Three Dimensional Geometry And Topology Vol 1

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Differential Topology - C. T. C. Wall 2016-07-04
Exploring the full scope of differential topology, this comprehensive account of geometric techniques for studying the topology of smooth manifolds offers a wide perspective on the field. Building up from first principles, concepts of manifolds are introduced, supplemented by thorough appendices giving background on topology and homotopy theory. Deep results are then developed from these foundations through in-depth treatments of the notions of general position and transversality, proper actions of Lie groups, handles (up to the h-cobordism theorem), immersions and embeddings, concluding with the surgery procedure and cobordism theory. Fully illustrated and rigorous in its approach, little prior knowledge is assumed, and yet growing complexity is instilled throughout. This structure gives advanced students and researchers an accessible route into the wide-ranging field of differential topology.
From Chemical Topology to Three-Dimensional Geometry - Alexandru T. Balaban 1997-01-31
Even high-speed supercomputers cannot easily convert traditional two-dimensional databases from chemical topology into the three-dimensional ones demanded by today's chemists, particularly those working in drug design. This fascinating volume resolves this problem by positing mathematical and topological models which greatly expand the capabilities of chemical graph theory. The authors examine QSAR and molecular similarity studies, the relationship between the sequence of amino acids and the less familiar secondary and tertiary protein structures, and new topological methods.
The Geometric Topology of 3-manifolds - R. H. Bing 1983-12-31
Suitable for students and researchers in topology. this work provides the reader with an understanding of the physical properties of Euclidean 3-space - the space in which we presume we live.
Characteristic Classes - John Willard Milnor 1974
The theory of characteristic classes provides a meeting ground for the various disciplines of differential topology, differential and algebraic geometry, cohomology, and fiber bundle theory. As such, it is a fundamental and an essential tool in the study of differentiable manifolds. In this volume, the authors provide a thorough introduction to characteristic classes, with detailed studies of Stiefel-Whitney classes, Chern classes, Pontrjagin classes, and the Euler class. Three appendices cover the basics of cohomology theory and the differential forms approach to characteristic classes, and provide an account of Bernoulli numbers. Based on lecture notes of John Milnor, which first appeared at Princeton University in 1957 and have been widely studied by graduate students of topology ever since, this published version has been completely revised and corrected.
Differential Geometry and Topology - Keith

Burns 2005-05-27
Accessible, concise, and self-contained, this book offers an outstanding introduction to three related subjects: differential geometry, differential topology, and dynamical systems. Topics of special interest addressed in the book include Brouwer's fixed point theorem, Morse Theory, and the geodesic flow. Smooth manifolds, Riemannian metrics, affine connections, the curvature tensor, differential forms, and integration on manifolds provide the foundation for many applications in dynamical systems and mechanics. The authors also discuss the Gauss-Bonnet theorem and its implications in non-Euclidean geometry models. The differential topology aspect of the book centers on classical, transversality theory, Sard's theorem, intersection theory, and fixed-point theorems. The construction of the de Rham cohomology builds further arguments for the strong connection between the differential structure and the topological structure. It also furnishes some of the tools necessary for a complete understanding of the Morse theory. These discussions are followed by an introduction to the theory of hyperbolic systems, with emphasis on the quintessential role of the geodesic flow. The integration of geometric theory, topological theory, and concrete applications to dynamical systems set this book apart. With clean, clear prose and effective examples, the authors' intuitive approach creates a treatment that is comprehensible to relative beginners, yet rigorous enough for those with more background and experience in the field.

Knots, Molecules, and the Universe - Erica Flapan 2015-12-22
This book is an elementary introduction to geometric topology and its applications to chemistry, molecular biology, and cosmology. It does not assume any mathematical or scientific background, sophistication, or even motivation to study mathematics. It is meant to be fun and engaging while drawing students in to learn about fundamental topological and geometric ideas. Though the book can be read and enjoyed by nonmathematicians, college students, or even eager high school students, it is intended to be used as an undergraduate textbook. The book is divided into three parts corresponding to the three areas referred to in the title. Part 1 develops techniques that enable two- and three-dimensional creatures to visualize possible shapes for their universe and to use topological and geometric properties to distinguish one such space from another. Part 2 is an introduction to knot theory with an emphasis on invariants. Part 3 presents applications of topology and geometry to molecular symmetries, DNA, and proteins. Each chapter ends with exercises that allow for better understanding of the material. The style of the book is informal and lively. Though all of the definitions and theorems are explicitly stated, they are given in an intuitive rather than a rigorous form, with several hundreds of figures illustrating the exposition. This allows students to develop intuition about topology and geometry without getting bogged down in technical details.

Hyperbolic Knot Theory - Jessica S. Purcell 2020-10-06
This book provides an introduction to hyperbolic geometry in dimension three, with motivation and applications arising from knot theory. Hyperbolic geometry was first used as a tool to study knots by Riley and then Thurston in the 1970s. By the 1980s, combining work of Mostow and Prasad with Gordon and Luecke, it was known that a hyperbolic structure on a knot complement in the 3-sphere gives a complete knot invariant. However, it remains a difficult problem to relate the hyperbolic geometry of a knot to other invariants arising from knot theory. In particular, it is difficult to determine hyperbolic geometric information from a knot diagram, which is classically used to describe a knot. This textbook provides background on these problems, and tools to determine hyperbolic information on knots. It also includes results and state-of-the art techniques on hyperbolic geometry and knot theory to date. The book was written to be interactive, with many examples and exercises. Some important results are left to guided exercises. The level is appropriate for graduate students with a basic background in algebraic topology, particularly fundamental groups and covering spaces. Some experience with some differential topology and Riemannian geometry will also be helpful.

Low-dimensional Geometry - Francis Bonahon 2009-07-14

The study of 3-dimensional spaces brings together elements from several areas of mathematics. The most notable are topology and geometry, but elements of number theory and analysis also make appearances. In the past 30 years, there have been striking developments in the mathematics of 3-dimensional manifolds. This book aims to introduce undergraduate students to some of these important developments. Low-Dimensional Geometry starts at a relatively elementary level, and its early chapters can be used as a brief introduction to hyperbolic geometry. However, the ultimate goal is to describe the very recently completed geometrization program for 3-dimensional manifolds. The journey to reach this goal emphasizes examples and concrete constructions as an introduction to more general statements. This includes the tessellations associated to the process of gluing together the sides of a polygon. Bending some of these tessellations provides a natural introduction to 3-dimensional hyperbolic geometry and to the theory of kleinian groups, and it eventually leads to a discussion of the geometrization theorems for knot complements and 3-dimensional manifolds. This book is illustrated with many pictures, as the author intended to share his own enthusiasm for the beauty of some of the mathematical objects involved. However, it also emphasizes mathematical rigor and, with the exception of the most recent research breakthroughs, its constructions and statements are carefully justified.

Topology and Geometry for Physicists - Charles Nash 2013-08-16

Written by physicists for physics students, this text assumes no detailed background in topology or geometry. Topics include differential forms, homotopy, homology, cohomology, fiber bundles, connection and covariant derivatives, and Morse theory. 1983 edition.

An Introduction to Contact Topology - Hansjörg Geiges 2008-03-13

This text on contact topology is a comprehensive introduction to the subject, including recent striking applications in geometric and differential topology: Eliashberg's proof of Cerf's theorem via the classification of tight contact structures on the 3-sphere, and the Kronheimer-Mrowka proof of property P for knots via symplectic fillings of contact 3-manifolds. Starting with the basic differential topology of contact manifolds, all aspects of 3-dimensional contact manifolds are treated in this book. One notable feature is a detailed exposition of Eliashberg's classification of overtwisted contact structures. Later chapters also deal with higher-dimensional contact topology. Here the focus is on contact surgery, but other constructions of contact manifolds are described, such as open books or fibre connected sums. This book serves both as a self-contained introduction to the subject for advanced graduate students and as a reference for researchers.

Floer Homology Groups in Yang-Mills Theory - S. K. Donaldson 2002-01-10

The concept of Floer homology was one of the most striking developments in differential geometry. It yields rigorously defined invariants which can be viewed as homology groups of infinite-dimensional cycles. The ideas led to great advances in the areas of low-dimensional topology and symplectic geometry and are intimately related to developments in Quantum Field Theory. The first half of this book gives a thorough account of Floer's construction in the context of gauge theory over 3 and 4-dimensional manifolds. The second half works out some further technical developments of the theory, and the final chapter outlines some research developments for the future - including a discussion of the appearance of modular forms in the theory. The scope of the material in this book means that it will appeal to graduate students as well as those on the frontiers of the subject.

The Wild World of 4-manifolds - Alexandru Scorpan 2005-05-10

What a wonderful book! I strongly recommend this book to anyone, especially graduate students, interested in getting a sense of 4-manifolds. --MAA Reviews The book gives an excellent overview of 4-manifolds, with many figures and historical notes. Graduate students, nonexperts, and experts alike will enjoy browsing through it. -- Robion C. Kirby, University of California, Berkeley This book offers a panorama of the topology of simply connected smooth manifolds of dimension four. Dimension four is unlike any other dimension; it is large enough to have room for wild things to

happen, but small enough so that there is no room to undo the wildness. For example, only manifolds of dimension four can exhibit infinitely many distinct smooth structures. Indeed, their topology remains the least understood today. To put things in context, the book starts with a survey of higher dimensions and of topological 4-manifolds. In the second part, the main invariant of a 4-manifold--the intersection form--and its interaction with the topology of the manifold are investigated. In the third part, as an important source of examples, complex surfaces are reviewed. In the final fourth part of the book, gauge theory is presented; this differential-geometric method has brought to light how unwieldy smooth 4-manifolds truly are, and while bringing new insights, has raised more questions than answers. The structure of the book is modular, organized into a main track of about two hundred pages, augmented by extensive notes at the end of each chapter, where many extra details, proofs and developments are presented. To help the reader, the text is peppered with over 250 illustrations and has an extensive index.

Teichmüller Theory and Applications to Geometry, Topology, and Dynamics - John Hamal Hubbard 2022-02

Foundations of Hyperbolic Manifolds - John Ratcliffe 2013-03-09

This book is an exposition of the theoretical foundations of hyperbolic manifolds. It is intended to be used both as a textbook and as a reference. Particular emphasis has been placed on readability and completeness of ar gument. The treatment of the material is for the most part elementary and self-contained. The reader is assumed to have a basic knowledge of algebra and topology at the first-year graduate level of an American university. The book is divided into three parts. The first part, consisting of Chap ters 1-7, is concerned with hyperbolic geometry and basic properties of discrete groups of isometries of hyperbolic space. The main results are the existence theorem for discrete reflection groups, the Bieberbach theorems, and Selberg's lemma. The second part, consisting of Chapters 8-12, is de voted to the theory of hyperbolic manifolds. The main results are Mostow's rigidity theorem and the determination of the structure of geometrically finite hyperbolic manifolds. The third part, consisting of Chapter 13, in tegrates the first two parts in a development of the theory of hyperbolic orbifolds. The main results are the construction of the universal orbifold covering space and Poincare's fundamental polyhedron theorem.

The Geometry and Topology of Coxeter Groups. (LMS-32) - Michael Davis 2012-11-26

The Geometry and Topology of Coxeter Groups is a comprehensive and authoritative treatment of Coxeter groups from the viewpoint of geometric group theory. Groups generated by reflections are ubiquitous in mathematics, and there are classical examples of reflection groups in spherical, Euclidean, and hyperbolic geometry. Any Coxeter group can be realized as a group generated by reflection on a certain contractible cell complex, and this complex is the principal subject of this book. The book explains a theorem of Moussong that demonstrates that a polyhedral metric on this cell complex is nonpositively curved, meaning that Coxeter groups are "CAT(0) groups." The book describes the reflection group trick, one of the most potent sources of examples of aspherical manifolds. And the book discusses many important topics in geometric group theory and topology, including Hopf's theory of ends; contractible manifolds and homology spheres; the Poincaré Conjecture; and Gromov's theory of CAT(0) spaces and groups. Finally, the book examines connections between Coxeter groups and some of topology's most famous open problems concerning aspherical manifolds, such as the Euler Characteristic Conjecture and the Borel and Singer conjectures.

An Introduction to Geometric Topology - Bruno Martelli 2016-10-26

This book provides a self-contained introduction to the topology and geometry of surfaces and three-manifolds. The main goal is to describe Thurston's geometrisation of three-manifolds, proved by Perelman in 2002. The book is divided into three parts: the first is devoted to hyperbolic geometry, the second to surfaces, and the third to three-manifolds. It contains complete proofs of Mostow's rigidity, the thick-thin decomposition, Thurston's classification of the diffeomorphisms of surfaces (via Bonahon's geodesic currents), the prime and JSJ

decomposition, the topological and geometric classification of Seifert manifolds, and Thurston's hyperbolic Dehn filling Theorem.

The Shape of Space - Jeffrey R. Weeks 2001-12-12

Maintaining the standard of excellence set by the previous edition, this textbook covers the basic geometry of two- and three-dimensional spaces Written by a master expositor, leading researcher in the field, and MacArthur Fellow, it includes experiments to determine the true shape of the universe and contains illustrated examples and engaging exercises that teach mind-expanding ideas in an intuitive and informal way. Bridging the gap from geometry to the latest work in observational cosmology, the book illustrates the connection between geometry and the behavior of the physical universe and explains how radiation remaining from the big bang may reveal the actual shape of the universe.

Compact Manifolds with Special Holonomy - Dominic D. Joyce 2000

This is a combination of a graduate textbook on Reimannian holonomy groups, and a research monograph on compact manifolds with the exceptional holonomy groups G2 and Spin (7). It contains much new research and many new examples.

The Arithmetic of Hyperbolic 3-Manifolds - Colin Maclachlan 2013-04-17

Recently there has been considerable interest in developing techniques based on number theory to attack problems of 3-manifolds; Contains many examples and lots of problems; Brings together much of the existing literature of Kleinian groups in a clear and concise way; At present no such text exists

Handbook of Geometry and Topology of Singularities I - José Luis Cisneros Molina 2020-10-24

This volume consists of ten articles which provide an in-depth and reader-friendly survey of some of the foundational aspects of singularity theory. Authored by world experts, the various contributions deal with both classical material and modern developments, covering a wide range of topics which are linked to each other in fundamental ways. Singularities are ubiquitous in mathematics and science in general. Singularity theory interacts energetically with the rest of mathematics, acting as a crucible where different types of mathematical problems interact, surprising connections are born and simple questions lead to ideas which resonate in other parts of the subject. This is the first volume in a series which aims to provide an accessible account of the state-of-the-art of the subject, its frontiers, and its interactions with other areas of research. The book is addressed to graduate students and newcomers to the theory, as well as to specialists who can use it as a guidebook.

Handbook of Geometric Topology - R.B. Sher 2001-12-20

Geometric Topology is a foundational component of modern mathematics, involving the study of spacial properties and invariants of familiar objects such as manifolds and complexes. This volume, which is intended both as an introduction to the subject and as a wide ranging resouce for those already grounded in it, consists of 21 expository surveys written by leading experts and covering active areas of current research. They provide the reader with an up-to-date overview of this flourishing branch of mathematics.

Singularities and Their Interaction with Geometry and Low Dimensional Topology - Javier Fernández de Bobadilla 2021-05-27

The book is a collection of surveys and original research articles concentrating on new perspectives and research directions at the crossroads of algebraic geometry, topology, and singularity theory. The papers, written by leading researchers working on various topics of the above fields, are the outcome of the "Némethi60: Geometry and Topology of Singularities" conference held at the Alfréd Rényi Institute of Mathematics in Budapest, from May 27 to 31, 2019. Both the conference and this resulting volume are in honor of Professor András Némethi, on the occasion of his 60th birthday, whose work plays a decisive and influential role in the interactions between the above fields. The book should serve as a valuable resource for graduate students and researchers to deepen the new perspectives, methods, and connections between geometry and topology regarding singularities.

Selected Applications of Geometry to Low-dimensional Topology - Michael H. Freedman

1989
The inaugural volume in the popular AMS softcover series designed to make more widely available some of the outstanding lectures presented by various faculty in North America.
Outer Circles - A. Marden 2007-05-31
We live in a three-dimensional space; what sort of space is it? Can we build it from simple geometric objects? The answers to such questions have been found in the last 30 years, and Outer Circles describes the basic mathematics needed for those answers as well as making clear the grand design of the subject of hyperbolic manifolds as a whole. The purpose of Outer Circles is to provide an account of the contemporary theory, accessible to those with minimal formal background in topology, hyperbolic geometry, and complex analysis. The text explains what is needed, and provides the expertise to use the primary tools to arrive at a thorough understanding of the big picture. This picture is further filled out by numerous exercises and expositions at the ends of the chapters and is complemented by a profusion of high quality illustrations. There is an extensive bibliography for further study.
Functional Analysis and Infinite-Dimensional Geometry - Marian Fabian 2013-04-17
This book introduces the basic principles of functional analysis and areas of Banach space theory that are close to nonlinear analysis and topology. The text can be used in graduate courses or for independent study. It includes a large number of exercises of different levels of difficulty, accompanied by hints.
Galois Groups and Fundamental Groups - Tamás Szamuely 2009-07-16
Ever since the concepts of Galois groups in algebra and fundamental groups in topology emerged during the nineteenth century, mathematicians have known of the strong analogies between the two concepts. This book presents the connection starting at an elementary level, showing how the judicious use of algebraic geometry gives access to the powerful interplay between algebra and topology that underpins much modern research in geometry and number theory. Assuming as little technical background as possible, the book starts with basic algebraic and topological concepts, but already presented from the modern viewpoint advocated by Grothendieck. This enables a systematic yet accessible development of the theories of fundamental groups of algebraic curves, fundamental groups of schemes, and Tannakian fundamental groups. The connection between fundamental groups and linear differential equations is also developed at increasing levels of generality. Key applications and recent results, for example on the inverse Galois problem, are given throughout.
Geometry, Topology and Physics - Mikio Nakahara 2018-10-03
Differential geometry and topology have become essential tools for many theoretical physicists. In particular, they are indispensable in theoretical studies of condensed matter physics, gravity, and particle physics. Geometry, Topology and Physics, Second Edition introduces the ideas and techniques of differential geometry and topology at a level suitable for postgraduate students and researchers in these fields. The second edition of this popular and established text incorporates a number of changes designed to meet the needs of the reader and reflect the development of the subject. The book features a considerably expanded first chapter, reviewing aspects of path integral quantization and gauge theories. Chapter 2 introduces the mathematical concepts of maps, vector spaces, and topology. The following chapters focus on more elaborate concepts in geometry and topology and discuss the application of these concepts to liquid crystals, superfluid helium, general relativity, and bosonic string theory. Later chapters unify geometry and topology, exploring fiber bundles, characteristic classes, and index theorems. New to this second edition is the proof of the index theorem in terms of supersymmetric quantum mechanics. The final two chapters are devoted to the most fascinating applications of geometry and topology in contemporary physics, namely the study of anomalies in gauge field theories and the analysis of Polakov's bosonic string theory from the geometrical point of view. Geometry, Topology and Physics, Second Edition is an ideal introduction to differential geometry and topology for postgraduate students and researchers in theoretical and mathematical physics.
Three-Dimensional Geometry and Topology,

Volume 1 - William P. Thurston 2014-10-31
This book develops some of the extraordinary richness, beauty, and power of geometry in two and three dimensions, and the strong connection of geometry with topology. Hyperbolic geometry is the star. A strong effort has been made to convey not just denatured formal reasoning (definitions, theorems, and proofs), but a living feeling for the subject. There are many figures, examples, and exercises of varying difficulty. This book was the origin of a grand scheme developed by Thurston that is now coming to fruition. In the 1920s and 1930s the mathematics of two-dimensional spaces was formalized. It was Thurston's goal to do the same for three-dimensional spaces. To do this, he had to establish the strong connection of geometry to topology--the study of qualitative questions about geometrical structures. The author created a new set of concepts, and the expression "Thurston-type geometry" has become a commonplace. Three-Dimensional Geometry and Topology had its origins in the form of notes for a graduate course the author taught at Princeton University between 1978 and 1980. Thurston shared his notes, duplicating and sending them to whoever requested them. Eventually, the mailing list grew to more than one thousand names. The book is the culmination of two decades of research and has become the most important and influential text in the field. Its content also provided the methods needed to solve one of mathematics' oldest unsolved problems--the Poincaré Conjecture. In 2005 Thurston won the first AMS Book Prize, for Three-dimensional Geometry and Topology. The prize recognizes an outstanding research book that makes a seminal contribution to the research literature. Thurston received the Fields Medal, the mathematical equivalent of the Nobel Prize, in 1982 for the depth and originality of his contributions to mathematics. In 1979 he was awarded the Alan T. Waterman Award, which recognizes an outstanding young researcher in any field of science or engineering supported by the National Science Foundation.

Differential Geometry of Three Dimensions - C. E. Weatherburn 2016-04-15
Originally published in 1927, this systematically organised textbook, primarily aimed at university students, contains a vectorial treatment of geometry.

Automorphisms of Surfaces After Nielsen and Thurston - Andrew J.. Casson 1988
A comprehensive introduction to selected aspects of modern low-dimensional topology for readers with a knowledge of basic algebra.

Fundamentals of Hyperbolic Manifolds - R. D. Canary 2006-04-13
Presents reissued articles from two classic sources on hyperbolic manifolds. Part I is an exposition of Chapters 8 and 9 of Thurston's pioneering Princeton Notes; there is a new introduction describing recent advances, with an up-to-date bibliography, giving a contemporary context in which the work can be set. Part II expounds the theory of convex hull boundaries and their bending laminations. A new appendix describes recent work. Part III is Thurston's famous paper that presents the notion of earthquakes in hyperbolic geometry and proves the earthquake theorem. The final part introduces the theory of measures on the limit set, drawing attention to related ergodic theory and the exponent of convergence. The book will be welcomed by graduate students and professional mathematicians who want a rigorous introduction to some basic tools essential for the modern theory of hyperbolic manifolds.

Algorithmic Topology and Classification of 3-Manifolds - Sergei Matveev 2013-04-17
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-mainfolds. 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.

Knots, Low-Dimensional Topology and Applications - Colin C. Adams 2019-06-26
This proceedings volume presents a diverse collection of high-quality, state-of-the-art

research and survey articles written by top experts in low-dimensional topology and its applications. The focal topics include the wide range of historical and contemporary invariants of knots and links and related topics such as three- and four-dimensional manifolds, braids, virtual knot theory, quantum invariants, braids, skein modules and knot algebras, link homology, quandles and their homology; hyperbolic knots and geometric structures of three-dimensional manifolds; the mechanism of topological surgery in physical processes, knots in Nature in the sense of physical knots with applications to polymers, DNA enzyme mechanisms, and protein structure and function. The contents is based on contributions presented at the International Conference on Knots, Low-Dimensional Topology and Applications – Knots in Hellas 2016, which was held at the International Olympic Academy in Greece in July 2016. The goal of the international conference was to promote the exchange of methods and ideas across disciplines and generations, from graduate students to senior researchers, and to explore fundamental research problems in the broad fields of knot theory and low-dimensional topology. This book will benefit all researchers who wish to take their research in new directions, to learn about new tools and methods, and to discover relevant and recent literature for future study.

Hyperbolic Manifolds and Discrete Groups - Michael Kapovich 2009-08-04

Hyperbolic Manifolds and Discrete Groups is at the crossroads of several branches of mathematics: hyperbolic geometry, discrete groups, 3-dimensional topology, geometric group theory, and complex analysis. The main focus throughout the text is on the "Big Monster," i.e., on Thurston’s hyperbolization theorem, which has not only completely changes the landscape of 3-dimensinal topology and Kleinian group theory but is one of the central results of 3-dimensional topology. The book is fairly self-contained, replete with beautiful illustrations, a rich set of examples of key concepts, numerous exercises, and an extensive bibliography and index. It should serve as an ideal graduate course/seminar text or as a comprehensive reference.

Geometry and Topology of Manifolds: Surfaces and Beyond - Vicente Muñoz 2020-10-21

This book represents a novel approach to differential topology. Its main focus is to give a comprehensive introduction to the classification of manifolds, with special attention paid to the case of surfaces, for which the book provides a complete classification from many points of view: topological, smooth, constant curvature, complex, and conformal. Each chapter briefly revisits basic results usually known to graduate students from an alternative perspective, focusing on surfaces. We provide full proofs of some remarkable results that sometimes are missed in basic courses (e.g., the construction of triangulations on surfaces, the classification of surfaces, the Gauss-Bonnet theorem, the degree-genus formula for complex plane curves, the existence of constant curvature metrics on conformal surfaces), and we give hints to questions about higher dimensional manifolds. Many examples and remarks are scattered through the book. Each chapter ends with an exhaustive collection of problems and a list of topics for further study. The book is primarily addressed to graduate students who did take standard introductory courses on algebraic topology, differential and Riemannian geometry, or algebraic geometry, but have not seen their deep interconnections, which permeate a modern approach to geometry and topology of manifolds.

How Surfaces Intersect in Space - J. Scott Carter 1995

This marvelous book of pictures illustrates the fundamental concepts of geometric topology in a way that is very friendly to the reader. It will be of value to anyone who wants to understand the subject by way of examples. Undergraduates, beginning graduate students, and non-professionals will profit from reading the book and from just looking at the pictures.

An Introduction to Manifolds - Loring W. Tu 2010-10-05

Manifolds, the higher-dimensional analogs of smooth curves and surfaces, are fundamental objects in modern mathematics. Combining aspects of algebra, topology, and analysis, manifolds have also been applied to classical mechanics, general relativity, and quantum field theory. In this streamlined introduction to the subject, the theory of manifolds is presented

with the aim of helping the reader achieve a rapid mastery of the essential topics. By the end of the book the reader should be able to compute, at least for simple spaces, one of the most basic topological invariants of a manifold, its de Rham cohomology. Along the way, the reader acquires the knowledge and skills necessary for further study of geometry and topology. The requisite point-set topology is included in an appendix of twenty pages; other appendices review facts from real analysis and linear algebra. Hints and solutions are provided to many of the exercises and problems. This work may be used as the text for a one-semester graduate or advanced undergraduate course, as well as by students engaged in self-study. Requiring only minimal undergraduate prerequisites, 'Introduction to Manifolds' is also an excellent foundation for Springer's GTM 82, 'Differential Forms in Algebraic Topology'.

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.

Algorithmic and Computer Methods for Three-Manifolds - A.T. Fomenko 2013-03-09

One service mathematics has rendered the human race. It has put common sense back where it belongs. It has put common sense back where it belongs, on the topmost shelf next to the dusty canister labelled discarded nonsense. Eric TBell Every picture tells a story. Advenisement for for Sloan's backache and kidney oils, 1907 The book you have in your hands as you are reading this, is a text on3-dimensional topology. It can serve as a pretty comprehensive text book on the subject. On the other hand, it frequently gets to the frontiers of current research in the topic. If pressed, I would initially classify it as a monograph, but, thanks to the over three hundred illustrations of the geometrical ideas involved, as a rather accessible one, and hence suitable for advanced classes. The style is somewhat informal; more or less like orally presented lectures, and the illustrations more than make up for all the visual aids and handwaving one has at one's command during an actual presentation.

Systolic Geometry and Topology - Mikhail Gersh Katz 2007

The systole of a compact metric space X is a metric invariant of X, defined as the least length of a noncontractible loop in X. When X is a graph, the invariant is usually referred to as the girth, ever since the 1947 article by W. Tutte. The first nontrivial results for systoles of surfaces are the two classical inequalities of C. Loewner and P. Pu, relying on integral-geometric identities, in the case of the two-dimensional torus and real projective plane, respectively. Currently, systolic geometry is a rapidly developing field, which studies systolic invariants in their relation to other geometric invariants of a manifold. This book presents the systolic geometry of manifolds and polyhedra, starting with the two classical inequalities, and then proceeding to recent results, including a proof of M. Gromov's filling area conjecture in a hyperelliptic setting. It then presents Gromov's inequalities and their generalisations, as well as asymptotic phenomena for systoles of surfaces of large genus, revealing a link both to ergodic theory and to properties of congruence subgroups of arithmetic groups. The author includes results on the systolic manifestations of Massey products, as well as of the classical Lusternik-Schnirelmann category.