

Discrete Mathematics Biggs

This fifth edition continues to improve on the features that have made it the market leader. The text offers a flexible organization, enabling instructors to adapt the book to their particular courses. The book is both complete and careful, and it continues to maintain its emphasis on algorithms and applications. Excellent exercise sets allow students to perfect skills as they practice. This new edition continues to feature numerous computer science applications-making this the ideal text for preparing students for advanced study.

This concise, readable book provides a sampling of the very large, active, and expanding field of artificial neural network theory. It considers select areas of discrete mathematics linking combinatorics and the theory of the simplest types of artificial neural networks. Neural networks have emerged as a key technology in many fields of application, and an understanding of the theories concerning what such systems can and cannot do is essential. Some classical results are presented with accessible proofs, together with some more recent perspectives, such as those obtained by considering decision lists. In addition, probabilistic models of neural network learning are discussed. Graph theory, some partially ordered set theory, computational complexity, and discrete probability are among the mathematical topics involved. Pointers to further reading and an extensive bibliography make this book a good starting point for research in discrete mathematics and neural networks.

Note: This is the 3rd edition. If you need the 2nd edition for a course you are taking, it can be found as a "other format" on amazon, or by searching its isbn: 1534970746 This gentle introduction to discrete mathematics is written for first and second year math majors, especially those who intend to teach. The text began as a set of lecture notes for the discrete mathematics course at the University of Northern Colorado. This course serves both as an introduction to topics in discrete math and as the "introduction to proof" course for math majors. The course is usually taught with a large amount of student inquiry, and this text is written to help facilitate this. Four main topics are covered: counting, sequences, logic, and graph theory. Along the way proofs are introduced, including proofs by contradiction, proofs by induction, and combinatorial proofs. The book contains over 470 exercises, including 275 with solutions and over 100 with hints. There are also Investigate! activities throughout the text to support active, inquiry based learning. While there are many fine discrete math textbooks available, this text has the following

advantages: It is written to be used in an inquiry rich course. It is written to be used in a course for future math teachers. It is open source, with low cost print editions and free electronic editions. This third edition brings improved exposition, a new section on trees, and a bunch of new and improved exercises. For a complete list of changes, and to view the free electronic version of the text, visit the book's website at discrete.openmathbooks.org

This new edition illustrates the power of linear algebra in the study of graphs. The emphasis on matrix techniques is greater than in other texts on algebraic graph theory. Important matrices associated with graphs (for example, incidence, adjacency and Laplacian matrices) are treated in detail. Presenting a useful overview of selected topics in algebraic graph theory, early chapters of the text focus on regular graphs, algebraic connectivity, the distance matrix of a tree, and its generalized version for arbitrary graphs, known as the resistance matrix. Coverage of later topics include Laplacian eigenvalues of threshold graphs, the positive definite completion problem and matrix games based on a graph. Such an extensive coverage of the subject area provides a welcome prompt for further exploration. The inclusion of exercises enables practical learning throughout the book. In the new edition, a new chapter is added on the line graph of a tree, while some results in Chapter 6 on Perron-Frobenius theory are reorganized. Whilst this book will be invaluable to students and researchers in graph theory and combinatorial matrix theory, it will also benefit readers in the sciences and engineering.

Graph Theory in Memory of G.A. Dirac
Mathematics for Economics and Finance
for New Technology

Combinatorics and Graph Theory

According to the great mathematician Paul Erdős, God maintains perfect mathematical proofs in The Book. This book presents the authors candidates for such "perfect proofs," those which contain brilliant ideas, clever connections, and wonderful observations, bringing new insight and surprising perspectives to problems from number theory, geometry, analysis, combinatorics, and graph theory. As a result, this book will be fun reading for anyone with an interest in mathematics.

This instructive book introduces the key ideas behind practical nonlinear optimization, accompanied by computational examples and supporting software. It combines computational finance with an important class of numerical techniques.

Invitation to Discrete Mathematics is an introduction and a thoroughly comprehensive text at the same time. A lively and entertaining style with mathematical precision and maturity uniquely combine into an intellectual happening and should delight the interested reader. A master

example of teaching contemporary discrete mathematics, and of teaching science in general.

Combinatorics is a subject of increasing importance, owing to its links with computer science, statistics and algebra. This is a textbook aimed at second-year undergraduates to beginning graduates. It stresses common techniques (such as generating functions and recursive construction) which underlie the great variety of subject matter and also stresses the fact that a constructive or algorithmic proof is more valuable than an existence proof. The book is divided into two parts, the second at a higher level and with a wider range than the first. Historical notes are included which give a wider perspective on the subject. More advanced topics are given as projects and there are a number of exercises, some with solutions given.

Quite Right

Invitation to Discrete Mathematics

Graph Theory, 1736-1936

Discrete and Combinatorial Mathematics

Selected Topics

The widespread use of computers and the rapid growth in computer science have led to a new emphasis on discrete mathematics, a discipline which deals with calculations involving a finite number of steps. This book provides a well-structured introduction to discrete mathematics, taking a self-contained approach that requires no ancillary knowledge of mathematics, avoids unnecessary abstraction, and incorporates a wide range of topics, including graph theory, combinatorics, number theory, coding theory, combinatorial optimization, and abstract algebra. Amply illustrated with examples and exercises. First published in 1976, this book has been widely acclaimed both for its significant contribution to the history of mathematics and for the way that it brings the subject alive. Building on a set of original writings from some of the founders of graph theory, the book traces the historical development of the subject through a linking commentary. The relevant underlying mathematics is also explained, providing an original introduction to the subject for students. From reviews: 'The book...serves as an excellent example in fact, as a model of a new approach to one aspect of mathematics, when mathematics is considered as a living, vital and developing tradition.' (Edward A. Maziark in Isis) 'Biggs, Lloyd and Wilson's unusual and remarkable book traces the evolution and development of graph theory...Conceived in a very original manner and obviously written with devotion and a very great amount of painstaking historical research, it contains an exceptionally fine collection of source material, and to a graph theorist it is a treasure chest of fascinating historical information and curiosities with rich food for thought.' (Gabriel Dirac in Centaurus) 'The lucidity, grace and wit of the writing makes this

book a pleasure to read and re-read.' (S. H. Hollingdale in Bulletin of the Institute of Mathematics and its Applications)

This much-awaited new edition of Biggs' best-selling text includes new chapters on statements and proof, logical framework, and natural numbers and the integers, in addition to updated chapters, over 1000 tailored exercises and an accompanying website containing hints and solutions to all exercises. The text is designed explicitly for mathematicians and computer scientists seeking a first approach to this important topic.

This an introduction to the theory of computational learning.

Codes: An Introduction to Information Communication and Cryptography

Discrete Mathematics of Neural Networks

Discrete Mathematics (eighth Edition)

An Open Introduction

Methods and Modelling

Graph theory goes back several centuries and revolves around the study of graphs—mathematical structures showing relations between objects. With applications in biology, computer science, transportation science, and other areas, graph theory encompasses some of the most beautiful formulas in mathematics—and some of its most famous problems. The Fascinating World of Graph Theory explores the questions and puzzles that have been studied, and often solved, through graph theory. This book looks at graph theory's development and the vibrant individuals responsible for the field's growth. Introducing fundamental concepts, the authors explore a diverse plethora of classic problems such as the Lights Out Puzzle, and each chapter contains math exercises for readers to savor. An eye-opening journey into the world of graphs, The Fascinating World of Graph Theory offers exciting problem-solving possibilities for mathematics and beyond. A Spiral Workbook for Discrete Mathematics covers the standard topics in a sophomore-level course in discrete mathematics: logic, sets, proof techniques, basic number theory, functions, relations, and elementary combinatorics, with an emphasis on motivation. The text explains and clarifies the unwritten conventions in mathematics, and guides the students through a detailed discussion on how a proof is revised from its draft to a final

polished form. Hands-on exercises help students understand a concept soon after learning it. The text adopts a spiral approach: many topics are revisited multiple times, sometimes from a different perspective or at a higher level of complexity, in order to slowly develop the student's problem-solving and writing skills.

Complex analysis is a classic and central area of mathematics, which is studied and exploited in a range of important fields, from number theory to engineering. Introduction to Complex Analysis was first published in 1985, and for this much awaited second edition the text has been considerably expanded, while retaining the style of the original. More detailed presentation is given of elementary topics, to reflect the knowledge base of current students. Exercise sets have been substantially revised and enlarged, with carefully graded exercises at the end of each chapter. This is the latest addition to the growing list of Oxford undergraduate textbooks in mathematics, which includes: Biggs: Discrete Mathematics 2nd Edition, Cameron: Introduction to Algebra, Needham: Visual Complex Analysis, Kaye and Wilson: Linear Algebra, Acheson: Elementary Fluid Dynamics, Jordan and Smith: Nonlinear Ordinary Differential Equations, Smith: Numerical Solution of Partial Differential Equations, Wilson: Graphs, Colourings and the Four-Colour Theorem, Bishop: Neural Networks for Pattern Recognition, Gelman and Nolan: Teaching Statistics. Aimed at undergraduate mathematics and computer science students, this book is an excellent introduction to a lot of problems of discrete mathematics. It discusses a number of selected results and methods, mostly from areas of combinatorics and graph theory, and it uses proofs and problem solving to help students understand the solutions to problems. Numerous examples, figures, and exercises are spread throughout the book.

Graphs and Matrices

The Story of Mathematics, Measurement, and Money

Nonlinear Optimization with Financial Applications

Information-Consciousness-Reality

Algebraic Graph Theory

Chartrand and Zhangs Discrete Mathematics presents a clearly written, student-friendly introduction to discrete mathematics. The authors draw from their background as researchers

and educators to offer lucid discussions and descriptions fundamental to the subject of discrete mathematics. Unique among discrete mathematics textbooks for its treatment of proof techniques and graph theory, topics discussed also include logic, relations and functions (especially equivalence relations and bijective functions), algorithms and analysis of algorithms, introduction to number theory, combinatorics (counting, the Pascal triangle, and the binomial theorem), discrete probability, partially ordered sets, lattices and Boolean algebras, cryptography, and finite-state machines. This highly versatile text provides mathematical background used in a wide variety of disciplines, including mathematics and mathematics education, computer science, biology, chemistry, engineering, communications, and business. Some of the major features and strengths of this textbook Numerous, carefully explained examples and applications facilitate learning. More than 1,600 exercises, ranging from elementary to challenging, are included with hints/answers to all odd-numbered exercises. Descriptions of proof techniques are accessible and lively. Students benefit from the historical discussions throughout the textbook.

Written for junior and senior undergraduates, this remarkably clear and accessible treatment covers set theory, the real number system, metric spaces, continuous functions, Riemann integration, multiple integrals, and more. 1968 edition.

This book presents and illustrates the main tools and ideas of algebraic graph theory, with a primary emphasis on current rather than classical topics. It is designed to offer self-contained treatment of the topic, with strong emphasis on concrete examples.

Originally published in 2006, reissued as part of Pearson's modern classic series.

Elementary and Beyond

The Mathematics of Chip-Firing

Discrete Mathematics with Graph Theory (Classic Version)

The Fascinating World of Graph Theory

Permutation Groups and Combinatorial Structures

Many people do not realise that mathematics provides the foundation for the devices we use to handle information in the modern world who do know probably think that the parts of mathematics involved are quite 'classical', such as Fourier analysis and differential equations. A great deal of the mathematical background is part of what used to be called 'pure' mathematics, indicating that it was created in order

problems that originated within mathematics itself. It has taken many years for mathematicians to come to terms with this situation, and are still not entirely happy about it. This book is an integrated introduction to Coding. By this I mean replacing symbolic information, such as a bits or a message written in a natural language, by another message using (possibly) different symbols. There are three main reasons for doing this: Economy (data compression), Reliability (correction of errors), and Security (cryptography). I have tried to cover each of these three areas in depth so that the reader can grasp the basic problems and go on to more advanced study. The mathematical theory is introduced in a way that states the basic problems to be stated carefully, but without unnecessary abstraction. The prerequisites (sets and functions, matrices, finite probability) should be familiar to anyone who has taken a standard course in mathematical methods or discrete mathematics. A course in elementary abstract algebra and/or number theory would be helpful, but the book contains the essential facts, and readers with some background should be able to understand what is going on. vi There are a few places where reference is made to computer algebra systems. A revision of an important textbook: essential reading for all combinatorialists.

A self-contained account suited for a wide audience describing coding theory, combinatorial designs and their relations.

Discrete Mathematics Oxford University Press

Discrete Mathematics

Graph Theory and Combinatorics

the David Rogers collection

Course Given at the University of Southampton, October-December 1969

Lead weights

The advent of fast computers and the search for efficient algorithms revolutionized combinatorics and brought about the field of discrete mathematics. This book is an introduction to the main ideas and results of discrete mathematics, and with its emphasis on algorithms it should be interesting to mathematicians and computer scientists alike. The book is organized into three parts: enumeration, graphs and algorithms, and algebraic systems. There are 600 exercises with hints and solutions to about half of them. The only prerequisites for understanding everything in the book are linear algebra and calculus at the undergraduate level. Praise for the German edition ... This book is a well-written introduction to discrete mathematics and is highly recommended to every student of mathematics and computer science as well as to teachers of these topics. --Konrad Engel for MathSciNet Martin Aigner is a professor of mathematics at the Free University of Berlin. He received his PhD at the University of Vienna and has held a number of positions in the USA and Germany before moving to Berlin. He is the author of several books on discrete mathematics, graph theory, and the theory of search. The Monthly article Turan's graph theorem earned him a 1995 Lester R. Ford Prize of the MAA for expository writing, and his book Proofs from the BOOK with Gunter M. Ziegler has been an international success with translations into 12 languages.

Discrete mathematics is a compulsory subject for undergraduate computer scientists. This new edition includes new chapters on statements and proof, logical framework, natural numbers and the integers and updated exercises from the previous edition.

Accessible to all students with a sound background in high school mathematics, A Concise Introduction to Pure Mathematics, Fourth Edition presents some of the most fundamental and beautiful ideas in pure mathematics. It covers not only standard material but also many interesting topics not usually encountered at this level, such as the theory of solving cubic equations; Euler's formula for the numbers of corners, edges, and faces of a solid object and the five Platonic solids; the use of prime numbers to encode and decode secret information; the theory of how to compare the sizes of two infinite sets; and the rigorous theory of limits and continuous functions. New to the Fourth Edition Two new chapters that serve as an introduction to abstract algebra via the theory of groups, covering abstract reasoning as well as many examples and applications New material on inequalities, counting methods, the inclusion-exclusion principle, and Euler's phi function Numerous new exercises, with solutions to the odd-numbered ones Through careful explanations and examples, this popular textbook illustrates the power and beauty of basic mathematical concepts in number theory, discrete mathematics, analysis, and abstract algebra. Written in a rigorous yet accessible style, it continues to provide a robust bridge between high school and higher-level mathematics, enabling students to study more advanced courses in abstract algebra and analysis.

The subject of this book is the action of permutation groups on sets associated with combinatorial structures. Each chapter deals with a particular structure: groups, geometries, designs, graphs and maps respectively. A unifying theme for the first four chapters is the construction of finite simple groups. In the fifth chapter, a theory of maps on orientable surfaces is developed within a combinatorial framework. This simplifies and extends the existing literature in the field. The book is designed both as a course text and as a reference book for advanced undergraduate and graduate students. A feature is the set of carefully constructed projects, intended to give the reader a deeper understanding of the subject.

Proceedings of the Cambridge Combinatorial Conference, in Honour of Paul Erdős

How a New Understanding of the Universe Can Help Answer Age-Old Questions of Existence

Introduction to Complex Analysis

Linear Algebra: Concepts and Methods

Finite Groups of Automorphisms

The Mathematics of Chip-firing is a solid introduction and overview of the growing field of chip-firing. It offers an appreciation for the richness and diversity of the subject. Chip-firing refers to a discrete dynamical system — a commodity is exchanged between sites of a network according to very simple local rules. Although governed by local rules, the long-term global behavior of the system reveals fascinating properties. The Fundamental properties of chip-firing are covered from a variety of perspectives. This gives the reader both a broad context of the field and concrete entry points from different backgrounds. Broken into two sections, the first examines the fundamentals of chip-firing, while the second half presents more general frameworks for chip-firing. Instructors and students will discover that this book provides a comprehensive background to approaching original sources. Features: Provides a broad introduction for researchers interested in the subject of chip-firing The text includes historical and current perspectives Exercises included at the end of each chapter About the Author: Caroline J. Klivans received a BA degree in mathematics from Cornell University and a PhD in applied mathematics from MIT. Currently, she is an Associate Professor in the Division of Applied Mathematics at Brown University. She is also an Associate Director of ICERM (Institute for Computational and Experimental Research in Mathematics). Before coming to Brown she held positions at MSRI, Cornell and the University of Chicago. Her research is in algebraic, geometric and topological combinatorics.

These notes were first used in an introductory course team taught by the authors at Appalachian State University to advanced undergraduates and beginning graduates. The text was written with four pedagogical goals in mind: offer a variety of topics in one course, get to the main themes and tools as efficiently as possible, show the relationships between the different topics, and include recent results to convince students that mathematics is a living discipline.

Any student of linear algebra will welcome this textbook, which provides a thorough treatment of this key topic. Blending practice and theory, the book enables the reader to learn and comprehend the standard methods, with an emphasis on understanding how they actually work. At every stage, the authors are careful to ensure that the discussion is no more complicated or abstract than it needs to be, and focuses on the fundamental topics. The book is ideal as a course text or for self-study. Instructors can draw on the many examples and exercises to supplement their own assignments. End-of-chapter sections summarise the material to help students consolidate their learning as they progress through the book.

This open access book chronicles the rise of a new scientific paradigm offering novel insights into the age-old enigmas of existence. Over 300 years ago, the human mind discovered the machine code of reality: mathematics. By utilizing abstract thought systems, humans began to decode the workings of the cosmos. From this understanding, the current scientific paradigm emerged, ultimately discovering the gift of technology. Today, however, our island of knowledge is surrounded by ever longer shores of ignorance. Science appears to have hit a dead end when confronted with the nature of reality and consciousness. In this fascinating and accessible volume, James Glattfelder explores a radical paradigm shift uncovering the ontology of reality. It is found to be information-theoretic and participatory, yielding a computational and programmable universe.

*Topics, Techniques, Algorithms
Pearson New International Edition*

Introduction to Analysis

Combinatorics

A Spiral Workbook for Discrete Mathematics

Mathematics has become indispensable in the modelling of economics, finance, business and management. Without expecting any particular background of the reader, this book covers the following mathematical topics, with frequent reference to applications in economics and finance: functions, graphs and equations, recurrences (difference equations), differentiation, exponentials and logarithms, optimisation, partial differentiation, optimisation in several variables, vectors and matrices, linear equations, Lagrange multipliers, integration, first-order and second-order differential equations. The stress is on the relation of maths to economics, and this is illustrated with copious examples and exercises to foster depth of understanding. Each chapter has three parts: the main text, a section of further worked examples and a summary of the chapter together with a selection of problems for the reader to attempt. For students of economics, mathematics, or both, this book provides an introduction to mathematical methods in economics and finance that will be welcomed for its clarity and breadth. This volume is a tribute to the life and mathematical work of G.A. Dirac (1925-1984). One of the leading graph theorists, he developed methods of great originality and made many fundamental discoveries. The forty-two papers are all concerned with (or related to) Dirac's main lines of research. A number of mathematicians pay tribute to his memory by presenting new results in different areas of graph theory. Among the topics included are paths and cycles, hamiltonian graphs, vertex colouring and critical graphs, graphs and surfaces, edge-colouring, and infinite graphs. Some of the papers were originally presented at a meeting held in Denmark in 1985. Attendance being by invitation only, some 55 mathematicians from 14 countries participated in various lectures and discussions on graph theory related to the work of Dirac. This volume contains contributions from others as well, so should not be regarded only as the proceedings of that meeting. A problems section is included, as well as a listing of Dirac's own publications. In a comprehensive yet easy-to-follow manner, Discrete Mathematics for New Technology follows the progression from the basic mathematical concepts covered by the GCSE in the UK and by high-school algebra in the USA to the more sophisticated mathematical concepts examined in the latter stages of the book. The book punctuates the rigorous treatment of theory with frequent uses of pertinent examples and exercises, enabling readers to achieve a feel for the subject at hand.

The exercise hints and solutions are provided at the end of the book. Topics covered include logic and the nature of mathematical proof, set theory, relations and functions, matrices and systems of linear equations, algebraic structures, Boolean algebras, and a thorough treatise on graph theory. Although aimed primarily at computer science students, the structured development of the mathematics enables this text to be used by undergraduate mathematicians, scientists, and others who require an understanding of discrete mathematics.

Mathematics did not spring spontaneously into life, with rules set in stone for all time. Its story is closely linked with the problems of measurement and money that have often driven its progress. *Quite Right* explains how mathematical ideas have gradually emerged since prehistoric times, so that they pervade almost every aspect of life in the twenty-first century. Many histories of mathematics focus on the activities of those for whom mathematics itself was the motivation. Professor Biggs adopts a wider viewpoint. Making use of new discoveries of artefacts and documents, he explains the part that mathematics has played in the human story, and what that tells us about the nature of mathematics. The story reveals the power and beauty of mathematical concepts, which often belie their utilitarian origins. The twin paradigms of logical justification and algorithmic calculation recur throughout the book. No other book tells the story of mathematics, measurement, and money in this way. Includes sections on: — The origins of calculation in ancient and medieval times — How mathematics provides answers that are right, and what that means — The impact of trade and the use of money on the development of mathematical algorithms — The use of mathematics for secure communications — How money and information are linked in our electronic world *Quite Right* is a fascinating story, suitable for anyone interested in the mathematical foundations of the world we live in. Norman Biggs is Professor (Emeritus) of Mathematics at the London School of Economics. He is the author of 12 books, including a perennial best-selling book *Discrete Mathematics* (Oxford University Press). He has a special interest in measurement and was Chair of the International Society of Weights and Scales Collectors from 2009-14. He served as a Vice President of the British Society for the History of Mathematics in 2014 and is an active member of the British Numismatic Society. 'This is a history of mathematics book with a difference. Instead of the usual chronological sequence of events, presented with mathematical hindsight (interpreting mathematical achievements from a modern point of view), this book tries to see things more from the context of the time - presenting the topics thematically rather than strictly chronologically, and including results

and problems only when they fit into the themes ... the level of exposition is first-rate, with a far greater fluency than most mathematical writers can attain ... I am very happy to recommend it wholeheartedly.' Professor Robin Wilson, University of Oxford

Computational Learning Theory

Designs and Their Codes

A Concise Introduction to Pure Mathematics

Proofs from THE BOOK