

Algorithms  
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in Mathematics

Volume 9

Sergei Matveev

# Algorithmic Topology and Classification of 3-Manifolds

Second Edition

 Springer

# Algorithmic Topology And Classification Of 3manifolds

**S Ashworth**



## **Algorithmic Topology And Classification Of 3-manifolds:**

Algorithmic Topology and Classification of 3-Manifolds Sergei Matveev, 2007-08-13 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, 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

**Geometrisation of 3-manifolds** ,2010 The Geometrisation Conjecture was proposed by William Thurston in the mid 1970s in order to classify compact 3 manifolds by means of a canonical decomposition along essential embedded surfaces into pieces that possess geometric structures It contains the famous Poincaré Conjecture as a special case In 2002 Grigory Perelman announced a proof of the Geometrisation Conjecture based on Richard Hamilton's Ricci flow approach and presented it in a series of three celebrated arXiv preprints Since then there has been an ongoing effort to understand Perelman's work by giving more detailed and accessible presentations of his ideas or alternative arguments for various parts of the proof This book is a contribution to this endeavour Its two main innovations are first a simplified version of Perelman's Ricci flow with surgery which is called Ricci flow with bubbling off and secondly a completely different and original approach to the last step of the proof In addition special effort has been made to simplify and streamline the overall structure of the argument and make the various parts independent of one another A complete proof of the Geometrisation Conjecture is given modulo pre Perelman results on Ricci flow Perelman's results on the functional and solutions as well as the Colding Minicozzi extinction paper The book can be read by anyone already familiar with these results or willing to accept them as black boxes The structure of the proof is presented in a lengthy introduction which does not require knowledge of geometric analysis The bulk of the proof is the existence theorem for Ricci flow with bubbling off which is treated in parts I and II Part III deals with the long time behaviour of Ricci flow with bubbling off Part IV finishes the proof of the Geometrisation Conjecture

*Geometry and Topology Down Under* Craig D. Hodgson,William H. Jaco,Martin G. Scharlemann,Stephan Tillmann,2013-08-23 This book contains the proceedings of the conference Geometry Topology Down Under held July 11 22 2011 at the University of Melbourne Parkville Australia in honour of Hyam Rubinstein The main topic of the book is low dimensional geometry and topology It includes both survey articles based on courses presented at the conferences and research articles devoted to important questions in low dimensional geometry Together these contributions show how methods from different fields of mathematics contribute to the study of 3 manifolds and Gromov hyperbolic groups It also contains a list of favorite problems by Hyam Rubinstein     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

***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 M ger 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

***Geometry in History*** S. G. Dani, Athanase Papadopoulos, 2019-10-18 This is a collection of surveys on important mathematical ideas their origin their evolution and their impact in current research The authors are mathematicians who are leading experts in their fields The book is addressed to all mathematicians from undergraduate students to senior researchers regardless of the specialty

***In the Tradition of Thurston II*** Ken'ichi Ohshika, Athanase Papadopoulos, 2022-08-02 The purpose of this volume and of the other volumes in the same series is to provide a collection of surveys that allows the reader to learn the important aspects of William Thurston s heritage Thurston s ideas have altered the course of twentieth century mathematics and they continue to have a significant influence on succeeding generations of mathematicians The topics covered in the present volume include complex hyperbolic Kleinian groups M bius structures hyperbolic ends cone 3 manifolds Thurston s norm surgeries in representation varieties triangulations spaces of polygonal decompositions and of singular flat structures on surfaces combination theorems in the theories of Kleinian groups hyperbolic groups and holomorphic dynamics the dynamics and iteration of rational maps automatic groups and the combinatorics of right angled Artin groups

***Low-dimensional and Symplectic Topology*** Michael Usher, 2011 Every eight years since 1961 the University of Georgia has hosted a major international topology conference aimed at disseminating important recent results and bringing together researchers at different stages of their careers This volume contains the proceedings of the 2009 conference which includes survey and research articles concerning such areas as knot theory contact and symplectic topology 3 manifold theory geometric group theory and equivariant topology Among other highlights of the volume a survey article by Stefan Friedl and Stefano Vidussi provides an accessible treatment of their important proof of Taubes conjecture on symplectic structures on the product of a 3 manifold and a circle and an intriguing

short article by Dennis Sullivan opens the door to the use of modern algebraic topological techniques in the study of finite dimensional models of famously difficult problems in fluid dynamics Continuing what has become a tradition this volume contains a report on a problem session held at the conference discussing a variety of open problems in geometric topology

**Visual Geometry and Topology** Anatolij T. Fomenko, 2012-12-06 Geometry and topology are strongly motivated by the visualization of ideal objects that have certain special characteristics A clear formulation of a specific property or a logically consistent proof of a theorem often comes only after the mathematician has correctly seen what is going on These pictures which are meant to serve as signposts leading to mathematical understanding frequently also contain a beauty of their own The principal aim of this book is to narrate in an accessible and fairly visual language about some classical and modern achievements of geometry and topology in both intrinsic mathematical problems and applications to mathematical physics The book starts from classical notions of topology and ends with remarkable new results in Hamiltonian geometry Fomenko lays special emphasis upon visual explanations of the problems and results and downplays the abstract logical aspects of calculations As an example readers can very quickly penetrate into the new theory of topological descriptions of integrable Hamiltonian differential equations The book includes numerous graphical sheets drawn by the author which are presented in special sections of Visual material These pictures illustrate the mathematical ideas and results contained in the book Using these pictures the reader can understand many modern mathematical ideas and methods Although Visual Geometry and Topology is about mathematics Fomenko has written and illustrated this book so that students and researchers from all the natural sciences and also artists and art students will find something of interest within its pages *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 **An Illustrated Introduction to Topology and Homotopy** Sasho

Kalajdzievski, 2015-03-24 *An Illustrated Introduction to Topology and Homotopy* explores the beauty of topology and homotopy theory in a direct and engaging manner while illustrating the power of the theory through many often surprising applications. This self-contained book takes a visual and rigorous approach that incorporates both extensive illustrations and full proofs.

**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.

*Spaces of Kleinian Groups* Yair N. Minsky, Makoto Sakuma, Caroline Series, 2006-06-19 The subject of Kleinian groups and hyperbolic 3-manifolds is currently undergoing explosively fast development the last few years having seen the resolution of many longstanding conjectures. This volume contains important expositions and original work by some of the main contributors on topics such as topology and geometry of 3-manifolds curve complexes classical Ahlfors-Bers theory computer explorations and projective structures. Researchers in these and related areas will find much of interest here.

*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.

**Algebraic Topology of Finite Topological Spaces and Applications** Jonathan A. Barmak, 2011-08-24 This volume deals with the theory of finite topological spaces and its relationship with the homotopy and simple homotopy theory of polyhedra. The interaction between their intrinsic combinatorial and topological structures makes finite spaces a useful tool for studying problems in Topology Algebra and Geometry from a new perspective. In particular the methods developed in this manuscript are used to study Quillen's conjecture on the poset of  $p$  subgroups of a finite group and the Andrews-Curtis conjecture on the 3-deformability of contractible two-dimensional complexes. This self-contained work constitutes the first detailed exposition on the algebraic topology of finite spaces. It is intended for topologists and combinatorialists but it is also recommended for advanced undergraduate students and graduate students with a modest knowledge of Algebraic Topology.

**Lectures on Geometry** Nicholas Michael John Woodhouse, 2017 This book contains a series of chapters by leading researchers and practitioners on community engagement approaches in the field of counterterrorism and counterinsurgency. It presents existing and emerging community engagement models in various parts

of the world which could serve as effective models for governments keen to work with community leaders to manage and reduce the terrorist threat The book emphasizes the strength of communities as central to government approaches in countering violent extremism

**Geometric Continuum Mechanics** Reuven Segev, Marcelo Epstein, 2020-05-13 This contributed volume explores the applications of various topics in modern differential geometry to the foundations of continuum mechanics In particular the contributors use notions from areas such as global analysis algebraic topology and geometric measure theory Chapter authors are experts in their respective areas and provide important insights from the most recent research Organized into two parts the book first covers kinematics forces and stress theory and then addresses defects uniformity and homogeneity Specific topics covered include Global stress and hyper stress theories Applications of de Rham currents to singular dislocations Manifolds of mappings for continuum mechanics Kinematics of defects in solid crystals Geometric Continuum Mechanics will appeal to graduate students and researchers in the fields of mechanics physics and engineering who seek a more rigorous mathematical understanding of the area Mathematicians interested in applications of analysis and geometry will also find the topics covered here of interest

Knots, Links and Their Invariants A. B. Sossinsky, 2023-05-22 This book is an elementary introduction to knot theory Unlike many other books on knot theory this book has practically no prerequisites it requires only basic plane and spatial Euclidean geometry but no knowledge of topology or group theory It contains the first elementary proof of the existence of the Alexander polynomial of a knot or a link based on the Conway axioms particularly the Conway skein relation The book also contains an elementary exposition of the Jones polynomial HOMFLY polynomial and Vassiliev knot invariants constructed using the Kontsevich integral Additionally there is a lecture introducing the braid group and shows its connection with knots and links Other important features of the book are the large number of original illustrations numerous exercises and the absence of any references in the first eleven lectures The last two lectures differ from the first eleven they comprise a sketch of non elementary topics and a brief history of the subject including many references



The Top Books of the Year Algorithmic Topology And Clabification Of 3manifolds The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous compelling novels enthralling the hearts of readers worldwide. Lets delve into the realm of bestselling books, exploring the fascinating narratives that have captivated audiences this year. Algorithmic Topology And Clabification Of 3manifolds : Colleen Hoovers "It Ends with Us" This poignant tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover skillfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids captivating storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Algorithmic Topology And Clabification Of 3manifolds : Delia Owens "Where the Crawdads Sing" This evocative coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These popular novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a exceptional and thrilling novel that will keep you wondering until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

<https://abp-london.co.uk/files/detail/default.aspx/A%20Maze%20Of%20Murders%20Inspector%20Alvarez%20Mystery%20Ser.pdf>

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