

Algorithms
and Computation
in Mathematics

Volume 9

Sergei Matveev

Algorithmic Topology and Classification of 3-Manifolds

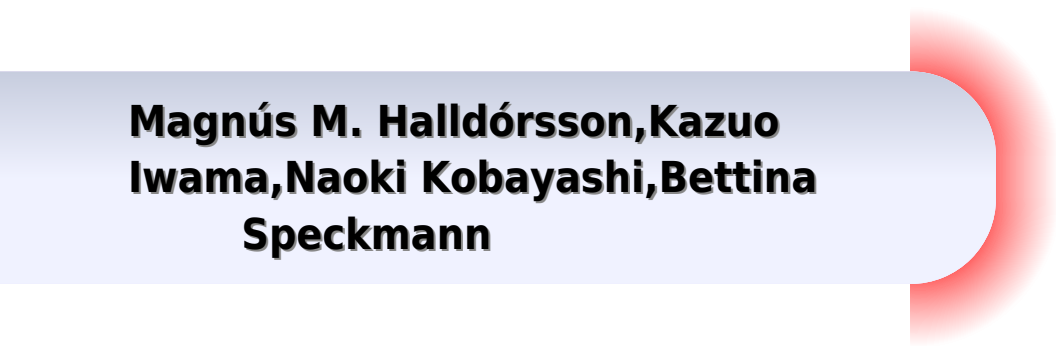
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Springer

Algorithmic Topology And Classification Of 3 Manifolds Algorithms And Computation In Mathematics

**Magnús M. Halldórsson, Kazuo
Iwama, Naoki Kobayashi, Bettina
Speckmann**



Algorithmic Topology And Classification Of 3 Manifolds Algorithms And Computation In Mathematics:

Algorithmic Topology and Classification of 3-Manifolds Sergei Matveev, 2003-07-10 Here is a thorough review of topics in 3 dimensional topology derived from a decade of courses taught by the author The author keeps the exposition to an elementary level by presenting the material mainly from the point of view of special polyhedra and special spines of 3 manifolds The book culminates with the recognition procedure for Haken manifolds and includes up to date results in computer enumeration of 3 manifolds The second edition adds new results new proofs and commentaries **Algorithmic Topology and Classification of 3 Manifolds** serves as a standard reference for algorithmic 3 dimensional topology for both graduate students and researchers

Algorithmic Topology and Classification of 3-Manifolds Sergei Matveev, 2009-09-02 From the reviews of the 1st edition This book provides a comprehensive and detailed account of different topics in algorithmic 3 dimensional topology culminating with the recognition procedure for Haken manifolds and including the up to date results in computer enumeration of 3 manifolds Originating from lecture notes of various courses given by the author over a decade the book is intended to combine the pedagogical approach of a graduate textbook without exercises with the completeness and reliability of a research monograph All the material with few exceptions is presented from the peculiar point of view of special polyhedra and special spines of 3 manifolds This choice contributes to keep the level of the exposition really elementary In conclusion the reviewer subscribes to the quotation from the back cover the book fills a gap in the existing literature and will become a standard reference for algorithmic 3 dimensional topology both for graduate students and researchers Zentralblatt f r Mathematik 2004 For this 2nd edition new results new proofs and commentaries for a better orientation of the reader have been added In particular in Chapter 7 several new sections concerning applications of the computer program 3 Manifold Recognizer have been included

Algorithmic Topology and Classification of 3-Manifolds Sergei Matveev, 2013-04-17 The book is devoted to algorithmic low dimensional topology This branch of mathematics has recently been undergoing an intense development On the one hand the exponential advancement of computer technologies has made it possible to conduct sophisticated computer experiments and to implement algorithmic solutions which have in turn provided a motivation to search for new and better algorithms On the other hand low dimensional topology has received an additional boost because of the discovery of numerous connections with theoretical physics There is also another deep reason why algorithmic topology has received a lot of attention It is that a search for algorithmic solutions generally proves to be a rich source of well stated mathematical problems Speaking out of my experience it seems that an orientation towards how to rather than just how is serves as a probing stone for choosing among possible directions of research much like problems in mechanics led once to the development of calculus

Introduction to 3-Manifolds Jennifer Schultens, 2014-05-21 This book grew out of a graduate course on 3 manifolds and is intended for a mathematically experienced audience that is new to low dimensional topology The exposition begins with the definition of a

manifold explores possible additional structures on manifolds discusses the classification of surfaces introduces key foundational results for 3 manifolds and provides an overview of knot theory It then continues with more specialized topics by briefly considering triangulations of 3 manifolds normal surface theory and Heegaard splittings The book finishes with a discussion of topics relevant to viewing 3 manifolds via the curve complex With about 250 figures and more than 200 exercises this book can serve as an excellent overview and starting point for the study of 3 manifolds *Quantum Invariants of Knots and 3-Manifolds* Vladimir G. Turaev, 2016-07-11 Due to the strong appeal and wide use of this monograph it is now available in its third revised edition The monograph gives a systematic treatment of 3 dimensional topological quantum field theories TQFTs based on the work of the author with N Reshetikhin and O Viro This subject was inspired by the discovery of the Jones polynomial of knots and the Witten Chern Simons field theory On the algebraic side the study of 3 dimensional TQFTs has been influenced by the theory of braided categories and the theory of quantum groups The book is divided into three parts Part I presents a construction of 3 dimensional TQFTs and 2 dimensional modular functors from so called modular categories This gives a vast class of knot invariants and 3 manifold invariants as well as a class of linear representations of the mapping class groups of surfaces In Part II the technique of 6j symbols is used to define state sum invariants of 3 manifolds Their relation to the TQFTs constructed in Part I is established via the theory of shadows Part III provides constructions of modular categories based on quantum groups and skein modules of tangles in the 3 space This fundamental contribution to topological quantum field theory is accessible to graduate students in mathematics and physics with knowledge of basic algebra and topology It is an indispensable source for everyone who wishes to enter the forefront of this fascinating area at the borderline of mathematics and physics Contents Invariants of graphs in Euclidean 3 space and of closed 3 manifolds Foundations of topological quantum field theory Three dimensional topological quantum field theory Two dimensional modular functors 6j symbols Simplicial state sums on 3 manifolds Shadows of manifolds and state sums on shadows Constructions of modular categories *Computing and Combinatorics* Zhipeng Cai, Alexander Zelikovskiy, Anu Bourgeois, 2014-07-05 This book constitutes the refereed proceedings of the 20th International Conference on Computing and Combinatorics COCOON 2014 held in Atlanta GA USA in August 2014 The 51 revised full papers presented were carefully reviewed and selected from 110 submissions There was a co organized workshop on computational social networks CSoNet 2014 where 8 papers were accepted The papers cover the following topics sampling and randomized methods logic algebra and automata database and data structures parameterized complexity and algorithms computational complexity computational biology and computational geometry approximation algorithm graph theory and algorithms game theory and cryptography scheduling algorithms and circuit complexity and CSoNet **Handbook of Knot Theory** William Menasco, Morwen Thistlethwaite, 2005-08-02 This book is a survey of current topics in the mathematical theory of knots For a mathematician a knot is a closed loop in 3 dimensional space imagine knotting an extension cord and then closing it up by

inserting its plug into its outlet Knot theory is of central importance in pure and applied mathematics as it stands at a crossroads of topology combinatorics algebra mathematical physics and biochemistry Survey of mathematical knot theory Articles by leading world authorities Clear exposition not over technical Accessible to readers with undergraduate background in mathematics *Toric Topology* Victor M. Buchstaber, Taras E. Pano, 2015-07-15 This book is about toric topology a new area of mathematics that emerged at the end of the 1990s on the border of equivariant topology algebraic and symplectic geometry combinatorics and commutative algebra It has quickly grown into a very active area with many links to other areas of mathematics and continues to attract experts from different fields The key players in toric topology are moment angle manifolds a class of manifolds with torus actions defined in combinatorial terms Construction of moment angle manifolds relates to combinatorial geometry and algebraic geometry of toric varieties via the notion of a quasitoric manifold Discovery of remarkable geometric structures on moment angle manifolds led to important connections with classical and modern areas of symplectic Lagrangian and non Kaehler complex geometry A related categorical construction of moment angle complexes and polyhedral products provides for a universal framework for many fundamental constructions of homotopical topology The study of polyhedral products is now evolving into a separate subject of homotopy theory A new perspective on torus actions has also contributed to the development of classical areas of algebraic topology such as complex cobordism This book includes many open problems and is addressed to experts interested in new ideas linking all the subjects involved as well as to graduate students and young researchers ready to enter this beautiful new area

Automata, Languages, and Programming Magnús M. Halldórsson, Kazuo Iwama, Naoki Kobayashi, Bettina Speckmann, 2015-06-19 The two volume set LNCS 9134 and LNCS 9135 constitutes the refereed proceedings of the 42nd International Colloquium on Automata Languages and Programming ICALP 2015 held in Kyoto Japan in July 2015 The 143 revised full papers presented were carefully reviewed and selected from 507 submissions The papers are organized in the following three tracks algorithms complexity and games logic semantics automata and theory of programming and foundations of networked computation models algorithms and information management *Monoidal Categories and Topological Field Theory* Vladimir Turaev, Alexis Virelizier, 2017-06-28 This monograph is devoted to monoidal categories and their connections with 3 dimensional topological field theories Starting with basic definitions it proceeds to the forefront of current research Part 1 introduces monoidal categories and several of their classes including rigid pivotal spherical fusion braided and modular categories It then presents deep theorems of Müger on the center of a pivotal fusion category These theorems are proved in Part 2 using the theory of Hopf monads In Part 3 the authors define the notion of a topological quantum field theory TQFT and construct a Turaev Viro type 3 dimensional state sum TQFT from a spherical fusion category Lastly in Part 4 this construction is extended to 3 manifolds with colored ribbon graphs yielding a so called graph TQFT and consequently a 3 2 1 extended TQFT The authors then prove the main result of the monograph the state sum graph TQFT

derived from any spherical fusion category is isomorphic to the Reshetikhin Turaev surgery graph TQFT derived from the center of that category The book is of interest to researchers and students studying topological field theory monoidal categories Hopf algebras and Hopf monads

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