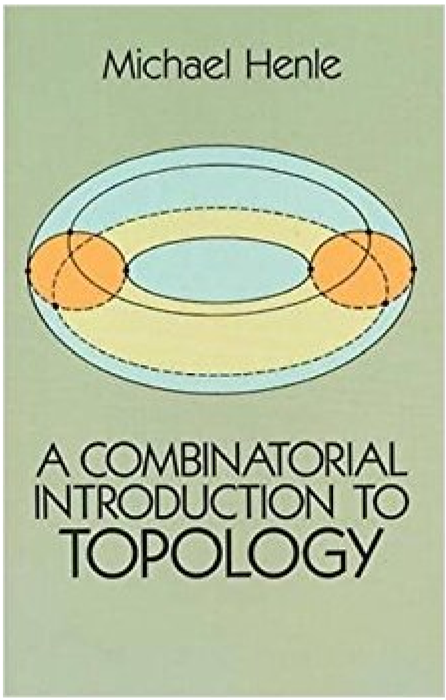
A Combinatorial Introduction To Topology (Dover Books On Mathematics)



Synopsis

The creation of algebraic topology is a major accomplishment of 20th-century mathematics. The goal of this book is to show how geometric and algebraic ideas met and grew together into an important branch of mathematics in the recent past. The book also conveys the fun and adventure that can be part of a mathematical investigation.Combinatorial topology has a wealth of applications, many of which result from connections with the theory of differential equations. As the author points out, "Combinatorial topology is uniquely the subject where students of mathematics below graduate level can see the three major divisions of mathematics â ” analysis, geometry, and algebra â ” working together amicably on important problems."To facilitate understanding, Professor Henle has deliberately restricted the subject matter of this volume, focusing especially on surfaces because the theorems can be easily visualized there, encouraging geometric intuition. In addition, this area presents many interesting applications arising from systems of differential equations. To illuminate the interaction of geometry and algebra, a single important algebraic tool â ” homology â ” is developed in detail.Written for upper-level undergraduate and graduate students, this book requires no previous acquaintance with topology or algebra. Point set topology and group theory are developed as they are needed. In addition, a supplement surveying point set topology is included for the interested student and for the instructor who wishes to teach a mixture of point set and algebraic topology. A rich selection of problems, some with solutions, are integrated into the text.

Book Information

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Customer Reviews

Usually books on algebraic topology, even with the title "introduction" or something, are extremely difficult. This book is an exception. And it is a exceptional book since the author tried his best to explain abstract concepts in charts. You know, most of the modern "geometry" books do not really use illustrations! (They only cares about group theory)

This is an excellent book on topology. It is perfect for the researcher or student who wants to get the hands dirty. It is very clear with great examples. I wish all of my books were as useful and delightful to read.A Combinatorial Introduction to Topology (Dover Books on Mathematics)

Historically, combinatorial topology was a precursor to what is now the field of algebraic topology, and this book gives an elementary introduction to the subject, directed towards the beginning student of topology or geometry. Due to its importance in applications, the physicist reader who is intending eventually to specialize in elementary particle physics will gain much in the perusal of this book. Combinatorial topology can be viewed first as an attempt to study the properties of polyhedra and how they fit together to form more complicated objects. Conversely, one can view it as a way of studying complicated objects by breaking them up into elementary polyhedral pieces. The author takes the former view in this book, and he restricts his attention to the study of objects that are built up from polygons, with the proviso that vertices are joined to vertices and (whole) edges are joined to (whole) edges. He begins the book with a consideration of the Euler formula, and as one example considers the Euler number of the Platonic solids, resulting in a Diophantine equation. This equation only has five solutions, the Platonic solids. The author then motivates the concept of a homeomorphism (he calls them "topological equivalences") by considering topological transformations in the plane. Using the notion of topological equivalence he defines the notions of cell, path, and Jordan curve. Compactness and connectedness are then defined, along with the general notion of a topological space. Elementary notions from differential topology are then considered in chapter 2, with the reader encountering for the first time the connections between analysis and topology, via the consideration of the phase portraits of differential equations. Brouwer’s fixed point theorem is proved via Sperner’s lemma, the latter being a combinatorial result which deals with the labeling of vertices in a triangulation of the cell. Gradient vector fields, the Poincare index theorem, and dual vector fields, which are some elementary notions in Morse theory, are treated here briefly. An excellent introduction to some elementary notions from algebraic topology is done in chapter 3. The author treats the case of plane homology (mod 2), which is discussed via the use of polygonal chains on a grating in the plane. Beginning students will find the presentation very understandable, and the formalism that is developed is used to give a proof of the Jordan curve theorem. Then in chapter 4, the author proves the classification theorem for surfaces, using a combinatorial definition of a surface. The author raises the level of complication in chapter 5, wherein he studies the (mod 2) homology of complexes. A complex is defined somewhat loosely as a topological space that is constructed out of vertices, edges, and polygons via topological identification. He proves the invariance theorem for triangulations of surfaces by showing that the homology groups of the triangulation are same as the homology groups of the plane model of the surface. This is an example of the invariance principle, and the author briefly details some of the history of invariance principles, such as the Hauptvermutung, its counterexample due to the mathematician John Milnor, and Heawood's conjecture, the latter of which deals with the minimum number of colors needed to color all maps on a surface with a given Euler characteristic. Integral homology is also introduced by the author, and he shows the origin of torsion in the consideration of the "twist" in a surface. In the last part of the book, the author returns to the consideration of continuous transformations, tackling first the idea of a universal covering space. Algebraic topology again makes its appearance via the consideration of transformations of triangulated topological spaces, i.e. simplicial transformations. He shows how these transformations induce transformations in the homology groups, thus introducing the reader to some notions from category theory. The elaboration of the invariance theorem for homology leads the author to studying the properties of the group homomorphisms via matrix algebra, and then to a proof of the Lefschetz fixed point theorem. The book ends with a brief discussion of homotopy, topological dynamics, and alternative homology theories. The beginning student of topology will thus be well prepared to move on to more rigorous and advanced treatments of differential, algebraic, and geometric topology after the reading of this book. There are still many unsolved problems in these areas, and each one of these will require a deep understanding and intuition of the underlying concepts in topology. This book is a good start.

Way back in 1980 I took a course at Oberlin College from Professor Henle in which he used this book (his own) as the text. Up until then I had been wavering as to a major, whether it should be in the hard sciences or Math. Michael Henle, his course, and this textbook decided me. I majored in Math.The book gives a very hands on, concrete approach to what is a very abstract realm. An example that comes immediately to mind is the proof of the classification of manifolds, which comes down to a sequence of clever cut and paste operations on a large sheet with labeled edges. This text also has a curious sense of humor subtly hidden through it. Just look in the index under 'Man in the moon'. I dare you! The exercises, which consist mostly of writing proofs, where there is very little notation and all your ideas have to be written out long-hand, are incredibly valuable for developing a logical mind. At least they were for me, back in 1980.

I think this is Dover Publications best title in topology.There is a fantastic and thorough introduction to many ofthe finer theorems (e.g.: Brouwer's Fixed Point Theorem, Sperner's Lemma, etc.). I was absolutely captivated with the ease with which Dr. Henle explained some remarkably difficult concepts. Much time is spent on some of the more unusual topics for a text at this level, including homology and even the qualitative behavior of differential equations! A serious book, for advanced undergraduates and graduates. Very enriching, and a definite plus as a reference tool.

This covers the basics of algebraic topology with simplexes, covering in essence the fundamental ideas behind of the work of Poincare, Brouwer, and Alexander. He proves the Jordan curve theorem, classifies all compact surfaces, and the relationship with vector fields. The homology groups are defined and used.There are excellent examples, clear writing, and humour. An outstanding introduction.One nice feature is that he bases his notions of continuity on "nearness" not epsilon-delta.

I believe the two existing reviews are over-ratng. True, the book is accessible to anyone without prior knowledge of topology/algebra, but the treatment is too "elementary". For example, the author doesn't even introduce the word "mod 2 homology". If you are resolutely to study algebraic (or differential) topology, this is NOT the book to "study". Try Bredon or Fomenko-Novikov or May. For the subject covered, look for the book by Stillwell.

This is the second time I have bought this book since I offeredthe first one to my son. An excellent introduction to the topic!

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