

algebraic topology allen hatcher

Algebraic Topology: A Deep Dive into Allen Hatcher's Masterpiece

Introduction:

Are you ready to embark on a journey into the fascinating world of algebraic topology? For mathematicians and students alike, Allen Hatcher's "Algebraic Topology" stands as a seminal text, renowned for its clarity, comprehensiveness, and accessibility. This comprehensive guide delves into Hatcher's book, offering a structured overview of its contents, key concepts, and its enduring impact on the field. Whether you're a seasoned mathematician seeking a refresher or a student beginning your foray into this intricate subject, this post provides a roadmap to navigate the intricacies of algebraic topology as presented by Hatcher. We will explore the book's structure, examine its key chapters, and illuminate its value as a foundational text. Prepare to unravel the elegant connections between topology and algebra!

Understanding the Power of Hatcher's "Algebraic Topology"

Allen Hatcher's "Algebraic Topology" is more than just a textbook; it's a gateway to a rich and complex mathematical landscape. Its popularity stems from its unique approach: Hatcher masterfully weaves together theoretical depth with practical examples and intuitive explanations, making even the most challenging concepts accessible. The book's success lies not in overly rigorous formalism, but in its clear presentation and gradual building of understanding. It's designed to guide the reader, fostering a genuine appreciation for the beauty and power of algebraic topology.

Structure and Key Chapters: Decoding Hatcher's Masterpiece

Hatcher's book is renowned for its logical progression, starting with fundamental concepts and steadily building toward more advanced topics. Let's dissect its key components:

1. Fundamental Group and Covering Spaces:

This foundational section lays the groundwork for the entire book. Hatcher skillfully introduces the fundamental group, a crucial algebraic invariant

that captures the topological properties of a space. He explains the concept of covering spaces and their profound connection to the fundamental group, providing both intuitive explanations and rigorous proofs. This section is crucial as it forms the basis for much of the later material. The use of examples like the torus and Klein bottle effectively illustrates abstract concepts.

2. Homology:

This is arguably the heart of the book. Hatcher meticulously develops the theory of homology groups, powerful algebraic tools used to distinguish between topological spaces. He covers simplicial homology, singular homology, and the crucial properties of homology groups, such as their functoriality and invariance under homotopy equivalence. The intuitive explanations of chain complexes and boundary maps are exceptionally clear.

3. Homology with Coefficients:

Building on the previous section, Hatcher introduces the concept of homology with coefficients in a given group. This generalization significantly expands the power and applicability of homology theory, allowing for a deeper understanding of topological spaces. The discussion of the universal coefficient theorem is a particularly significant highlight.

4. Cohomology:

This section introduces the dual concept to homology: cohomology. Hatcher elegantly explains the relationship between homology and cohomology, highlighting their complementary nature. The introduction of cup products and their geometric significance are essential elements in understanding the richer algebraic structure of cohomology.

5. Homotopy Theory:

This section explores the fundamental notion of homotopy equivalence, a powerful tool for classifying topological spaces. Hatcher carefully explains the relationship between homotopy groups and homology groups, showcasing the profound connection between algebraic and topological properties. The discussions on higher homotopy groups and their intricate behavior provide a deeper understanding of the subject.

6. Applications:

While the earlier chapters focus on theoretical foundations, the later sections provide illuminating applications of algebraic topology. This includes applications to manifolds, knot theory, and other advanced mathematical concepts. These applications demonstrate the practical utility

of the theory developed in previous chapters.

7. Appendix:

Hatcher includes a helpful appendix covering basic algebraic concepts, which ensures the text is accessible to a broad range of readers. This thoughtful inclusion makes the book more self-contained and easier for students from diverse backgrounds to engage with.

Detailed Outline of Allen Hatcher's "Algebraic Topology"

Title: Algebraic Topology

Contents:

Introduction: A brief overview of the subject, motivating its study and highlighting its connections to other areas of mathematics.

Chapter 1: Fundamental Group and Covering Spaces: Introduction to the fundamental group, path-connectedness, covering spaces, lifting properties, and applications to classifying spaces. Includes examples such as the fundamental group of the circle and the torus.

Chapter 2: Homology: Simplicial homology, singular homology, chain complexes, boundary maps, homology groups, Mayer-Vietoris sequence, and applications to calculating homology groups of various spaces.

Chapter 3: Homology with Coefficients: Extending the theory of homology to include modules over a given ring, universal coefficient theorem, and applications.

Chapter 4: Cohomology: Introduction to cohomology groups, cup products, and their relationship to homology.

Chapter 5: Homotopy Theory: Fundamental groups, higher homotopy groups, homotopy equivalences, and their applications in classifying topological spaces.

Chapter 6: Applications: Applications of algebraic topology to manifolds, knot theory, and other advanced topics.

Appendix: Review of basic algebraic concepts relevant to the text.

Bibliography: A list of relevant further reading material.

Index: For easy navigation through the book's content.

Explaining Each Point of the Outline:

Each point in the outline above corresponds directly to a major section in Hatcher's book. The descriptions provided earlier in the "Structure and Key Chapters" section offer a more detailed explanation of the content within each chapter. Hatcher's approach emphasizes a gradual build-up of knowledge, starting with intuitive explanations and gradually introducing more rigorous techniques and proofs. This pedagogical approach makes the book both accessible and mathematically sound.

9 Unique FAQs about Allen Hatcher's "Algebraic Topology"

1. Is Hatcher's book suitable for self-study? Yes, its clear writing style and numerous examples make it suitable for self-study, though a strong background in undergraduate mathematics is beneficial.
1. What prerequisites are necessary to understand Hatcher's book? A solid understanding of point-set topology and basic algebra is crucial. Familiarity with group theory and linear algebra is highly recommended.
1. How does Hatcher's book compare to other algebraic topology textbooks? Hatcher's book is widely praised for its clarity, accessibility, and comprehensive coverage, standing out from more formally rigorous texts.
1. Is Hatcher's book suitable for undergraduates? While challenging, it's suitable for advanced undergraduates with a strong mathematical background, often used in graduate courses.
1. Are there solutions manuals available for Hatcher's book? While no official solutions manual exists, numerous online resources and student-created solutions can be found.
1. What are the most challenging concepts in Hatcher's book? Concepts like higher homotopy groups, spectral sequences, and advanced applications can be challenging for even experienced mathematicians.
1. What makes Hatcher's book so popular amongst mathematicians? Its clear writing style, intuitive explanations, and comprehensive coverage make it a go-to resource for both students and professionals.

1. Is there a specific order to read the chapters in Hatcher's book? The chapters are generally structured in a logical progression, with each building upon the previous ones. Following the order is recommended.
1. Where can I find errata for Hatcher's book? Errata lists can sometimes be found on the author's website or through online mathematical communities.

9 Related Articles:

1. Introduction to Point-Set Topology: A foundational prerequisite to understanding topological concepts in Hatcher's book.
2. Understanding Group Theory for Algebraic Topology: Covers the necessary algebraic background for grasping Hatcher's material.
3. Simplicial Complexes and Homology: A detailed exploration of simplicial homology, a core topic in Hatcher's book.
4. Singular Homology and its Applications: A deeper dive into singular homology and its use in algebraic topology.
5. Covering Spaces and the Fundamental Group: A comprehensive exploration of these foundational concepts.
6. Homotopy Theory and its Relationship to Homology: Explores the connection between homotopy and homology.
7. Cohomology Theory: A Beginner's Guide: An introductory explanation of cohomology theory, complementing the homology theory.
8. Applications of Algebraic Topology in Knot Theory: Illustrates one practical application of the concepts explored in Hatcher's book.
9. Advanced Topics in Algebraic Topology: Explores more advanced topics not explicitly covered in Hatcher's book, such as spectral sequences and homotopy theory.

algebraic topology allen hatcher: Algebraic Topology Allen Hatcher, 2002 An introductory textbook suitable for use in a course or for self-study, featuring broad coverage of the subject and a readable exposition, with many examples and exercises.

algebraic topology allen hatcher: *Introduction to Topological Manifolds* John M. Lee, 2006-04-06 Manifolds play an important role in topology, geometry, complex analysis, algebra, and classical mechanics. Learning manifolds differs from most other introductory mathematics in that the subject matter is often completely unfamiliar. This introduction guides readers by explaining the roles manifolds play in diverse branches of mathematics and physics. The book begins with the basics of general topology and gently moves to manifolds, the fundamental group, and covering spaces.

algebraic topology allen hatcher: *A Basic Course in Algebraic Topology* William S. Massey, 2019-06-28 This textbook is intended for a course in algebraic topology at the beginning graduate level. The main topics covered are the classification of compact 2-manifolds, the fundamental group, covering spaces, singular homology theory, and singular cohomology theory. These topics are developed systematically, avoiding all unnecessary definitions, terminology, and technical machinery. The text consists of material from the first five chapters of the author's earlier book, *Algebraic Topology; an Introduction* (GTM 56) together with almost all of his book, *Singular Homology Theory* (GTM 70). The material from the two earlier books has been substantially revised, corrected, and brought up to date.

algebraic topology allen hatcher: *Introduction to Knot Theory* R. H. Crowell, R. H. Fox, 2012-12-06 Knot theory is a kind of geometry, and one whose appeal is very direct because the objects studied are perceivable and tangible in everyday physical space. It is a meeting ground of such diverse branches of mathematics as group theory, matrix theory, number theory, algebraic geometry, and differential geometry, to name some of the more prominent ones. It had its origins in the mathematical theory of electricity and in primitive atomic physics, and there are hints today of new applications in certain branches of chemistry. The outlines of the modern topological theory were worked out by Dehn, Alexander, Reidemeister, and Seifert almost thirty years ago. As a subfield of topology, knot theory forms the core of a wide range of problems dealing with the position of one manifold imbedded within another. This book, which is an elaboration of a series of lectures given by Fox at Haverford College while a Philips Visitor there in the spring of 1956, is an attempt to make the subject accessible to everyone. Primarily it is a text book for a course at the junior-senior level, but we believe that it can be used with profit also by graduate students. Because the algebra required is not the familiar commutative algebra, a disproportionate amount of the book is given over to necessary algebraic preliminaries.

algebraic topology allen hatcher: *Algebraic Topology* Edwin H. Spanier, 2012-12-06 This book surveys the fundamental ideas of algebraic topology. The first part covers the fundamental group, its definition and application in the study of covering spaces. The second part turns to homology theory including cohomology, cup products, cohomology operations and topological manifolds. The final part is devoted to Homotopy theory, including basic facts about homotopy groups and applications to obstruction theory.

algebraic topology allen hatcher: *Algebraic Topology: An Intuitive Approach* Hajime Satō, 1999 The single most difficult thing one faces when one begins to learn a new branch of mathematics is to get a feel for the mathematical sense of the subject. The purpose of this book is to help the aspiring reader acquire this essential common sense about algebraic topology in a short period of time. To this end, Sato leads the reader through simple but meaningful examples in concrete terms. Moreover, results are not discussed in their greatest possible generality, but in terms of the simplest and most essential cases. In response to suggestions from readers of the original edition of this book, Sato has added an appendix of useful definitions and results on sets, general topology, groups and such. He has also provided references. Topics covered include fundamental notions such as homeomorphisms, homotopy equivalence, fundamental groups and higher homotopy groups, homology and cohomology, fiber bundles, spectral sequences and characteristic classes. Objects and examples considered in the text include the torus, the Möbius strip, the Klein bottle, closed surfaces, cell complexes and vector bundles.

algebraic topology allen hatcher: *Homology Theory* James W. Vick, 2012-12-06 This

introduction to some basic ideas in algebraic topology is devoted to the foundations and applications of homology theory. After the essentials of singular homology and some important applications are given, successive topics covered include attaching spaces, finite CW complexes, cohomology products, manifolds, Poincare duality, and fixed point theory. This second edition includes a chapter on covering spaces and many new exercises.

algebraic topology allen hatcher: Algebraic Topology Tammo tom Dieck, 2008 This book is written as a textbook on algebraic topology. The first part covers the material for two introductory courses about homotopy and homology. The second part presents more advanced applications and concepts (duality, characteristic classes, homotopy groups of spheres, bordism). The author recommends starting an introductory course with homotopy theory. For this purpose, classical results are presented with new elementary proofs. Alternatively, one could start more traditionally with singular and axiomatic homology. Additional chapters are devoted to the geometry of manifolds, cell complexes and fibre bundles. A special feature is the rich supply of nearly 500 exercises and problems. Several sections include topics which have not appeared before in textbooks as well as simplified proofs for some important results. Prerequisites are standard point set topology (as recalled in the first chapter), elementary algebraic notions (modules, tensor product), and some terminology from category theory. The aim of the book is to introduce advanced undergraduate and graduate (master's) students to basic tools, concepts and results of algebraic topology. Sufficient background material from geometry and algebra is included.

algebraic topology allen hatcher: More Concise Algebraic Topology J. P. May, K. Ponto, 2012-02 With firm foundations dating only from the 1950s, algebraic topology is a relatively young area of mathematics. There are very few textbooks that treat fundamental topics beyond a first course, and many topics now essential to the field are not treated in any textbook. J. Peter May's A Concise Course in Algebraic Topology addresses the standard first course material, such as fundamental groups, covering spaces, the basics of homotopy theory, and homology and cohomology. In this sequel, May and his coauthor, Kathleen Ponto, cover topics that are essential for algebraic topologists and others interested in algebraic topology, but that are not treated in standard texts. They focus on the localization and completion of topological spaces, model categories, and Hopf algebras. The first half of the book sets out the basic theory of localization and completion of nilpotent spaces, using the most elementary treatment the authors know of. It makes no use of simplicial techniques or model categories, and it provides full details of other necessary preliminaries. With these topics as motivation, most of the second half of the book sets out the theory of model categories, which is the central organizing framework for homotopical algebra in general. Examples from topology and homological algebra are treated in parallel. A short last part develops the basic theory of bialgebras and Hopf algebras.

algebraic topology allen hatcher: Topology and Geometry Glen E. Bredon, 1993-06-24 This book offers an introductory course in algebraic topology. Starting with general topology, it discusses differentiable manifolds, cohomology, products and duality, the fundamental group, homology theory, and homotopy theory. From the reviews: An interesting and original graduate text in topology and geometry...a good lecturer can use this text to create a fine course....A beginning graduate student can use this text to learn a great deal of mathematics.—MATHEMATICAL REVIEWS

algebraic topology allen hatcher: Elementary Applied Topology Robert W. Ghrist, 2014 This book gives an introduction to the mathematics and applications comprising the new field of applied topology. The elements of this subject are surveyed in the context of applications drawn from the biological, economic, engineering, physical, and statistical sciences.

algebraic topology allen hatcher: An Introduction to Differentiable Manifolds and Riemannian Geometry , 1975-08-22 An Introduction to Differentiable Manifolds and Riemannian Geometry

algebraic topology allen hatcher: Algebra: Chapter 0 Paolo Aluffi, 2021-11-09 Algebra: Chapter 0 is a self-contained introduction to the main topics of algebra, suitable for a first sequence on the subject at the beginning graduate or upper undergraduate level. The primary distinguishing

feature of the book, compared to standard textbooks in algebra, is the early introduction of categories, used as a unifying theme in the presentation of the main topics. A second feature consists of an emphasis on homological algebra: basic notions on complexes are presented as soon as modules have been introduced, and an extensive last chapter on homological algebra can form the basis for a follow-up introductory course on the subject. Approximately 1,000 exercises both provide adequate practice to consolidate the understanding of the main body of the text and offer the opportunity to explore many other topics, including applications to number theory and algebraic geometry. This will allow instructors to adapt the textbook to their specific choice of topics and provide the independent reader with a richer exposure to algebra. Many exercises include substantial hints, and navigation of the topics is facilitated by an extensive index and by hundreds of cross-references.

algebraic topology allen hatcher: Categorical Homotopy Theory Emily Riehl, 2014-05-26 This book develops abstract homotopy theory from the categorical perspective with a particular focus on examples. Part I discusses two competing perspectives by which one typically first encounters homotopy (co)limits: either as derived functors definable when the appropriate diagram categories admit a compatible model structure, or through particular formulae that give the right notion in certain examples. Emily Riehl unifies these seemingly rival perspectives and demonstrates that model structures on diagram categories are irrelevant. Homotopy (co)limits are explained to be a special case of weighted (co)limits, a foundational topic in enriched category theory. In Part II, Riehl further examines this topic, separating categorical arguments from homotopical ones. Part III treats the most ubiquitous axiomatic framework for homotopy theory - Quillen's model categories. Here, Riehl simplifies familiar model categorical lemmas and definitions by focusing on weak factorization systems. Part IV introduces quasi-categories and homotopy coherence.

algebraic topology allen hatcher: Complex Cobordism and Stable Homotopy Groups of Spheres Douglas C. Ravenel, 2003-11-25 Since the publication of its first edition, this book has served as one of the few available on the classical Adams spectral sequence, and is the best account on the Adams-Novikov spectral sequence. This new edition has been updated in many places, especially the final chapter, which has been completely rewritten with an eye toward future research in the field. It remains the definitive reference on the stable homotopy groups of spheres. The first three chapters introduce the homotopy groups of spheres and take the reader from the classical results in the field through the computational aspects of the classical Adams spectral sequence and its modifications, which are the main tools topologists have to investigate the homotopy groups of spheres. Nowadays, the most efficient tools are the Brown-Peterson theory, the Adams-Novikov spectral sequence, and the chromatic spectral sequence, a device for analyzing the global structure of the stable homotopy groups of spheres and relating them to the cohomology of the Morava stabilizer groups. These topics are described in detail in Chapters 4 to 6. The revamped Chapter 7 is the computational payoff of the book, yielding a lot of information about the stable homotopy group of spheres. Appendices follow, giving self-contained accounts of the theory of formal group laws and the homological algebra associated with Hopf algebras and Hopf algebroids. The book is intended for anyone wishing to study computational stable homotopy theory. It is accessible to graduate students with a knowledge of algebraic topology and recommended to anyone wishing to venture into the frontiers of the subject.

algebraic topology allen hatcher: Foundations of Algebraic Topology Samuel Eilenberg, Norman Steenrod, 2015-12-08 The need for an axiomatic treatment of homology and cohomology theory has long been felt by topologists. Professors Eilenberg and Steenrod present here for the first time an axiomatization of the complete transition from topology to algebra. Originally published in 1952. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton

University Press since its founding in 1905.

algebraic topology allen hatcher: *Bordism, Stable Homotopy and Adams Spectral Sequences* Stanley O. Kochman, 1996 This book is a compilation of lecture notes that were prepared for the graduate course ``Adams Spectral Sequences and Stable Homotopy Theory'' given at The Fields Institute during the fall of 1995. The aim of this volume is to prepare students with a knowledge of elementary algebraic topology to study recent developments in stable homotopy theory, such as the nilpotence and periodicity theorems. Suitable as a text for an intermediate course in algebraic topology, this book provides a direct exposition of the basic concepts of bordism, characteristic classes, Adams spectral sequences, Brown-Peterson spectra and the computation of stable stems. The key ideas are presented in complete detail without becoming encyclopedic. The approach to characteristic classes and some of the methods for computing stable stems have not been published previously. All results are proved in complete detail. Only elementary facts from algebraic topology and homological algebra are assumed. Each chapter concludes with a guide for further study.

algebraic topology allen hatcher: *A Concise Course in Algebraic Topology* J. P. May, 1999-09 Algebraic topology is a basic part of modern mathematics, and some knowledge of this area is indispensable for any advanced work relating to geometry, including topology itself, differential geometry, algebraic geometry, and Lie groups. This book provides a detailed treatment of algebraic topology both for teachers of the subject and for advanced graduate students in mathematics either specializing in this area or continuing on to other fields. J. Peter May's approach reflects the enormous internal developments within algebraic topology over the past several decades, most of which are largely unknown to mathematicians in other fields. But he also retains the classical presentations of various topics where appropriate. Most chapters end with problems that further explore and refine the concepts presented. The final four chapters provide sketches of substantial areas of algebraic topology that are normally omitted from introductory texts, and the book concludes with a list of suggested readings for those interested in delving further into the field.

algebraic topology allen hatcher: *Basic Category Theory* Tom Leinster, 2014-07-24 A short introduction ideal for students learning category theory for the first time.

algebraic topology allen hatcher: *Algebraic Topology - Homotopy and Homology* Robert M. Switzer, 2017-12-01 From the reviews: The author has attempted an ambitious and most commendable project. [...] The book contains much material that has not previously appeared in this format. The writing is clean and clear and the exposition is well motivated. [...] This book is, all in all, a very admirable work and a valuable addition to the literature. Mathematical Reviews

algebraic topology allen hatcher: *Classical Topology and Combinatorial Group Theory* John Stillwell, 2012-12-06 In recent years, many students have been introduced to topology in high school mathematics. Having met the Mobius band, the seven bridges of Königsberg, Euler's polyhedron formula, and knots, the student is led to expect that these picturesque ideas will come to full flower in university topology courses. What a disappointment undergraduate topology proves to be! In most institutions it is either a service course for analysts, on abstract spaces, or else an introduction to homological algebra in which the only geometric activity is the completion of commutative diagrams. Pictures are kept to a minimum, and at the end the student still does not understand the simplest topological facts, such as the reason why knots exist. In my opinion, a well-balanced introduction to topology should stress its intuitive geometric aspect, while admitting the legitimate interest that analysts and algebraists have in the subject. At any rate, this is the aim of the present book. In support of this view, I have followed the historical development where practicable, since it clearly shows the influence of geometric thought at all stages. This is not to claim that topology received its main impetus from geometric recreations like the seven bridges; rather, it resulted from the visualization of problems from other parts of mathematics—complex analysis (Riemann), mechanics (Poincaré), and group theory (Dehn). It is these connections to other parts of mathematics which make topology an important as well as a beautiful subject.

algebraic topology allen hatcher: *Topology* Tai-Danae Bradley, Tyler Bryson, John Terilla, 2020-08-18 A graduate-level textbook that presents basic topology from the perspective of category

theory. This graduate-level textbook on topology takes a unique approach: it reintroduces basic, point-set topology from a more modern, categorical perspective. Many graduate students are familiar with the ideas of point-set topology and they are ready to learn something new about them. Teaching the subject using category theory--a contemporary branch of mathematics that provides a way to represent abstract concepts--both deepens students' understanding of elementary topology and lays a solid foundation for future work in advanced topics.

algebraic topology allen hatcher: Categories and Functors Bodo Pareigis, 1970

algebraic topology allen hatcher: *Algebraic Topology* William Fulton, 2013-12-01 To the Teacher. This book is designed to introduce a student to some of the important ideas of algebraic topology by emphasizing the relations of these ideas with other areas of mathematics. Rather than choosing one point of view of modern topology (homotopy theory, simplicial complexes, singular theory, axiomatic homology, differential topology, etc.), we concentrate our attention on concrete problems in low dimensions, introducing only as much algebraic machinery as necessary for the problems we meet. This makes it possible to see a wider variety of important features of the subject than is usual in a beginning text. The book is designed for students of mathematics or science who are not aiming to become practicing algebraic topologists--without, we hope, discouraging budding topologists. We also feel that this approach is in better harmony with the historical development of the subject. What would we like a student to know after a first course in topology (assuming we reject the answer: half of what one would like the student to know after a second course in topology)? Our answers to this have guided the choice of material, which includes: understanding the relation between homology and integration, first on plane domains, later on Riemann surfaces and in higher dimensions; winding numbers and degrees of mappings, fixed-point theorems; applications such as the Jordan curve theorem, invariance of domain; indices of vector fields and Euler characteristics; fundamental groups

algebraic topology allen hatcher: *Undergraduate Algebraic Geometry* Miles Reid, Miles A. Reid, 1988-12-15 Algebraic geometry is, essentially, the study of the solution of equations and occupies a central position in pure mathematics. This short and readable introduction to algebraic geometry will be ideal for all undergraduate mathematicians coming to the subject for the first time. With the minimum of prerequisites, Dr Reid introduces the reader to the basic concepts of algebraic geometry including: plane conics, cubics and the group law, affine and projective varieties, and non-singularity and dimension. He is at pains to stress the connections the subject has with commutative algebra as well as its relation to topology, differential geometry, and number theory. The book arises from an undergraduate course given at the University of Warwick and contains numerous examples and exercises illustrating the theory.

algebraic topology allen hatcher: *Algebraic Topology* Hatcher, 2005-09-01 In most mathematics departments at major universities one of the three or four basic first-year graduate courses is in the subject of algebraic topology. This introductory textbook in algebraic topology is suitable for use in a course or for self-study, featuring broad coverage of the subject and a readable exposition, with many examples and exercises. The four main chapters present the basic material of the subject: fundamental group and covering spaces, homology and cohomology, higher homotopy groups, and homotopy theory generally. The author emphasizes the geometric aspects of the subject, which helps students gain intuition. A unique feature of the book is the inclusion of many optional topics which are not usually part of a first course due to time constraints, and for which elementary expositions are sometimes hard to find. Among these are: Bockstein and transfer homomorphisms, direct and inverse limits, H-spaces and Hopf algebras, the Brown representability theorem, the James reduced product, the Dold-Thom theorem, and a full exposition of Steenrod squares and powers. Researchers will also welcome this aspect of the book.

algebraic topology allen hatcher: *Basic Concepts of Algebraic Topology* F.H. Croom, 2012-12-06 This text is intended as a one semester introduction to algebraic topology at the undergraduate and beginning graduate levels. Basically, it covers simplicial homology theory, the fundamental group, covering spaces, the higher homotopy groups and introductory singular

homology theory. The text follows a broad historical outline and uses the proofs of the discoverers of the important theorems when this is consistent with the elementary level of the course. This method of presentation is intended to reduce the abstract nature of algebraic topology to a level that is palatable for the beginning student and to provide motivation and cohesion that are often lacking in abstract treatments. The text emphasizes the geometric approach to algebraic topology and attempts to show the importance of topological concepts by applying them to problems of geometry and analysis. The prerequisites for this course are calculus at the sophomore level, a one semester introduction to the theory of groups, a one semester introduction to point-set topology and some familiarity with vector spaces. Outlines of the prerequisite material can be found in the appendices at the end of the text. It is suggested that the reader not spend time initially working on the appendices, but rather that he read from the beginning of the text, referring to the appendices as his memory needs refreshing. The text is designed for use by college juniors of normal intelligence and does not require mathematical maturity beyond the junior level.

algebraic topology allen hatcher: An Illustrated Theory of Numbers Martin H. Weissman, 2020-09-15 News about this title: — Author Marty Weissman has been awarded a Guggenheim Fellowship for 2020. (Learn more here.) — Selected as a 2018 CHOICE Outstanding Academic Title — 2018 PROSE Awards Honorable Mention An Illustrated Theory of Numbers gives a comprehensive introduction to number theory, with complete proofs, worked examples, and exercises. Its exposition reflects the most recent scholarship in mathematics and its history. Almost 500 sharp illustrations accompany elegant proofs, from prime decomposition through quadratic reciprocity. Geometric and dynamical arguments provide new insights, and allow for a rigorous approach with less algebraic manipulation. The final chapters contain an extended treatment of binary quadratic forms, using Conway's topograph to solve quadratic Diophantine equations (e.g., Pell's equation) and to study reduction and the finiteness of class numbers. Data visualizations introduce the reader to open questions and cutting-edge results in analytic number theory such as the Riemann hypothesis, boundedness of prime gaps, and the class number 1 problem. Accompanying each chapter, historical notes curate primary sources and secondary scholarship to trace the development of number theory within and outside the Western tradition. Requiring only high school algebra and geometry, this text is recommended for a first course in elementary number theory. It is also suitable for mathematicians seeking a fresh perspective on an ancient subject.

algebraic topology allen hatcher: Algebraic Topology Marvin J. Greenberg, 2018-03-05 Great first book on algebraic topology. Introduces (co)homology through singular theory.

algebraic topology allen hatcher: A Topological Introduction to Nonlinear Analysis Robert F. Brown, 2014-11-27 This third edition is addressed to the mathematician or graduate student of mathematics - or even the well-prepared undergraduate - who would like, with a minimum of background and preparation, to understand some of the beautiful results at the heart of nonlinear analysis. Based on carefully-expounded ideas from several branches of topology, and illustrated by a wealth of figures that attest to the geometric nature of the exposition, the book will be of immense help in providing its readers with an understanding of the mathematics of the nonlinear phenomena that characterize our real world. Included in this new edition are several new chapters that present the fixed point index and its applications. The exposition and mathematical content is improved throughout. This book is ideal for self-study for mathematicians and students interested in such areas of geometric and algebraic topology, functional analysis, differential equations, and applied mathematics. It is a sharply focused and highly readable view of nonlinear analysis by a practicing topologist who has seen a clear path to understanding. For the topology-minded reader, the book indeed has a lot to offer: written in a very personal, eloquent and instructive style it makes one of the highlights of nonlinear analysis accessible to a wide audience.-Monatshefte fur Mathematik (2006)

algebraic topology allen hatcher: Characteristic Classes John Willard Milnor, James D. Stasheff, 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.

algebraic topology allen hatcher: *Topology Through Inquiry* Michael Starbird, Francis Su, 2020-09-10 *Topology Through Inquiry* is a comprehensive introduction to point-set, algebraic, and geometric topology, designed to support inquiry-based learning (IBL) courses for upper-division undergraduate or beginning graduate students. The book presents an enormous amount of topology, allowing an instructor to choose which topics to treat. The point-set material contains many interesting topics well beyond the basic core, including continua and metrizability. Geometric and algebraic topology topics include the classification of 2-manifolds, the fundamental group, covering spaces, and homology (simplicial and singular). A unique feature of the introduction to homology is to convey a clear geometric motivation by starting with mod 2 coefficients. The authors are acknowledged masters of IBL-style teaching. This book gives students joy-filled, manageable challenges that incrementally develop their knowledge and skills. The exposition includes insightful framing of fruitful points of view as well as advice on effective thinking and learning. The text presumes only a modest level of mathematical maturity to begin, but students who work their way through this text will grow from mathematics students into mathematicians. Michael Starbird is a University of Texas Distinguished Teaching Professor of Mathematics. Among his works are two other co-authored books in the Mathematical Association of America's (MAA) Textbook series. Francis Su is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College and a past president of the MAA. Both authors are award-winning teachers, including each having received the MAA's Haimo Award for distinguished teaching. Starbird and Su are, jointly and individually, on lifelong missions to make learning—of mathematics and beyond—joyful, effective, and available to everyone. This book invites topology students and teachers to join in the adventure.

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