergence in probability to quantile estimation are given. Chapter 7 and 8 are dedicated to the weak and strong laws of large numbers and to the convergence in distribution. Chapter 9 begins with characteristic functions of random variables and their properties, the connection between moments and derivatives of characteristic function, the uniqueness theorem and continuity theorem. All these then are needed to prove the classical central limit theorem for sums of independent identically distributed random variables and the Lindeberg-Feller central limit theorem. Chapter 10 consists of conditional expectations and martingales. Among other basics, one notes Radon-Nikodym theorem, Doob decomposition theorem, stopping

times, positive super martingales, stopping theorems, random walks, reversed martingales, fundamenatal theorems of mathematical finance.

The work is unique in its conception and has many special scientific and applying qualities. The wide variety and broad range of examples and exercises are motivational and provide the reader with heuristics and practice for solving new problems.

This important new book can be recommended for both beginning graduate students and researchers of other disciplines.

Petru Blaga

MARTIN SCHECHTER, *Linking Methods in Critical Point Theory*, Birkhäuser, Boston-Basel-Berlin, 1999, XVIII+294 pp., ISBN 0-8176-4095-9.

This new book on variational methods comes to complete an already consistent series of textbooks and monographs in the fields: P.H. Rabinowitz, *Minimax Methods in Critical Point Theory and Applications to Nonlinear Partial Differential Equations*, AMS, 1986; J. Mawhin and M. Willem, *Critical Point Theory and Hamiltonian Systems*, Springer, 1989; B. Dacorogna, *Methods in the Calculus of Variations*, Springer, 1989; K.-C. Chang, *Infinite Dimensional Morse Theory and Multiple Solution Problems*, Birkhäuser, 1993; A. Ambrosetti and G. Prodi, *A Primer of Nonlinear Analysis, Cambridge*, 1993; N. Ghoussoub, *Duality and Perturbation Methods in Critical Point Theory*, Cambridge, 1993; O. Kavian, *Introduction la Thorie des Points Critiques et Applications aux Problmes Elliptiques*, Springer, 1995; M. Willem, *Minimax Theorems*, Birkhäuser, 1996; M. Struwe, *Variational Methods. Applications to Nonlinear Partial Differential Equations and Hamiltonian Systems*, Springer, 1996; J. Chabrowski, *Variational Methods for Potential Operator Equations. With Applications to Nonlinear Elliptic Equations*, Walter de Gryter & Co., 1997.

The present book presents a systematic way of finding critical points that are neither maxima nor minima, by so called *linking methods*. The main idea is that there are subsets A, B of a space X such that every "nice" functional on X possesses a critical point if its values on A are less than its values on B. If this is the case, we say that A links B. The concept of linking subsets was introduced by the author and represents the core of this monograph. Any linking method consists into the following steps: (1) find linking subsets; (2) obtain a Palaïs-Smale sequence of the functional; (3) verify that the Palais-Smale condition holds, i.e. that there exists a convergent subsequence (whose limit is a critical point). The book gives answers to these problems and presents applications to semilinear subcritical elliptic boundary value problems of the form $Au = f(x, u)$, where A is a linear operator corresponding to a linear elliptic boundary value problem.

The contents are as follows: 1. Critical point theory (20 pp.); 2. Linking (34 pp.); 3. Semilinear boundary value problems (18 pp.); 4. Alternative methods (26 pp.); 5. Bounded saddle point methods (30 pp.); 6. Estimates on subspaces (14 pp.); 7. The Fucik spectrum (22 pp.); 8. Resonance (37 pp.); 9. Boundary conditions (14 pp.); 10. Multiple solutions (10 pp.); 11. Nonlinear eigenvalues (10 pp.); 12. Strong resonance (15 pp.); 13. Notes, Remarks and References (14 pp.); Bibliography and Index.

The book is extremely carefully written. It requires little more than knowledge of the elements of functional analysis and the elementary theory of Lebesgue integration. Topics like Sobolev spaces and pseudogradients are presented in some appendixes. The theory is introduced and developed in an elementary and systematically way and no homotopy and homology theory is used. Due to these qualities, the book would form a good source for

an introductory course on critical point theory and its applications to semilinear elliptic boundary value problems.

Like in any other monograph, the choice of topics reflects the author's own interest in the fields which can intersect or not the interest of others. Thus, some of the results, methods and applications presented here can be also found in other books on calculus of variations, but other topics (like Fucik spectrum and of course linking sets) are preferentially treated, some of the results being completely new. Consequently, the book will be also of interest to researchers and graduate students working in nonlinear analysis and nonlinear ordinary and partial differential equations.

However the biggest benefit of reading this book will be taken by those who would like to deeply introduce themselves into the critical point theory and their applications to PDE. To them, this book is highly recommended with priority.

Radu Precup

C. T. KELLEY, *Iterative Methods for Optimization*, Frontiers in Applied Mathematics 18, SIAM, Philadelphia PA, 1999, XV+180 pp., ISBN 0-89871-433-8.

The book concerns the iterative methods for unconstrained and bound constrained optimization. It consists of two parts, optimization of smooth functions and optimization of noisy functions. After the basic concepts are introduced in Ch. 1, in Ch. 2 there is discussed the local convergence of the Newton method and of the inexact Newton method. Ch. 3 addresses the global convergence for line search methods and thrust region methods. The following chapter contains the analysis and implementation of the BFGS method; the last chapter of part on – *Simple Bound Constraints* – analyzes the gradient projective algorithm and its superlinear convergence.

The second part starts by describing the basic concepts and goals in optimization of noisy functions; an analysis of the simplex gradient method is given. In Ch. 7 the author describes the implicit filtering algorithm. Finally, Ch. 8 deals with some direct search algorithms: the Nelder-Meat algorithm, multidirectional search, the Hooke-Jeeves algorithm and some other approaches.

The book ends with a bibliography and an index.

As the author notes in the introduction, there are a small number of methods treated in depth, while a few of them are described in a less detail. The stated aim is for clarity and brevity rather than complete generality. These goals, together with the facts that, on one hand, each chapter contains examples and exercises, and, on the other hand, the book is accompanied by a suite of MATLAB codes, recommend the book as a textbook in an introductory optimization course.

E. Cătinaş

INSTRUCTIONS FOR CONTRIBUTORS

Revue d'Analyse Numérique et de Théorie de l'Approximation will consider for publication papers on the following subjects: the best approximation, uniform approximation, interpolation, numerical analysis, mathematical programming and also their applications in different areas of sciences.

Authors wishing to submit an article for publication are strongly encouraged to prepare their manuscript in a LATEX file (or AMS TEX or TEX), or in a file using Word 2.0 (or higher) under Windows. In this case, the figures must be either translated into the picture environment of LATEX or Encapsulated Postscript Format (EPS), or sent into a PCX file format.

The proper position of each table and figure must be clearly indicated in the paper.

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For books there should be given: author, title, publisher, place and year of publication. For instance: TRAUB, J. F., *Iterative Methods for the Solution of Equations*, Prentice-Hall, Inc., Englewood Cliffs; N.J., 1964.

Three copies of the paper and a floppy disk containing the corresponding file(s) should be sent to the following address:

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