Computing The Continuous Discretely

Many of the best researchers and writers in discrete mathematics come together in a volume inspired by Ron Graham.

This book presents a number of topics related to surfaces, such as Euclidean, spherical and hyperbolic geometry, the fundamental group, universal covering surfaces, Riemannian manifolds, the Gauss-Bonnet Theorem, and the Riemann mapping theorem. The main idea is to get to some interesting mathematics without too much formality. The book also includes some material only tangentially related to surfaces, such as the Cauchy Rigidity Theorem, the Dehn Dissection Theorem, and the Banach-Tarski Theorem. The goal of the book is to present a tapestry of ideas from various areas of mathematics in a clear and rigorous yet informal and friendly way. Prerequisites include undergraduate courses in real analysis and in linear algebra, and some knowledge of complex analysis.

Vladimir Arnold is one of the most outstanding mathematicians of our time Many of these problems are at the front line of current research

This eagerly awaited textbook covers everything the graduate student in probability wants to know about Brownian motion, as well as the latest research in the area. Starting with the construction of Brownian motion, the book then proceeds to sample path properties like continuity and nowhere differentiability. Notions of fractal dimension are introduced early and are used throughout the book to describe fine properties of Brownian paths. The relation of Brownian motion and

random walk is explored from several viewpoints, including a development of the theory of Brownian local times from random walk embeddings. Stochastic integration is introduced as a tool and an accessible treatment of the potential theory of Brownian motion clears the path for an extensive treatment of intersections of Brownian paths. An investigation of exceptional points on the Brownian path and an appendix on SLE processes, by Oded Schramm and Wendelin Werner, lead directly to recent research themes.

This unique text brings together into a single framework current research in the three areas of discrete calculus, complex networks, and algorithmic content extraction. Many example applications from several fields of computational science are provided.

The basic ideas of the subject and the analogues with enumerative combinatorics are described and exploited.

?Optimization has long been a source of both inspiration and applications for geometers, and conversely, discrete and convex geometry have provided the foundations for many optimization techniques, leading to a rich interplay between these subjects. The purpose of the Workshop on Discrete Geometry, the Conference on Discrete Geometry and Optimization, and the Workshop on Optimization, held in September 2011 at the Fields Institute, Toronto, was to further stimulate the interaction between geometers and optimizers. This volume reflects the interplay between these areas. The inspiring Fejes Tóth Lecture Series, delivered by Thomas Hales of the University of Pittsburgh, exemplified this approach. While these fields have recently witnessed a lot of activity and successes, many questions remain open. For example, Fields medalist Stephen Smale stated that the

question of the existence of a strongly polynomial time algorithm for linear optimization is one of the most important unsolved problems at the beginning of the 21st century. The broad range of topics covered in this volume demonstrates the many recent and fruitful connections between different approaches, and features novel results and state-of-the-art surveys as well as open problems.

Global computing refers to computation over "global computers," i.e., com- tational infrastructures available globally and able to provide uniform services with variable guarantees for communication, cooperation and mobility, resource usage, security policies and mechanisms, etc., with particular regard to explo- ing their universal scale and the programmability of their services. As the scope and computational power of such global infrastructures continue to grow, it - comes more and more important to develop methods, theories and techniques for trustworthy systems running on global computers. This book constitutes the thoroughly refereed proceedings of the ?fth e- tion of the International Symposium on Trustworthy Global Computing (TGC 2010)thatwasheldinMunich,Germany,Fe bruary24-26,2010.TheSymposium on Trustworthy Global Computing is an international annual venue dedicated to safe and reliable computation in global computers. It focuses on providing frameworks, tools, and protocols for constructing well-behaved applications and on reasoning rigorouslyabout their behavior and properties. The related models of computation incorporate code and data mobility over distributed networks with highly dynamic topologies and heterogeneous devices.

Lectures on Discrete Geometry

A Course in Enumeration

Introduction to Geometric Probability
A Celebration of the Work of Ron Graham
A First Course in Complex Analysis
Mostly Surfaces
The Art of Proof
Twentieth Anniversary Volume: Discrete & Computational Geometry
Applied Analysis on Graphs for Computational Science
Structural Analysis of Complex Networks
Algebraic and Geometric Methods in Discrete Mathematics

Combinatorial reciprocity is a very interesting phenomenon, which can be described as follows: A polynomial, whose values at positive integers count combinatorial objects of some sort, may give the number of combinatorial objects of a different sort when evaluated at negative integers (and suitably normalized). Such combinatorial reciprocity theorems occur in connections with graphs, partially ordered sets, polyhedra, and more. Using the combinatorial reciprocity theorems as a leitmotif, this book unfolds central ideas and techniques in enumerative and geometric combinatorics. Written in a friendly writing style, this is an accessible graduate textbook with almost 300 exercises, numerous illustrations, and pointers to the research literature. Topics include concise introductions to partially ordered sets, polyhedral geometry, and rational generating functions, followed by highly original chapters on subdivisions, geometric realizations of partially ordered sets, and hyperplane arrangements.

The Art of Proof is designed for a one-semester or two-quarter course. A typical student will have studied calculus (perhaps also linear algebra) with reasonable

success. With an artful mixture of chatty style and interesting examples, the student's previous intuitive knowledge is placed on solid intellectual ground. The topics covered include: integers, induction, algorithms, real numbers, rational numbers, modular arithmetic, limits, and uncountable sets. Methods, such as axiom, theorem and proof, are taught while discussing the mathematics rather than in abstract isolation. The book ends with short essays on further topics suitable for seminar-style presentation by small teams of students, either in class or in a mathematics club setting. These include: continuity, cryptography, groups, complex numbers, ordinal number, and generating functions.

This volume contains the proceedings of the AMS Special Session on Algebraic and Geometric Methods in Applied Discrete Mathematics, held on January 11, 2015, in San Antonio, Texas. The papers present connections between techniques from "pure" mathematics and various applications amenable to the analysis of discrete models, encompassing applications of combinatorics, topology, algebra, geometry, optimization, and representation theory. Papers not only present novel results, but also survey the current state of knowledge of important topics in applied discrete mathematics. Particular highlights include: a new computational framework, based on geometric combinatorics, for structure prediction from RNA sequences; a new method for approximating the optimal solution of a sum of squares problem; a survey of recent Helly-type geometric theorems; applications of representation theory to voting theory and game theory; a study of fixed points of tensors; and exponential random graph models from the

perspective of algebraic statistics with applications to networks. This volume was written for those trained in areas such as algebra, topology, geometry, and combinatorics who are interested in tackling problems in fields such as biology, the social sciences, data analysis, and optimization. It may be useful not only for experts, but also for students who wish to gain an applied or interdisciplinary perspective.

This commemorative book contains the 28 major articles that appeared in the 2008 Twentieth Anniversary Issue of the journal Discrete & Computational Geometry, and presents a comprehensive picture of the current state of the field. The articles in this volume, a number of which solve long-outstanding problems in the field, were chosen by the editors of DCG for the importance of their results, for the breadth of their scope, and to show the intimate connections that have arisen between discrete and computational geometry and other areas of both computer science and mathematics. Apart from the articles, the editors present an expanded preface, along with a set of photographs of groups and individuals who have played a major role in the history of the field during the past twenty years.

A Sampler of Useful Computational Tools for Applied Geometry, Computer Graphics, and Image Processing shows how to use a collection of mathematical techniques to solve important problems in applied mathematics and computer science areas. The book discusses fundamental tools in analytical geometry and linear algebra. It covers a wide range of topics

The third edition of this popular introduction to the classical underpinnings of the mathematics behind

finance continues to combine sound mathematical principles with economic applications. Concentrating on the probabilistic theory of continuous arbitrage pricing of financial derivatives, including stochastic optimal control theory and Merton's fund separation theory, the book is designed for graduate students and combines necessary mathematical background with a solid economic focus. It includes a solved example for every new technique presented, contains numerous exercises, and suggests further reading in each chapter. In this substantially extended new edition Bjork has added separate and complete chapters on the martingale approach to optimal investment problems, optimal stopping theory with applications to American options, and positive interest models and their connection to potential theory and stochastic discount factors. More advanced areas of study are clearly marked to help students and teachers use the book as it suits their needs.

One of the basic tenets of science is that deterministic systems are completely predictable-given the initial condition and the equations describing a system, the behavior of the system can be predicted 1 for all time. The discovery of chaotic systems has eliminated this viewpoint. Simply put, a chaotic system is a deterministic system that exhibits random behavior. Though identified as a robust phenomenon only twenty years ago, chaos has almost certainly been encountered by scientists and engi neers many times during the last century only to be dismissed as physical noise. Chaos is such a wide-spread phenomenon that it has now been reported in virtually every scientific discipline: astronomy, biology, biophysics, chemistry, engineering, geology,

mathematics, medicine, meteorology, plasmas, physics, and even the social sci ences. It is no coincidence that during the same two decades in which chaos has grown into an independent field of research, computers have permeated society. It is, in fact, the wide availability of inex pensive computing power that has spurred much of the research in chaotic dynamics. The reason is simple: the computer can calculate a solution of a nonlinear system. This is no small feat. Unlike lin ear systems, where closed-form solutions can be written in terms of the system's eigenvalues and eigenvectors, few nonlinear systems and virtually no chaotic systems possess closed-form solutions.

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This easy-to-read book introduces the basics of solving partial differential equations by means of finite difference methods. Unlike many of the traditional academic works on the topic, this book was written for practitioners. Accordingly, it especially addresses: the construction of finite difference schemes, formulation and implementation of algorithms, verification of implementations, analyses of physical behavior as implied by the numerical solutions, and how to apply the methods and software to solve problems in the fields of physics and biology.

Practical Numerical Algorithms for Chaotic Systems
Discrete Geometry and Optimization
Triangulations
Continuous Time Modeling in the Behavioral and Related Sciences
A Mathematical Introduction
Fourier Transforms
Discrete Calculus

A Modern Software Approach
Century of Digitalization and Increasing Expectations
Planning Algorithms
Theory and Algorithms

The main topics in this introductory text to discrete geometry include basics on convex sets, convex polytopes and hyperplane arrangements, combinatorial complexity of geometric configurations, intersection patterns and transversals of convex sets, geometric Ramsey-type results, and embeddings of finite metric spaces into normed spaces. In each area, the text explains several key results and methods.

This richly illustrated textbook explores the amazing interaction between combinatorics, geometry, number theory, and analysis which arises in the interplay between polyhedra and lattices. Highly accessible to advanced undergraduates, as well as beginning graduate students, this second edition is perfect for a capstone course, and adds two new chapters, many new exercises, and updated open problems. For scientists, this text can be utilized as a self-contained tooling

device. The topics include a friendly invitation to Ehrhart's theory of counting lattice points in polytopes, finite Fourier analysis, the Frobenius coin-exchange problem, Dedekind sums, solid angles, Euler-Maclaurin summation for polytopes, computational geometry, magic squares, zonotopes, and more. With more than 300 exercises and open research problems, the reader is an active participant, carried through diverse but tightly woven mathematical fields that are inspired by an innocently elementary question: What are the relationships between the continuous volume of a polytope and its discrete volume? Reviews of the first edition: "You owe it to yourself to pick up a copy of Computing the Continuous Discretely to read about a number of interesting problems in geometry, number theory, and combinatorics." — MAA Reviews "The book is written as an accessible and engaging textbook, with many examples, historical notes, pithy quotes, commentary integrating the mate rial, exercises, open problems and an extensive bibliography." — Zentralblatt

MATH "This beautiful book presents, at a level suitable for advanced undergraduates, a fairly complete introduction to the problem of counting lattice points inside a convex polyhedron." — Mathematical Reviews "Many departments recognize the need for capstone courses in which graduating students can see the tools they have acquired come together in some satisfying way. Beck and Robins have written the perfect text for such a course." — CHOICE

This book comprehensively documents the many and varied ways that polyhedra have come to the fore throughout the development of mathematics.

Resources for Teaching Discrete Mathematics presents nineteen classroom tested projects complete with student handouts, solutions, and notes to the instructor. Topics range from a first day activity that motivates proofs to applications of discrete mathematics to chemistry, biology, and data storage. Other projects provide: supplementary material on classic topics such as the towers of Hanoi and the Josephus problem, how to use a calculator to

explore various course topics, how to employ Cuisenaire rods to examine the Fibonacci numbers and other sequences, and how you can use plastic pipes to create a geodesic dome. The book contains eleven history modules that allow students to explore topics in their original context. Sources range from eleventh century Chinese figures that prompted Leibniz to write on binary arithmetic, to a 1959 article on automata theory. Excerpts include: Pascal's "Treatise on the Arithmetical Triangle," Hamilton's "Account of the Icosian Game," and Cantor's (translated) "Contributions to the Founding of the Theory of Transfinite Numbers." Five articles complete the book. Three address extensions of standard discrete mathematics content: an exploration of historical counting problems with attention to discovering formulas, a discussion of how computers store graphs, and a survey connecting the principle of inclusion-exclusion to Möbius inversion. Finally, there are two articles on pedagogy specifically related to discrete mathematics courses: a summary of adapting a group

discovery method to larger classes, and a discussion of using logic in encouraging students to construct proofs.

Core Statistics is a compact starter course on the theory, models, and computational tools needed to make informed use of powerful statistical methods.

This is a self-contained exposition of several core aspects of the theory of rational polyhedra with a view towards algorithmic applications to efficient counting of integer points, a problem arising in many areas of pure and applied mathematics. The approach is based on the consistent development and application of the apparatus of generating functions and the algebra of polyhedra. Topics range from classical, such as the Euler characteristic, continued fractions, Ehrhart polynomial, Minkowski Convex Body Theorem, and the Lenstra-Lenstra-Lovasz lattice reduction algorithm, to recent advances such as the Berline-Vergne local formula. The text is intended for graduate students and researchers. Prerequisites are a modest background

in linear algebra and analysis as well as some general mathematical maturity. Numerous figures, exercises of varying degree of difficulty as well as references to the literature and publicly available software make the text suitable for a graduate course.

This unique book provides an overview of continuous time modeling in the behavioral and related sciences. It argues that the use of discrete time models for processes that are in fact evolving in continuous time produces problems that make their application in practice highly questionable. One main issue is the dependence of discrete time parameter estimates on the chosen time interval, which leads to incomparability of results across different observation intervals. Continuous time modeling by means of differential equations offers a powerful approach for studying dynamic phenomena, yet the use of this approach in the behavioral and related sciences such as psychology, sociology, economics and medicine, is still rare. This is unfortunate, because in these fields often only a few discrete time

(sampled) observations are available for analysis (e.g., daily, weekly, yearly, etc.). However, as emphasized by Rex Bergstrom, the pioneer of continuous-time modeling in econometrics, neither human beings nor the economy cease to exist in between observations. In 16 chapters, the book addresses a vast range of topics in continuous time modeling, from approaches that closely mimic traditional linear discrete time models to highly nonlinear state space modeling techniques. Each chapter describes the type of research questions and data that the approach is most suitable for, provides detailed statistical explanations of the models, and includes one or more applied examples. To allow readers to implement the various techniques directly, accompanying computer code is made available online. The book is intended as a reference work for students and scientists working with longitudinal data who have a Master's- or early PhD-level knowledge of statistics. Triangulations presents the first comprehensive treatment of the theory

of secondary polytopes and related topics. The text discusses the geometric structure behind the algorithms and shows new emerging applications, including hundreds of illustrations, examples, and exercises.

This book provides comprehensive coverage of the modern methods for geometric problems in the computing sciences. It also covers concurrent topics in data sciences including geometric processing, manifold learning, Google search, cloud data, and R-tree for wireless networks and BigData. The author investigates digital

geometry and its related constructive methods in discrete geometry, offering detailed methods and algorithms. The book is divided into five sections: basic geometry; digital curves, surfaces and manifolds; discretely represented objects; geometric computation and processing; and advanced topics. Chapters especially focus on the applications of these methods to other types of geometry, algebraic topology, image processing, computer vision and computer graphics. Digital and Discrete Geometry: Theory and Algorithms targets researchers and professionals working in digital image processing analysis, medical imaging (such as CT and MRI) and informatics, computer graphics, computer vision, biometrics, and information theory. Advanced-level students in electrical engineering, mathematics, and computer science will also find this book useful as a secondary text book or reference. Praise for this book: This book does present a large collection of important concepts, of mathematical, geometrical, or algorithmical nature, that are frequently used in computer graphics and image processing. These concepts range from graphs through manifolds to homology. Of particular value are the sections dealing

with discrete versions of classic continuous notions. The reader finds compact definitions and concise explanations that often appeal to intuition, avoiding finer, but then necessarily more complicated, arguments... As a first introduction, or as a reference for professionals working in computer graphics or image processing, this book should be of considerable value." - Prof. Dr. Rolf Klein, University of Bonn.

This book provides a systematic treatment of the mathematical underpinnings of work in data assimilation, covering both theoretical and computational approaches. Specifically the authors develop a unified mathematical framework in which a Bayesian formulation of the problem provides the bedrock for the derivation, development and analysis of algorithms; the many examples used in the text, together with the algorithms which are introduced and discussed, are all illustrated by the MATLAB software detailed in the book and made freely available online. The book is organized into nine chapters: the first contains a brief introduction to the mathematical tools around which the material is organized; the next four are concerned with discrete time dynamical systems and discrete time data; the last

four are concerned with continuous time dynamical systems and continuous time data and are organized analogously to the corresponding discrete time chapters. This book is aimed at mathematical researchers interested in a systematic development of this interdisciplinary field, and at researchers from the geosciences, and a variety of other scientific fields, who use tools from data assimilation to combine data with time-dependent models. The numerous examples and illustrations make understanding of the theoretical underpinnings of data assimilation accessible. Furthermore, the examples, exercises and MATLAB software, make the book suitable for students in applied mathematics, either through a lecture course, or through self-study.
Stochastic differential equations are differential equations whose solutions are stochastic processes. They exhibit appealing mathematical properties that are useful in modeling uncertainties and noisy phenomena in many disciplines. This book is motivated by applications of stochastic differential equations in target tracking and medical technology and, in particular, their use in methodologies such as filtering, smoothing, parameter estimation, and machine learning. It

builds an intuitive hands-on understanding of what stochastic differential equations are all about, but also covers the essentials of It calculus, the central theorems in the field, and such approximation schemes as stochastic Runge-Kutta. Greater emphasis is given to solution methods than to analysis of theoretical properties of the equations. The book's practical approach assumes only prior understanding of ordinary differential equations. The numerous worked examples and end-of-chapter exercises include application-driven derivations and computational assignments. MATLAB/Octave source code is available for download, promoting hands-on work with the methods.

The 21st century ushered in a new era of technology that has been reshaping everyday life, simplifying outdated processes, and even giving rise to entirely new business sectors. Today, contemporary users of products and services expect more and more personalized products and services that can meet their unique needs. In that sense, it is necessary to further develop existing methods, adapt them to new applications, or even discover new methods. This book provides a thorough review of some methods

that have an increasing impact on humanity today and that can solve different types of problems even in specific industries. Upgrading with Fourier Transformation gives a different meaning to these methods that support the development of new technologies and have a good projected acceleration in the future.

This textbook illuminates the field of discrete mathematics with examples, theory, and applications of the discrete volume of a polytope. The authors have weaved a unifying thread through basic yet deep ideas in discrete geometry, combinatorics, and number theory. We encounter here a friendly invitation to the field of "counting integer points in polytopes", and its various connections to elementary finite Fourier analysis, generating functions, the Frobenius coin-exchange problem, solid angles, magic squares, Dedekind sums, computational geometry, and more. With 250 exercises and open problems, the reader feels like an active participant.

Foremost book available on polytopes, incorporating ancient Greek and most modern work. Discusses polygons, polyhedrons, and multi-dimensional polytopes. Definitions of symbols. Includes 8 tables plus many diagrams and

examples. 1963 edition.

A First Course in Complex Analysis was developed from lecture notes for a one-semester undergraduate course taught by the authors. For many students, complex analysis is the first rigorous analysis (if not mathematics) class they take, and these notes reflect this. The authors try to rely on as few concepts from real analysis as possible. In particular, series and sequences are treated from scratch.

Filling a gap in literature, this self-contained book presents theoretical and application-oriented results that allow for a structural exploration of complex networks. The work focuses not only on classical graph-theoretic methods, but also demonstrates the usefulness of structural graph theory as a tool for solving interdisciplinary problems. Applications to biology, chemistry, linguistics, and data analysis are emphasized. The book is suitable for a broad, interdisciplinary readership of researchers, practitioners, and graduate students in discrete mathematics, statistics, computer science, machine learning, artificial intelligence, computational and systems biology, cognitive science, computational

linguistics, and mathematical chemistry. It may also be used as a supplementary textbook in graduate-level seminars on structural graph analysis, complex networks, or network-based machine learning methods.

Computing the Continuous Discretely
Trustworthy Global Computing
Integer Points in Polyhedra
Core Statistics
How to Guard an Art Gallery and Other Discrete Mathematical Adventures
Digital and Discrete Geometry
Cyber-Physical Systems: A Model-Based Approach
Applied Stochastic Differential Equations
Regular Polytopes
A Sampler of Useful Computational Tools for Applied Geometry, Computer Graphics, and Image Processing

The explanations and formulas can be grasped with a basic understanding of linear equations.

This self-contained introduction to modern cryptography emphasizes the mathematics behind the theory of public key cryptosystems and digital signature schemes. The book focuses on these key topics while developing the mathematical tools needed for the construction and

security analysis of diverse cryptosystems. Only basic linear algebra is required of the reader; techniques from algebra, number theory, and probability are introduced and developed as required. This text provides an ideal introduction for mathematics and computer science students to the mathematical foundations of modern cryptography. The book includes an extensive bibliography and index; supplementary materials are available online. The book covers a variety of topics that are considered central to mathematical cryptography. Key topics include: classical cryptographic constructions, such as Diffie–Hellmann key exchange, discrete logarithm–based cryptosystems, the RSA cryptosystem, and digital signatures; fundamental mathematical tools for cryptography, including primality testing, factorization algorithms, probability theory, information theory, and collision algorithms; an in-depth treatment of important cryptographic innovations, such as elliptic curves, elliptic curve and pairing–based cryptography, lattices, lattice–based cryptography, and the NTRU cryptosystem. The second edition of An Introduction to Mathematical Cryptography includes a significant revision of the

material on digital signatures, including an earlier introduction to RSA, Elgamal, and DSA signatures, and new material on lattice-based signatures and rejection sampling. Many sections have been rewritten or expanded for clarity, especially in the chapters on information theory, elliptic curves, and lattices, and the chapter of additional topics has been expanded to include sections on digital cash and homomorphic encryption. Numerous new exercises have been included.

This open access book gives a complete and comprehensive introduction to the fields of medical imaging systems, as designed for a broad range of applications. The authors of the book first explain the foundations of system theory and image processing, before highlighting several modalities in a dedicated chapter. The initial focus is on modalities that are closely related to traditional camera systems such as endoscopy and microscopy. This is followed by more complex image formation processes: magnetic resonance imaging, X-ray projection imaging, computed tomography, X-ray phase-contrast imaging, nuclear imaging, ultrasound, and optical coherence tomography.

Computing the Continuous DiscretelyInteger-Point Enumeration in PolyhedraSpringer

This textbook develops the essential tools of linear algebra, with the goal of imparting technique alongside contextual understanding. Applications go hand-in-hand with theory, each reinforcing and explaining the other. This approach encourages students to develop not only the technical proficiency needed to go on to further study, but an appreciation for when, why, and how the tools of linear algebra can be used across modern applied mathematics. Providing an extensive treatment of essential topics such as Gaussian elimination, inner products and norms, and eigenvalues and singular values, this text can be used for an in-depth first course, or an application-driven second course in linear algebra. In this second edition, applications have been updated and expanded to include numerical methods, dynamical systems, data analysis, and signal processing, while the pedagogical flow of the core material has been improved. Throughout, the text emphasizes the conceptual connections between each application and the underlying linear algebraic techniques, thereby enabling students not only to learn how to apply the mathematical tools in routine contexts, but also to understand what is required to adapt to

unusual or emerging problems. No previous knowledge of linear algebra is needed to approach this text, with single-variable calculus as the only formal prerequisite. However, the reader will need to draw upon some mathematical maturity to engage in the increasing abstraction inherent to the subject. Once equipped with the main tools and concepts from this book, students will be prepared for further study in differential equations, numerical analysis, data science and statistics, and a broad range of applications. The first author's text, Introduction to Partial Differential Equations, is an ideal companion volume, forming a natural extension of the linear mathematical methods developed here.

Combinatorial enumeration is a readily accessible subject full of easily stated, but sometimes tantalizingly difficult problems. This book leads the reader in a leisurely way from basic notions of combinatorial enumeration to a variety of topics, ranging from algebra to statistical physics. The book is organized in three parts: Basics, Methods, and Topics. The aim is to introduce readers to a fascinating field, and to offer a sophisticated source of information for professional mathematicians desiring to

learn more. There are 666 exercises, and every chapter ends with a highlight section, discussing in detail a particularly beautiful or famous result. Planning algorithms are impacting technical disciplines and industries around the world, including robotics, computer-aided design, manufacturing, computer graphics, aerospace applications, drug design, and protein folding. This coherent and comprehensive book unifies material from several sources, including robotics, control theory, artificial intelligence, and algorithms. The treatment is centered on robot motion planning, but integrates material on planning in discrete spaces. A major part of the book is devoted to planning under uncertainty, including decision theory, Markov decision processes, and information spaces, which are the 'configuration spaces' of all sensor-based planning problems. The last part of the book delves into planning under differential constraints that arise when automating the motions of virtually any mechanical system. This text and reference is intended for students, engineers, and researchers in robotics, artificial intelligence, and control theory as well as computer graphics, algorithms, and

computational biology.

Arnold's Problems

Basic Training for Deeper Mathematics

Brownian Motion

Combinatorial Reciprocity Theorems: An Invitation to Enumerative Geometric Combinatorics

Integer-Point Enumeration in Polyhedra

Medical Imaging Systems

Classroom Projects, History Modules, and Articles

Resources for Teaching Discrete Mathematics