Bibliographie

Karl-Heinz Becker—Michael Dörffer, Dynamical Systems and Fractals (Computer graphics experiments in Pascal), XII+398 pages, Cambridge University Press, New York—Portchester—Melbourne—Sydney, 1989.

Nowadays nobody is surprised about that the computer enters in almost every area of the life. At the same time one could think of fractals as the things too hard to use PC-s for them. This book proves that the most wide-spread PC-s, such as IBM and Apple for example, can offer some really good results and experiences in the area of chaos and fractals.

The book is very good for two purposes. We can recommend it to all people who have some familiarity with computers and enjoy making nice graphics on screen or printer. The book is so well-illustrated and so various that the reader may not lose his/her interest for years.

A more serious use of the book can be in teaching dynamical systems and fractals. The teacher can demonstrate the result of the rigorous mathematics or can motivate the students. It is advisable to give the book to students for undertaking their own experience in the subject. It is worth noting that the book also has a very good bibliography.

In sum, this book is well-written and has very few misprints, which is very important in the lists of programs.

Á. Kurusa (Szeged)

Jürgen Bokowski—Bernd Sturmfels, Computational Synthetic Geometry, (Lecture Notes in Mathematics, 1359), 168 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo—Hong Kong, 1989.

Computational geometry is a rapidly growing young field on the border line of mathematics and computer science. The main object of this volume is the discussion of the algorithmic aspects of certain fundamental realizability problems in discrete geometry.

The authors investigate the algorithmic Steinitz problem: Given a lattice, is it polytopal?; projective incidence theorems: Give an enumeration procedure for all incidence types over a given field; diophantine problems in combinatorical geometry: Given a configuration of points and lines in the plane, can it be constructed with pencil and ruler only?; the embedding of triangulated manifolds. The methods are based on the theory of matroids and oriented matroids. The book is recommended to geometers and computer scientists as an introduction and motivation for further research.

J. Kincses (Szeged)

N. Bourbaki, Elements of Mathematics, Algebra I, XXIII+708 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1989.

N. Bourbaki, Elements of Mathematics, Commutative Algebra, XXIV+625 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1989.

In the late thirties of our century appeared the first volume in the famous series "Éléments de mathematique" by the polycephalic mathematician known as Nicolas Bourbaki. This was a nonexistent Frenchman. The name has simply been appropriated to designate a group of mathematicians, almost exclusively French, who form a sort of cryptic "société anonyme". As an institutional connection N. Bourbaki sometimes used the University of Nancago, a playful reference to the fact, that two of the moving spirit within the group were for a while connected with universities in the Chicago area and Nancy (André Weil and Han Dieudonné).

The first part of the series "Les structures fondamentales de l'analyse" contains half a dozen subheadings: Set Theory, Algebra, General Topology, Functions of Real Variable, Topological Vector Spaces and Integration. It was followed by four subsequent works: Lie Groups and Lie Algebras, Commutative Algebra, Spectral Theory, Differential and Analytic Manifolds.

The presentation of the subject by Bourbaki can be characterized by uncompromising adherence to the axiomatic approach and to a starkly abstract and general form that portrays clearly the logical structure. The text of each book consists of the dogmatic exposition of the theory, therefore it contains in general no references to the literature. Few bibliographical references are gathered together in "Historical Notes" usually at the end of each chapter.

The volume Algebra I contains the first three chapters of the whole one: Algebraic Structures; Linear Algebra; Tensor Algebras, Exterior Algebras, Symmetric Algebras.

The whole Algebra has the following six additional chapters: Polynomials and Rational Fractions, Fields Ordered Groups and Fields, Modules over Principal Ideal Rings, Semi-simple Modules and Rings, Sesquilinear and Quadratic Forms.

The volume Commutative Algebra has seven chapters: Flat Modules, Localization, Graduations, Filtrations and Topologies, Associated Prime Ideals and Primary Decomposition, Integers, Valuations, Divisors.

In both volumes each chapter is followed by exercises.

The works of N. Bourbaki are not easy pieces of reading, but everybody can enjoy them, who likes the strict axiomatic treatment. In my opinion these masterpieces must have places in every good mathematical library.

Lajos Klukovits (Szeged)

Kenneth S. Brown, Buildings, VIII+215 pages, Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo, 1989.

This book was written with the explicit aim of offering a profound and systematical introduction to the "theory of buildings". It is a kind of theories which brings hard connection between geometry and group theory. In order to illustrate this connection, it is sufficient to refer some concepts playing an important role constructing buildings: reflection groups, associated simplicial complexes, Coxeter diagram, Coxeter complexes, etc.

Whereas the study of this book does not presume any high level preliminary knowledge, in consequence of the material, readers who are in possession of well-founded knowledges on the classification of algebras and abstract simplicial complexes, have an advantage over the beginners when look for the central ideas of this theory.

These important basic blocks of the theory are also given in the book, each of them is discussed in accordance with desirable depth. In the first chapter the reader get acquainted with geometric imagination (finite reflexion groups) which aid him further on to pursue and approach the theory. After developing the necessary apparatuses (abstract reflection groups and Coxeter complexes in Chapter II and Chapter III) the notion of a building is introduced:

"A building is a simplicial complex Δ which can be expressed as the union of subcomplexes Σ (called apartments) satisfying the following axioms:

(B0) Each apartment Σ is a Coxeter complex.

(B1) For any two simplices $A, B \in \Delta$, there is an apartment Σ containing both of them.

(B2) If Σ and Σ' are two apartments containing A and B, then there is an isomorphism $\Sigma \to \Sigma'$ fixing A and B pointwise."

The author propounds possible directions for further studies himself, refering Tits' works first of all.

This monograph makes it possible for a beginner getting acquinted with theory of buildings by means of various knowledges arranged in it. The book is also useful for readers well up in the referred branches of geometry and algebra to examine a new interesting theory.

J. Kozma (Szeged)

Komaravolu Chandrasekharan, Classical Fourier Transforms (Universitext), III+172 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1989.

"Again a new book about Fourier transform" — one may think of, but this book rises above the others from many viewpoints.

This self-contained book gives a through introduction to classical Fourier transforms in a very clear and compact form. It only needs a basic knowledge in real and complex analysis.

It is divided into two main parts, the first of which is about the L_1 theory. After the basic properties, the Poisson's summation formula, the central limit theorem, Wiener's general tauberian theorem are given.

In the second part the L_2 theory can be found. Plancherel's theorem, Heisenberg's inequality, the Paley—Wiener theorem, Hardy's beautiful interpolation formula and Bernstein's inequalities are in this part.

At the end of the book a third chapter about the Fourier—Stieltjes transform is placed.

We recommend it not only to undergraduates from almost any area of the technical sciences, physics or mathematics but also to teachers who want to teach the classical Fourier transform in a modern form.

Á. Kurusa (Szeged)

Judith N. Cederberg, A Course in Modern Geometries (Undergraduate Texts in Mathematics), XII+232 pages, Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo, 1989.

This new introductionary work is a good possibility for undergraduate students to have a view of the geometries: How are they built? In this way different geometries become palpable even for the beginners.

Chapter 1 presents in a brief and clear manner the structure of some a little complicated finite geometries. It gives an excellent introduction for an inexperienced student to axiomatic way of thinking.

In Chapter 2 a short axiomatic development of the Euclidean plane geometry is given, after that follows a detailed (in the necessary degree) observation of non-Euclidean geometries: hyperbolic geometry and elliptic geometry.

The reader can find a circumstantial discussion of the theory of parallels in the respective geometries.

Chapter 3 covers the treatment of transformation groups in the Euclidean plane. A self-contained section deals with the problems of symmetry groups of the Euclidean plane, furthermore here can be found a brief characterization of the seven frieze groups. As the analytic model of the Euclidean plane is also developed, it is easy to show the matrix representation of transformation groups.

In Chapter 4 — after a short axiomatic introduction and the presentation of infinite model — a clear and well arranged treatment of the real projective plane follows.

A large number of good exercises at the end of each section especially makes the book suitable for using up as a textbook of an undergraduate course.

Each chapter ends with a section proposing further readings regarding the previously discussed subject. In such a way the author can emphasize the introductionary feature of the book on one hand, and the sufficiency of the material for following deeper studies, on the other hand.

J. Kozma (Szeged)

Complex Analysis, Edited by J. Hersch and A. Huber, XII+245 pages, Birkhäuser Verlag, Basel—Boston—Berlin, 1988.

The present volume contains 22 papers dedicated to Albert Pfluger on the occasion of his 80th birthday.

The wide range of the topic of these articles shows Albert Pflugler's strong influence on complex analysts all over the world. His main research is relating to the following fields: entire functions, Riemann surfaces, quasiconformal mappings, schlicht functions. The papers contained in this volume deal with the most important subjects such as conformal and quasiconformal mappings and related extremal problems, Riemann surfaces, meromorphic functions, subharmonic functions, approximation and interpolation.

The collection of these interesting papers gives the reader an insight into the newest results of complex analysis particularly concerning its fields mentioned above.

J. Németh (Szeged)

Edwards B. Davies, Heat Kernels and Spectral Theory (Cambridge tracts in mathematics, 92), IX+197 pages, Cambridge University Press, Cambridge—New York—New Rochelle—Melbourne—Sydney, 1989.

What on Earth can be said to be more classical subject than the heat equation in the theory of second order elliptic operators?! I think nothing is more classical.

But the heat equation at present also is the most recent subject in my opinion. This book is just about the dramatic recent improvements in the quantitative understanding of the heat kernels. This is also shown by its bibliography in which most of the references are dated after 1980.

The author, one of the most known researchers of this subject, considers variable coefficient operators on regions in Euclidean space and the Laplace—Beltrami operators on complete Riemannian manifolds. The most important toole for these investigations is the Grass' theory of logarithmic Sobolev inequalities which yields to ultracontractive bounds. The reader can find some historical notes and supplementary information after each chapter that help the orientation in the subject very well.

We recommend this book to the researchers of this subject as well as to the mathematical physicists.

Á. Kurusa (Szeged)

J. Dieudonné, A History of Algebraic and Differential Topology 1900—1960, XXXI+648 pages, Birkhäuser, Boston—Basel, 1989.

This book describes the main events and results in the expansion of the algebraic and differential topology prior to 1960. There is only one part which is not covered by the text at all, namely, that which is called "low-dimensional topology". In the focus of setting up of the material stay the history on the emergence of ideas and methods which open new fields of research. The text is divided into three parts. The first part presents the various homology and cohomology theorems, the concept of differentiable manifolds. The second part introduces the concept of degree, discusses dimension theory and separation theorems, the fixed point theorems, local homological properties, quotient spaces and their homology, homology groups and homogeneous spaces and at the end of this part applications of homology to geometry and analysis are given. The third part defines homotopy groups and covering spaces, introduces the concept of fibrations and the homology at fibrations, studies the relations between homotopy and homology, investigates the cohomology operations and generalized homology and cohomology.

The familiarity of the reader with elementary algebra and general topology is assumed.

L. Gehér (Szeged)

Differential Games and Applications, Proceedings. Edited by T. S. Basar, P. Bernhard (Lecture Notes in Control and Information Sciences, 119), VII+201 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1989.

The proceedings contain fifteen articles on differential and dynamic games based on the lectures given at the Third International Symposium on Differential Games and Applications held at INRIA, Sophia-Antipolis, France in 1988. Some of the topics involved are: discrete two-person constant-sum dynamic games; zero-sum differential games of the pursuit-evasion type; stochastic games; applications of the nonzero-sum discrete-time dynamic theory, differential game theory in predator-prey system.

The volume covers a large variety of areas and presents recent developments on topics of current interest. It is warmly recommended to researchers in differential and dynamic games, systems and control, operation research and mathematical economics.

L. Hatvani (Szeged)

Differential Geometry and Topology (Lecture Notes in Mathematics, 1369), VI+366 pages, Springer-Verlag, Berlin—Heidelberg—New York, 1989.

The Nankai Institute of Mathematics, Tianjin, PR China held a Special Year in Geometry and Topology during the academic year 1986—87. This volume contains articles written by invited speakers: T. E. Cecil and S. S. Chern: Dupin Submanifolds in Lie sphere Geometry; R. L. Cohen and U. Tillmann: Lectures on Immersion Theory; S. Murakami: Exceptional Simple Lie Groups and Related Topics in Recent Differential Geometry; U. Simon: Dirichlet Problems and the Laplacian in Affine Hypersurface Theory. The other 20 papers give an up-to-date account on the research activity of the participants of this Special Year from PR China in differential geometry. The central theme of these articles is the geometry and topology of submanifolds and immersions.

This volume will be of interest to researchers in this field or on related subjects.

Péter T. Nagy (Szeged)

Dynamical Systems, Proceedings. Edited by J. C. Alexander (Lecture Notes in Mathematics, 1342), VIII+726 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1988.

The Mathematics Department of the University of Maryland devoted its special academic year 1986—1987 to various aspects of Dynamics. They had a great number of visitors during the special year and organized three conferences entitled Ergodic Theory and Topological Dynamics; Symbolic Dynamics and Coding Theory; Smooth Dynamics, Dynamics and Applied Dynamics. These proceedings contain some of the lectures given at the conferences, some achievements of the special year and papers concerned with the questions and problems raised at the conferences. The reader can find articles on such important topics of dynamics as periodicity, ergodicity, strange attractors, chaotic behaviour, Markov shifts, entropy, automata, etc. The space is not enough here to give a complete list of topics but the reviewer can guarantee that the volume helps the reader obtain an insight into the modern theory of dynamical systems and its application.

L. Hatvani (Szeged)

Foundations of Software Technology and Theoretical Computer Science, Edited by Kesav V. Nori (Proceedings of the Seventh Conference in Pune, India, LNCS, 287), IX+540 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1987.

These Proceedings contain 31 selected contributions and five invited talks or, more exactly, two of them plus three rather short abstracts. The lecture "Parallelism and Programming: A Perspective" presented by K. M. Chandy and J. Misra gives a real perspective and a good overview of the topic. The other invited speaker, R. Parikh mixes the thoughts of ancient philosophers with formal models of knowledge and logic in his brilliant mini-essay "Some Recent Applications of Knowledge".

The ordinary papers were organized in the following 9 sessions.

S.1 Automata and Formal Languages; S.2 Graph Algorithms & Goemetric Algorithms; S.3 Distributed Computing; S.4 Parallel Algorithms; S.5 Database Theory; S.6 Logic Programming; S.7 Programming Methodology; S.8 Theory of Algorithms; S.9 Software Technology.

Some results and methods became a bit dated because of the later archivements (e.g. the equivalence problem for n-tape finite automata considered by Culik and Linna has been settled since then). The interested specialist, however, will still find a lot of valuable information and challenging problems in this volume.

J. Virágh (Szeged)

R. V. Gamkrelidze, Analysis I, (Encyclopaedia of Mathematical Sciences, 13), 238 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo—Hong Kong, 1989.

The text is divided into three parts. The first part (Series and Integral Representations) develops the theory of numerical and function series and of improper integrations in two directions. One of them is the justification of operations with infinite series and the other is the creation of techniques for using series in the solution of mathematical and applied problems. The second part (Asymptotic Methods in Analysis) starts with giving the simplest examples of asymptotic expansions and the basic ideas behind Laplace's method, the method of stationary phase and some asymptotic estimates for sums and series are also considered. Further asymptotic methods for the solutions of ordinary and partial differential equations and systems are described and asymptotic forms for the solutions of second order equations in the complex domain is constructed. The third part (Integral Transforms) deals with the usual integral transforms especially with the Fourier, Laplace, Mellin, Bessel and Hankel transforms. These are considered not from the point of view of functional analysis, that is not as mappings from a function space into another function space, but from the point of view of the applications to the solutions of ordinary and partial differential equations and of integral equations.

The book is highly recommended to anybody who are interested in the applications of the integral transform methods for solutions of differential equations.

L. Gehér (Szeged)

Geometric Aspects of Functional Analysis, Edited by J. Lindenstrauss and V. D. Milman. (Lecture Notes in Mathematics, 1317, 1376), VI+289 and VI+288 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1988.

These are the third and fourth published volumes of the proceedings of the Israel Seminar on Geometric Aspects of Functional Analysis which cover the 1986—87 and 1987—88 sessions of the seminar. From the volumes it turns out that one of the main objects of the seminar was the systematic study of the connections between finite dimensional convexity theory and Banach space theory. The participants developed a powerful technic based on probabilistic and combinatorial methods to obtain quantitative versions of classical theorems of convexity. It is worth quoting here a typical result of this kind which can be found in the paper of I. Bourgin, J. Lindenstrauss and V. D. Milman "Minkowski sums and symmetrizations". They proved that for every $\varepsilon>0$ we get from K (a given n-dimensional convex body) after performing $c\cdot n\cdot\log n+c(\varepsilon)\cdot n$ random Minkowski symmetrizations a body which is (with a large probability) up to ε an Euclidean ball.

Most of the papers in both volumes are original research papers and contain new and strong methods. The volumes are recommended to research workers in convex geometry and functional analysis.

J. Kincses (Szeged)

Vladislav V. Goldberg, Theory of Multidimensional $(n+1)$-Webs, (Mathematics and Its Applications), XXI+466 pages, Kluwer Academic Publishers, Dordrecht—Boston—London, 1988.

This comprehensive book on web geometry gives a complete treatment of the new development of this theory, which principally was connected with the scientific activity of the author of this book.

The history of differential geometric web theory has three periods. The first one was the work of the school of Wilhelm Blaschke between the two World Wars in Germany. Blaschke and his associates published a series of papers under the heading "Topologische Fragen der Differentialgeometrie" and a monograph: W. Blaschke—G. Bol: "Geometrie der Gewebe". The basic idea of the papers and the book was to apply the theory of local invariants of analytical differential equations to the classification of finite sets of smooth local line families in plane domains, whose abstract analogies appear in the axiomatics of projective planes. These local line structures of the plane (and also line and plane configurations in the 3-space) were called webs of lines or surfaces. The most interesting result of this period was the introduction of local coordinate loops for three families of "parallel" lines (3-webs) in the plane and the translation of geometric closure conditions into algebraic language. These results made an essential influence on the rapid development of abstract geometric algebra, and motivated investigations in non-associative algebra, combinatorial and topological geometry. The second period was initiated by the dissertation of S. S. Chern written under Blaschke in Hamburg (1936), where 3-webs on $2r$-dimensional domains were introduced as $3r$-codimensional foliations in general position. After more than 30 years this research had a new beginning in the series of papers of M. A. Akivis and his school in Moscow. They worked out a complete, closed theory of local 3-webs on $2r$-dimensional manifolds, using Cartan's differential calculus and reduction techniques of principal fiber bundles associated to differential geometric structures. They have clarified the interrelation of this theory to non-associative algebra, algebraic geometry and projective differential geometry.

In the third period the investigations were extended to the theory of more than three foliations. In this case the geometric picture will be, of course, much more complicated, but the theory establishes new connections with other branches of mathematics, especially with algebraic geometry, complex analysis, Abelian differential equations, characteristic classes, etc. The purpose of the present book is to give a systematic explanation of the theory developed in this period, whose essential part consists of the author's own results. The first two Chapters contain a treatment of the differential geometric methods and constructions, used in the study of $(n+1)$-webs, which are defined by $n+1$ foliations of codimension r in general position on a manifold of dimension nr. In Chapter 3 there a treatment of the correspondence between $(n+1)$-webs and local differentiable n-quasigroups is given. Chapter 4 contains the characterization of different classes of $(n+1)$-webs satisfying certain closure conditions. Chapter 5 gives a study of the realization of webs by foliations of Schubert varieties induced by projective surfaces. There is also given a systematic investigation of the case, when the generating projective surfaces are algebraic varieties. These results present a lot of very interesting examples of $(n+1)$-webs, making clear the very close relationship between web geometry and algebraic geometry. Chapter 6 is devoted to the study of application of web theory to the theory of point correspondences of $n+1$ projective spaces and to the theory of holomorphic mappings between polyhedral domains in a complex vector space. Chapter 7 contains a study of webs, which is given by four r-codimensional foliations on a $2r$-dimensional manifold. These webs can be coordinatized by a pair of orthogonal quasigroups. Different closure conditions and their realization as webs on Grassmannians induced by projective or algebraic surfaces are investigated. The last Chapter 8 is devoted to the rank problem of webs formulated by S. S. Chern and P. A. Griffiths in connection with the theory of Abelian differential equations.

This book is a basic reference of web geometry and gives a new impulse to the further development of this theory and of the related fields: non-associative algebra, topological, combinatorial and algebraic geometry, theory of foliations and their applications. It is highly recommended to all mathematicians interested in the interrelations of analytical theory, geometry, algebra and topology.

Peter T. Nagy (Szeged)

Harmonic Analysis and Partial Differential Equations, Edited by J. Garcia-Cuerva (Lecture Notes in Mathematics, 1384), VII+213 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo—Hong Kong, 1989.

Since 1979 every four year a conference has been organized on Harmonic Analysis and Partial Differential Equations in El Escorial, Spain. This book contains the courses and lectures held in 1987. The characteristic main courses took three or four hours. Their authors and titles were: D. L. Burkholder: Differential subordination of harmonic functions and martingales; P. W. Jones: Square functions, Cauchy integrals, analytic capacity and harmonic measure; C. E. Kenig: Restriction theorems, Carleman estimates, uniform Sobolev inequalities and unique continuation; S. Wainger: Problems in harmonic analysis related to curves and surfaces with infinitely flat points.

Let us cite a few introductory sentences from the first of them to characterize the text: "A fruitful analogy in harmonic analysis is the analogy between a conjugate harmonic function and a martingale transform. One idea that underlies both of these concepts is the idea of differential subordination. Our study of it here yields new information about harmonic functions and martingales, and their interaction. For example, let H be a real or complex Hilbert space with norm $|\cdot|$. Let u and v be harmonic in the open unit disk of C with values in H. If $|v(0)|\leqq|u(0)|$ and $|\nabla v(z)|\leqq\leqq|\nabla u(z)|$ for all z with $|z|<1$, then

$$m(\{t\in[0,2\pi)\colon |u(re^{it})|+|v(re^{it})|\geqq 1\})\leqq 2\int_0^{2\pi}|u(re^{it})|\,dt,$$

where $0<r<1$ and m denotes Lebesgue measure."

The second half of the book consists of the ten 45-minute lectures.

The material comprehending more branches of mathematics offers up-to-date results and problems and at the same time by its presentation it is attractive for non specialists as well.

L. Pintér (Szeged)

M. Humi—W. Miller, Second Course in Ordinary Differential Equations for Scientists and Engineers (Universitext), XI+441 pages, Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo, 1988.

Nowadays the number of students taking courses in differential equations has been growing in consequence of the important applications of this theory in sciences and engineering. More and more of these students want to get acquainted with the more advanced topics of the theory of differential equations. While there are many good elementary books, there is a need for texts on the advanced topics. This book, which is an outgrowth of second courses in differential equations taught by the authors in the last ten years at Worcester Polytechnic Institute, bridges this gap.

Chapter 0 recalls the method of solutions of differential equations by series. Chapter 1 is devoted to boundary value problems. Chapter 2 treats special functions being solutions of important boundary value problems. Chapter 3 contains some additional material to the theory of linear systems given by beginning texts. Chapter 4 through 10, forming the most attractive and valuable part of the book, examine specific applications of differential equations: Chapter 4: Applications of Symmetry Principles to Differential Equations; Chapter 5: Equations with Periodic Coefficients; Chapter 6: Green's Functions; Chapter 7: Perturbation Theory; Chapter 8: Phase Diagrams and Stability; Chapter 9: Catastrophes and Bifurcations; Chapter 10: Sturmian Theory.

The style of the book is well-guided by the intended audience: it does not contain exhausting proofs of mathematical theorems, they are rather motivated by examples. By the way, the great number of examples make the book easily readable and useful for students and users interested in advanced topics of differential equations and their applications.

L. Hatvani (Szeged)

Robion C. Kirby, The Topology of 4-manifolds (Lecture Notes in Mathematics, 1374), VI+108 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo—Hong Kong, 1989.

Well, the reviewer's task is very hard when the subject of the book is so special, recent and actively studied as the present one. I think the best I can do is to enumerate the main titles of the book not to bore the non-specialists: Rihlin's theorem, Freedman's work, Donaldson's work. $p_1(M)=3\sigma(M)$, Wall's diffeomorphisms and Casson handless.

Anyway the book gives some introduction to the most necessary specialities of the subject as well as some interesting new results. It offers a review on the present state of its subject so it is necessary not only to the researchers who work on this topic but also for those mathematicians and physicists who want to work on or only want to know the main results for possible applications.

Á. Kurusa (Szeged)

P. J. M. van Laarhoven—E. H. L. Aarts, Simulated Annealing: Theory and Applications (Mathematics and its Applications), XI+187 pages, D. Reidel Publishing Company, Dodrecht—Boston—Lancaster—Tokyo, 1987.

The general local search method to solve a combinatorial optimization problem such as the Travelling Salesman Problem is to get iteratively better solutions by searching a neighborhood of the current solution for improvement. The simulated annealing algorithm modifies this approach by introducing two new components: the next solution is selected using randomization and sometimes it is accepted even if it is worse than the previous solution (thus giving, a chance to get out of a local minimum). The name comes from an analogy in physics (annealing is a process of slowly cooling a solid to obtain a low energy state).

Simulated annealing was introduced by Kirkpatrick, Gelatt and Vecchi, and independently by Černy in the early 80's. It was received with great interest as a possible way of obtaining good approximate solutions for notoriously hard computational problems.

The book of van Laarhoven and Aarts gives an overview of the considerable amount of research done already in this field. Theoretically the main problem is to find good "cooling schedules" — the questions arising here concern inhomogeneous Markov chains. The relevant results are formulated without proofs. More emphasis is given to the description of several proposed cooling schedules and their performance in practice. These chapters provide valuable information about the efficiency of the simulated annealing method by comparing it with other known approximation algorithms. A good survey is given of different applications e.g. in computer-aided circuit design. (We note here that a new aspect is described in the book: Simulated Annealing and Boltzmann Machines — A Stochastic Approach to Combinatorial Optimization and Neural Computing, by E. Aarts and J. Korst, Wiley-Interscience Series in Discrete Mathematics and Optimization, 1988.)

The book is a very nice synthesis and it solves the difficult task of presenting a diverse field within 200 pages excellently. It has a clear organization, gives an insightful and balanced picture and it is accessible to non-specialists as well. As simulated annealing is a tool that should be at the disposal of everybody interested in combinatorial optimization, the book is highly recommended as an introduction and guide to this topic.

György Turán (Szeged)

P. Lochak—C. Meunier, Multiphase Averaging for Classical Systems (With Applications to Adiabatic Theorems), (Applied Mathematical Sciences, 72), XI+360 pages, Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo, 1988.

It is known that the most of differential equations are not integrable even they do not admit a complete qualitative investigation. However, some equations often can be considered as perturbed systems of simpler equations whose solutions or behaviour of the solutions are known. The perturbation theory reduces the investigation of the system to that of the simpler perturbed equation. If the effect of the perturbation is characterized by a small parameter, then this reduction is made by the method of averaging. It is needed when we are interested in the behaviour of solutions during a long period. For example, in celestial mechanics, the unperturbed model takes into account the interactions between only the Sun and the planets; the interactions between the planets give the perturbations, whose effects are characterized by the proportions of the masses of the planets and the Sun. The method of averaging gives the opportunity of predicting the evolution of the orbits of planets during the thousands of years.

The book is an excellent well-written monograph of the averaging method. It yields a systematic treatment of the modern results, a great part of which was available earlier only in Russian. It gives a good survey on the general case and examines the role of ergodicity in averaging. Special attention is devoted to Hamiltonian systems and to the relation of stability results of the averaging method to Kam Theory. Finally, both classical and quantum adiabatic theorems are considered.

The monograph should be useful to researchers and graduate students in applied mathematics, engineering and physics.

L. Hatvani (Szeged)

Gerhard Maess, Vorlesungen Über numerische Mathematik, II. Analysis, 327 pages, Akademie Verlag, Berlin and Birkhäuser Verlag, Basel, 1988.

This two-volume introduction contains the standard "first book" topics in Numerical Analysis. For orientation here follows a brief review of the contents with a few characteristic keywords in parentheses.

Volume I. Linear Algebra (published separately)

Ch. 1. The basics of numerical computation (roundoff error analysis, interval arithmetic).
Ch. 2. Systems of linear equations (direct and iteration methods, sparse systems, error analysis).
Ch. 3. Overdetermined linear systems (linear least squares, orthogonalization techniques, pseudoinverse).
Ch. 4. Eigenvalue problems (basic facts, vector iteration, QR-method).

Volume II. Analysis

Ch. 5. (Systems of) nonlinear equations (bisection, secant and Newton method, roots of polynomials, inclusion theorems, Bairstow's method, generalized Newton method, rank 1 methods).

Ch. 6. Interpolation and approximation (interpolation by polynomials and spline functions, least square approximations, fast Fourier transform, best approximation with polynomials).

Ch. 7. Numerical quadrature and cubature (Newton—Cotes formulae, Richardson-extrapolation, Gaussian integration methods, Newton—Cotes cubature).

Ch. 8. Initial value problems of ODE (one-step methods, explicit Runge—Kutta methods, extrapolation methods).

The author follows an "inductive Scheme" by expanding each of the subtopics. As a first step, different examples are exposed from various fields, e.g. classical mathematics, physics, engineering, etc. After the mathematical formulation of the problem and the theoretical background the discussion of the algorithm(s) starts. These algorithms are presented in tabular form using "semi-formalized" natural language. A few numerical experiments of the reviewer justify the author's claim: these descriptions can be converted with moderate efforts into working computer programs, indeed. Each topic ends with a "notes and remarks" section that gives a lot of valuable information both on the mathematical details and the bibliographical sources of the relevant methods. Finally, hundreds of exercises are listed ranging from simple calculations to theoretical problems loosely connected with the tackled methods. Moreover, 12 pages on literature (approximately half of them with German items) and a detailed index section aid the reader. This volume contains much more material than you would think at first sight. But this is not a compliment: the typesetting is a bit thick.

The main body of the book contains relatively few full proofs. This makes it suitable for undergraduate courses even for students with neither a math nor a computer science major. The more talented student can find hints for further study at the end of the sections.

J. Virágh (Szeged)

Eli Maor, To Infinity and Beyond, A Cultural History of the Infinite, XVI+275 pages, with 162 illustrations and 6 color plates, Birkhäuser, Boston—Basel—Stuttgart, 1987.

"I see it, but I don't believe it!" (G. Cantor in a letter to R. Dedekind.)

Perhaps you have read the paper of R. Péter "Mathematics is beautiful" published in The Mathematical Intelligencer Vol. 12, No. 1. In this paper R. Péter tried to show that one can fall in love with mathematics, because it is beautiful. It is possible that the succeeded to convince you, but after reading the book of E. Maor you have not the slightest doubt that mathematics is really beautiful, and perhaps you will find more handsomeness in everyday life as well. This book is written for everyone who is eager to know the world over us, for everyone who is curious to catch the beauty around us.

The Infinity is an interesting question for every educated person, because it has many faces. In this book the discussed four faces are: Mathematical Infinity, Geometric Infinity, Aesthetic Infinity, and Cosmological Infinity. (There is an Appendix with some necessary mathematical results.)

Every chapter is a masterpiece, but for me the third chapter on aesthetic infinity was the shocking hit and above all M. Escher Master of the Infinite in it. Let us cite Escher: "I am happy about the contact and friendship of mathematicians that resulted from it all. They have often given me new ideas, and sometimes there even is an interaction between us. How playful they can be, those learned ladies and gentlemen!"

The illustrations, the presentation of the book are marvellous.

In my opinion this work is extraordinarily useful for teachers, after reading it we understand better our mission.

L. Pintér (Szeged)

Mathematical Aspects of Scientific Software, Edited by J. R. Rice (The IMA Volumes in Mathematics and Its Applications, 14), XI+208 pages, Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo, 1988.

From the Preface:

"Scientific software is the fuel that drives today's computers to solve a vast range of problems. Huge efforts are put into developing new software, new systems and new algorithms for scientific problem solving. The ramifications of this effort echo throughout science and, in particular, into mathematics. This book explores how scientific software impacts the structure of mathematics, how it creates new subfields and how new classes of mathematical problems arise."

The Editor identifies a dozen of characteristic topics in his opening survey. The 8 further contributions are from the following fields.

1. Different aspects of parallelism are investigated in "The Mapping Problem in Parallel Computation" (by F. Berman) and "Data Parallel Programming and Basic Linear Algebra Subroutines" (by S. L. Johnsson).
2. Symbolic and numeric computation is the content of the works "Scratchpad II: An Abstract Datatype System for Mathematical Computation" (by R. D. Jenks, R. S. Sutor and S. M. Watt) and "Integrating Symbolic, Numeric and Graphics Computing Techniques" (by P. S. Wang).
3. In the paper "Performance of Scientific Software" (by E. N. Houstis, J. R. Rice, C. C. Christara and E. A. Vavalis) an abstract Performance Evaluation Model is introduced and applied for elliptic PDE solvers of the ELLPACK.
4. The remaining three works are more or less connected with algorithms for geometry: "Applications of Gröbner Bases in Non-linear Computational Geometry" (by B. Buchberger), "Geometry in Design: The Bezier Method" (by G. Farin) and C. M. Hoffmann's "Algebraic Curves".

Although the contributions are rather different both in scope and depth (my favorites were Buchberger's paper and the Scratchpad II description), as a whole, they give a good overview of this rapidly developing branch.

J. Virágh (Szeged)

Mathematical Economics, Edited by A. Ambrosetti, F. Gori and R. Lucchetti (Lecture Notes in Mathematics, 1330), VII+137 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1988.

Nowadays more and more sciences have used mathematics. This phenomenon results in very fruitful interactions between mathematics and sciences, among them economics. The varying relationship between mathematicians and economists has been described very properly by the first paragraph of Introduction of the book: "In the last few years an ever increasing interest has been shown by economists and mathematicians in deepening and multiplying the many links already existing between their areas of research. Economists are looking for more advanced mathematical techniques to be applied to the analysis of formal models of greater complexity; mathematicians have found in problems from economics the stimulus to start new directions of study and to explore different trends within their theories."

To offer scholars from the two fields an opportunity of meeting and working together, the Centro Internazionale Mathematico Estivo (C.I.M.E.) organized a Session on "Mathematical Economics" at Villa La Querceta in Montecatini Terme, Italy in 1986. The present lecture notes contains the subject-matter of the four survey courses of the Session: I. Ekeland, Some variational methods arising from mathematical economics; A. Mas-Cobell, Four lectures on the differentiable approach to general equilibrium theory; J. Scheinkman, Dynamic general equilibrium models; S. Zamir, Topics in non-cooperative game theory.

After having read the volume one believes that the editors' opinion is true: the mathematics has become more and more important for economists, and the mathematicians can find more and more stimulating problems in economics.

L. Hatvani (Szeged)

László Máté, Hilbert Space Methods in Science and Engineering, VIII+273 pages, Akadémiai Kiadó, Budapest, 1989.

Do you think that you ought to become more familiar with mathematical methods applied in your special line? Certainly many students, engineers and scientists do so. One, who uses methods based on "higher" mathematics, has often not enough time and energy for studying such disciplines.

In case if this discipline is Hilbert space theory, the present book can certainly help to overcome the difficulties. Even a look at the table of "Contents" shows that it contains pretty large material, the potential reader surely will find something of his special interest.

Reading then only a few pages, one can easily recognize: This book differs from a usual "Introduction to the Theory of ...". This is a work for those, who want to understand the basic facts and notions, to get aquainted with the corresponding methods, but prefers some illustrative examples rather than the details of complicated arguments. However, the proofs are not completely omitted, and the book is far from a collection of definitions, theorems and simple descriptions of methods to be applied. From the Preface: "The bulk of the applications revolve around reproducing kernel Hilbert spaces and causal operators. Several applications are treated here for the first time at an introductory level."

The prerequirements certainly will not keep back the reader from understanding the text. He needs to be familiar only with the elements of mathematical analysis and basic facts of linear algebra. Then how to treat L^2-spaces? Well, the author considers only the submanifold consisting of the continuous functions whenever he can do so. However, the concept of Lebesgue integral clearly cannot be completely avoided.

Who to recommend this book to? I think, the answer is suggested already by its title.

E. Durszt (Szeged)

Johannes C. C. Nitsche, Lectures on Minimal Surfaces Vol. 1, XXV+563 pages, Cambridge University Press, New York—New Rochelle—Melbourne—Sydney, 1989.

This book is the enlarged and updated version of the first five chapters of the author's book "Vorlesungen über Minimalflachen" originally published in the series "Grundlehren der matematischen Wissenschaften" in 1975.

Since the last decade has been one of extraordinary research activities on all fronts of minimal surface theory recently there was a claim to a more or less synthetic book of this subject. In the last decade the key book of this topic was the author's one, mentioned above, which not only summarized the results before but also formulated research problems (mainly in section IX. 2) which have become actively studied.

Therefore I could not find better solution to satisfy the real titles of the subject than this development of the German book.

We avoid the detailed review of the book because its original is so well known. It preserved the spirit and scope of the Vorlesungen. Its style with many figures is as clear as or sometimes clearer than its original version. We are looking forward the second and third parts.

In our opinion this book is indispensable to anyone working in the field.

Á. Kurusa (Szeged)

R. S. Palais—C. L. Terng, Critical Point Theory and Submanifold Geometry (Lecture Notes in Mathematics, 1353), X+271 pages, Springer-Verlag, Berlin—Heidelberg—New York, 1988.

This book grew out of the lectures given by the authors at Nankai Institute of Mathematics, Tianjin, China in May of 1987. The book consists of two, inter-related parts corresponding to the two series of these lectures. Chapters 1—4 of Part I give an introduction to the classical and modern submanifold theory of Euclidean and Hilbert spaces: Levi—Civita connections, vector fields and differential equations, local invariants of submanifolds, fundamental theorem of submanifolds in space forms, Weingarten surfaces in three dimensional space forms, immersed flat tori in S^3, focal structure of submanifolds. Chapters 5—8 contain a systematic treatment of the theory of isoparametric submanifolds of Hilbert spaces developed by the authors in the last years. (A submanifold is called isoparametric if its normal curvature is zero and the principal curvatures along any parallel normal field are constant.) These submanifolds arise naturally in representation theory for, in particular the principal orbits of the isotropy representation of a symmetric space are homogeneous isoparametric, but there are also many non-homogeneous examples. Part II is a self-contained account of critical point theory on Hilbert manifolds. The two parts are connected through the Morse Index Theorem, which is applied to the investigation of the topology of isoparametric submanifolds of Hilbert spaces.

The reader is assumed to be familiar only with the elementary theory of differentiable manifolds and Riemannian geometry. The book is a very good introduction to the research problems in the field, and can be warmly recommended to the mathematicians who are interested in a beautiful interplay between Riemannian geometry, functional analysis, topology and transformation group theory.

Peter T. Nagy (Szeged)

R. R. Phelps, Convex Functions, Monotone Operators and Differentiability (Lecture Notes in Mathematics, 1364), VII+114 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1989.

This clearly written book contains wealthy material on the differentiability properties of convex functions on infinite dimensional spaces. The genesis of this work is the set of notes "Differentiability of convex functions on Banach spaces" which was written by the author for a graduate course at University College London.

The first Chapter deals with the definition of convex functions; Mazur's theorem on differentiability of convex function on a separable Banach space; and the subdifferential of a convex function. Chapter 2 is devoted to the monotone operators (as a matter of fact the subdifferential is a special case of a monotone operator). The results of this Chapter all involve continuous convex functions defined on open convex sets. But in many applications lower semicontinuous convex function should be considered. This topic is the main subject of Chapter 3. Borwein—Preiss smooth-variational principle (which uses differential perturbation) is the central question in Chapter 4. The following Chapter 5 deals with spaces with Radon—Nikodym property and some questions related to the optimization (particularly to the so-called perturbed optimization). The short Chapter 6 is devoted to the class of Banach spaces in which every continuous convex function is Gateaux differentiable in a dense set of points. Chapter 7 gives a generalization of monotone operators to the upper semicontinuous compact valued maps.

The present book is highly recommended to all who interested in mathematical analysis.

J. Németh (Szeged)

András Recski, Matroid Theory and its Applications, XIII+531 pages, Akadémiai Kiadó, Budapest, 1989.

Matroid theory is one of the most deepest parts of combinatorics, as well as being one of the most important ones from the point of view of application.

The author's aim was to show the present state of the theory with special emphasis on its algorithmic aspects and on the applications in electrical engineering and in statics.

The book is divided into two parts. The first part contains the background about graphs and algebra.

Here it can be found the fundamental constructions and algorithms in graph theory which serve as a root of matroids: trees, forests, cut sets, circuits, planar graphs, duality, matching for bipartite graphs and flow theory.

The second part is devoted to matroids. After presenting the basic concepts such as duality, minors, direct sum, connectivity, greedy algorithm, the following topics are discussed in detail: the representations of matroids, the sum of matroids, induced matroids. The last "mathematical" section is devoted to some recent results in matroid theory.

The book is self-contained, written very carefully. Mathematical results are presented in the odd numbered chapters only. Even numbered chapters describe associated applications. It contains quite a lot of figures which illustrate the abstract constructions and proofs. Each section ends with exercises for checking the reader's understanding and problems which are more difficult.

The book is recommended to both mathematicians and engineers who are interested in matroid theory and its applications but it may serve as a handbook for researchers in matroid theory.

J. Kincses (Szeged)

Elmer G. Rees, Notes on Geometry (Universitext), VIII+109 pages, Springer-Verlag, Berlin—Heidelberg—New York, 1988.

This book is about the Euclidean, the projective and the hyperbolic geometry. In some sense it is a review on these topics from a relatively new viewpoint. At the same time it uses the material most natural for undergraduate students, such as linear algebra, group theory, metric spaces and complex analysis.

What is new in this book is its viewpoint, which makes bridge between the classical geometry and the topology or differential geometry. While this viewpoint gives undergraduate students a deeper understanding of these geometries it may be considered as a step before the first one to differential geometry.

We recommend this book to all undergraduate students interested in geometry, because of the advantages mentioned above and the concrete treats of these very important geometries. The students can also find a large number of exercises and problems.

Á. Kurusa (Szeged)

Martin Schlichenmaier, An Introduction to Riemann Surfaces, Algebraic Curves and Moduli Spaces (Lecture Notes in Physics, 322), VII+148 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1989.

The algebraic and analytic geometry are becoming more and more useful in theoretical physics due to the string theories among others. This book contains an introductory lecture course for physicists in this subjects.

Although the book is very thin one may be surprised about what a large number of topics are in it. At the same time, and this is really a surprise, it can teach basic calculations together with a basic view of these subjects. This book is not self-contained because some fundamental theorems, as the Riemann—Roch theorem for example, are not proven, but I think this makes it more useful as an introduction for physicists. If a reader would like to learn further the well-selected bibliography will help him/her.

In sum, we recommend this book to all physicists who want to know these modern subjects and to students of mathematics or physics who are looking for a short introduction to the various aspects of these subjects.

Á. Kurusa (Szeged)

L. Sirovich, Introduction to Applied Mathematics (Texts in Applied Mathematics, 1) XII+370 pages, Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo, 1988.

It is a commonplace that mathematics plays a more and more important role in various sciences. The circle of the users of mathematics is continuously widening. The aim of this series is to present textbooks for use in advanced undergraduate and beginning graduate courses.

Perhaps the main problem of this kind of works is in some sense pedagogical: to give the students confidence in mathematical methods and — the most important — success in problem solving. The appropriate rank of mathematical rigor in discussions makes the work understandable and applicable.

This book grew out of courses held by the author at Brown University. Chapter headings are: Complex Numbers, Convergence and Limit, Differentiation and Integration, Discrete Linear Systems, Fourier Series and Applications, Spaces of Functions, Partial Differential Equations, The Fourier and Laplace Transforms, Partial Differential Equations (continued).

The author's basic aim was to present standard methods, as he says "a basic bag of tricks". He disregards the theorem-proof format for the sake of a more informal style.

The distinguishing feature of the work is the 4th chapter on discrete linear systems. Here one finds periodic sequences; discrete Fourier series and transforms; the fast Fourier algorithm; the cell model of diffusion; the Z-transform and applications; the Wiener—Hopf method.

Two chapters are devoted to the partial differential equations applying various methods especially an eigenfunction approach. Perhaps a little more discussion on the Dirac delta function would be useful.

There is a fine collection of exercises, in which many important applications appear. Perhaps some more hints would be useful but separately and not immediately after the problems.

At last I would like to mention the extraordinarily beautiful and useful illustrations.

L. Pintér (Szeged)

Hans L. Trinkaus, Probleme? Höhere Mathematik! Eine Aufgabensammlung zur Analysis, Vektor- und Matrizenrechnung, Herausgegeben von H. Neunzert (Mathematik für Physiker und Ingenieure), IX+337 pages, Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo, 1988.

This is an interesting book and I would like to have one on my table.

The book consists of two approximately equal parts: 1. Theory and Praxis, 2. Results (solutions and remarks). Some titles from the first part: real numbers, mathematical induction, complex numbers, real functions, sequences, series, differentiation, integration, Taylor series, R^n space, matrices, determinants. In every chapter you will find the necessary simple notations, clear definitions, important theorems (without proofs), several interesting remarks, and then the most essential part: the exercises. These are useful both for students and teachers, because almost every problem is in strong connection with everyday life. There are problems from physics, biophysics, chemistry, biology, psychology, music, sports (e.g. Fosbury-Flop) and so on.

In studying physics (or more general natural sciences) students have troubles because they do not know the necessary mathematical ideas or they cannot apply their mathematical knowledge. (Sometimes they believe that it is good for nothing.) This book can change their ground. The literary citations (the authors are: Goethe, Platon, Kant, Nietzsche, Storm, Camus and others) and above all the historical remarks (quotations, letters, dates etc.) make this work a many-coloured reading.

Finally here is one of the inspiring citations (it may be found in chapter on mathematical induction): "Man heisst die Ehe gut, erstens weil man sie noch nicht kennt, zweitens weil man sich an sie gewöhnt hat, drittens weil man sie geschlossen hat, — das heisst fast in allen Fallen. Und doch ist damit nichts für die Güte der Ehe überhaupt bewiesen." (F. Nietzsche).

L. Pintér (Szeged