An Introduction To Algebraic Topology Andrew H Wallace

Homotopy Theory: An Introduction to Algebraic Topology

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.

This English translation of a Russian book presents the basic notions of differential and algebraic topology, which are indispensable for specialists and useful for research mathematicians and theoretical physicists. In particular, ideas and results are introduced related to manifolds, cell spaces, coverings and fibrations, homotopy groups, intersection index, etc. The author notes, ``The lecture note origins of the book left a significant imprint on its style. It contains very few detailed proofs: I tried to give as many illustrations as possible and to show what really occurs in topology, not always explaining why it occurs.'' He concludes, ``As a rule, only those proofs (or sketches of proofs) that are interesting per se and have important generalizations are presented.''

Algebraic geometry, central to pure mathematics, has important applications in such fields as engineering, computer science, statistics and computational biology, which exploit the computational algorithms that the theory provides. Users get the full benefit, however, when they know something of the underlying theory, as well as basic procedures and facts. This book is a systematic introduction to the central concepts of algebraic geometry most useful for computation. Written for advanced undergraduate and graduate students in mathematics and researchers in application areas, it focuses on specific examples and restricts development of formalism to what is needed to address these examples. In particular, it introduces the notion of Gröbner bases early on and develops algorithms for almost everything covered. It is based on courses given over the past five years in a large interdisciplinary programme in computational algebraic geometry at Rice University, spanning mathematics, computer science, biomathematics and bioinformatics.

Fundamentals of Algebraic Topology

A Geometric Introduction to Topology

Handbook of Algebraic Topology

Algebraic Topology: An Intuitive Approach

To the Teacher. This book is designed to introduce a student to some of the important ideas of algebraic topology by emphasizing the re lations of these ideas with other areas of mathematics. Rather than choosing one point of view of modem topology (homotopy theory, simplicial complexes, singular theory, axiomatic homology, differ ential topology, etc.), we concentrate our attention on concrete prob lems in low dimensions, introducing only as much algebraic machin ery 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 topol ogists-without, we hope, discouraging budding topologists. We also feel that this approach is in better harmony with the historical devel opment of the subject. What would we like a student to know after a first course in to pology (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: under standing the relation between homology and integration, first on plane domains, later on Riemann surfaces and in higher dimensions; wind ing numbers and degrees of mappings, fixed-point theorems; appli cations such as the Jordan curve theorem, invariance of domain; in dices of vector fields and Euler characteristics; fundamental groups

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

Informally, K-theory is a tool for probing the structure of a mathematical object such as a ring or a topological space in terms of suitably parameterized vector spaces and producing important intrinsic invariants which are useful in the study of algebr

First course in algebraic topology for advanced undergraduates. Homotopy theory, the duality theorem, relation of topological ideas to other branches of pure mathematics. Exercises and problems. 1972 edition.

Introduction to Algebraic Geometry

Localization, Completion, and Model Categories

A First Course in Algebraic Topology

An Introduction to Manifolds

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.

A clear exposition, with exercises, of the basic ideas of algebraic topology. Suitable for a two-semester course at the beginning graduate level, it assumes a knowledge of point set topology and basic algebra. Although categories and functors are introduced early in the text, excessive generality is avoided, and the author explains the geometric or analytic origins of abstract concepts as they are introduced.

Algebraic topology (also known as homotopy theory) is a flourishing branch of modern mathematics. It is very much an international subject and this is reflected in the background of the 36 leading experts who have contributed to the Handbook. Written for the reader who already has a grounding in the subject, the volume consists of 27 expository surveys covering the most active areas of research. They provide the researcher with an up-to-date overview of this exciting branch of mathematics.

Surveys several algebraic invariants, including the fundamental group, singular and Cech homology groups, and a variety of cohomology groups.

Introduction to Topology

Homology and Cohomology

Algebraic Topology - Homotopy and Homology

A Basic Course in Algebraic Topology

viii homology groups. A weaker result, sufficient nevertheless for our purposes, is proved in Chapter 5, where the reader will also find some discussion of the need for a more powerful in variance theorem and a summary of the proof of such a theorem. Secondly the emphasis in this book is on low-dimensional examples the graphs and surfaces of the title since it is there that geometrical intuition has its roots. The goal of the book is the investigation in Chapter 9 of the properties of graphs in surfaces; some of the problems studied there are mentioned briefly in the Introduction, which contains an in formal survey of the material of the book. Many of the results of Chapter 9 do indeed generalize to higher dimensions (and the general machinery of simplicial homology theory is available from earlier chapters) but I have confined myself to one example, namely the theorem that non-orientable closed surfaces do not embed in three-dimensional space. One of the principal results of Chapter 9, a version of Lefschetz duality, certainly generalizes, but for an effective presentation such a gener- ization needs cohomology theory. Apart from a brief mention in connexion with Kirchhoff's laws for an electrical network I do not use any cohomology here. Thirdly there are a number of digressions, whose purpose is rather to illuminate the central argument from a slight dis tance, than to contribute materially to its exposition.

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'.

This work has been selected by scholars as being culturally important and is part of the knowledge base of civilization as we know it. This work is in the public domain in the United States of America, and possibly other nations. Within the United States, you may freely copy and distribute this work, as no entity (individual or corporate) has a copyright on the body of the work. Scholars believe, and we concur, that this work is important enough to be preserved, reproduced, and made generally available to the public. To ensure a quality reading experience, this work has been proofread and republished using a format that seamlessly blends the original graphical elements with text in an easy-to-read typeface. We appreciate your support of the preservation process, and thank you for being an important part of keeping this knowledge alive and relevant.

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.

The K-book

Homotopy Theory: An Introduction to Algebraic Topology

Basic Algebraic Topology

Topology

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 abstact 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 introduc tion 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.

An Introduction to Algebraic TopologySpringer Science & Business Media

This account of algebraic topology is complete in itself, assuming no previous knowledge of the subject. It is used as a textbook for students in the final year of an undergraduate course or on graduate courses and as a handbook for mathematicians in other branches who want some knowledge of the subject.

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.

An Introduction to Algebraic K-theory

An Introduction To Algebraic Topology

An Introduction to the Point-set and Algebraic Areas

Lecture Notes in Algebraic Topology

Algebraic Topology is an introductory textbook based on a class for advanced high-school students at the Stanford University Mathematics Camp (SUMaC) that the authors have taught for many years. Each chapter, or lecture, corresponds to one day of class at SUMaC. The book begins with the preliminaries needed for the formal definition of a surface. Other topics covered in the book include the classification of surfaces, group theory, the fundamental group, and homology. This book assumes no background in abstract algebra or real analysis, and the material from those subjects is presented as needed in the text. This makes the book readable to undergraduates or high-school students who do not have the background typically assumed in an algebraic topology book or class. The book contains many examples and exercises, allowing it to be used for both self-study and for an introductory undergraduate topology course.

This rapid and concise presentation of the essential ideas and results of algebraic topology follows the axiomatic foundations pioneered by Eilenberg and Steenrod. The approach of the book is pragmatic: while most proofs are given, those that are particularly long or technical are omitted, and results are stated in a form that emphasizes practical use over maximal generality. Moreover, to better reveal the logical structure of the subject, the separate roles of algebra and topology are illuminated. Assuming a background in point-set topology, Fundamentals of Algebraic Topology covers the canon of a first-year graduate course in algebraic topology: the fundamental group and covering spaces, homology and cohomology, CW complexes and manifolds, and a short introduction to homotopy theory. Readers wishing to deepen their knowledge of algebraic topology beyond the fundamentals are guided by a short but carefully annotated bibliography.

Topology as a subject, in our opinion, plays a central role in university education. It is not really possible to design courses in differential geometry, mathematical analysis, differential equations, mechanics, functional analysis that correspond to the temporary state of these disciplines without involving topological concepts. Therefore, it is essential to acquaint students with topo logical research methods already in the first university courses. This textbook is one possible version of an introductory course in topo logy and elements of differential geometry, and it absolutely reflects both the authors' personal preferences and experience as lecturers and researchers. It deals with those areas of topology and geometry that are most closely related to fundamental courses in general mathematics. The educational material leaves a lecturer a free choice in designing his own course or his own seminar. We draw attention to a number of particularities in our book. The first chap ter, according to the authors' intention, should acquaint readers with topolo gical problems and concepts which arise from problems in geometry, analysis, and physics. Here, general topology (Ch. 2) is presented by introducing con structions, for example, related to the concept of quotient spaces, much earlier than various other notions of general topology thus making it possible for students to study important examples of manifolds (two-dimensional surfaces, projective spaces, orbit spaces, etc.) as topological spaces, immediately.

Building on rudimentary knowledge of real analysis, point-set topology, and basic algebra, Basic Algebraic Topology provides plenty of material for a two-semester course in algebraic topology. The book first introduces the necessary fundamental concepts, such as relative homotopy, fibrations and cofibrations, category theory, cell complexes, and si

A First Course

Basic Concepts of Algebraic Topology

Homology Theory

More Concise Algebraic Topology

Comprehensive coverage of elementary general topology as well as algebraic topology, specifically 2-manifolds, covering spaces and fundamental groups. Problems, with selected solutions. Bibliography. 1975 edition.

The amount of algebraic topology a graduate student specializing in topology must learn can be intimidating. Moreover, by their second year of graduate studies, students must make the transition from understanding simple proofs line-by-line to understanding the overall structure of proofs of difficult theorems. To help students make this transition, the material in this book is presented in an increasingly sophisticated manner. It is intended to bridge the gap between algebraic and geometric topology, both by providing the algebraic tools that a geometric topologist needs and by concentrating on those areas of algebraic topology that are geometrically motivated. Prerequisites for using this book include basic set-theoretic topology, the definition of CW-complexes, some knowledge of the fundamental group/covering space theory, and the construction of singular homology. Most of this material is briefly reviewed at the beginning of the book. The topics discussed by the authors include typical material for first- and second-year graduate courses. The core of the exposition consists of chapters on homotopy groups and on spectral sequences. There is also material that would interest students of geometric topology (homology with local coefficients and obstruction theory) and algebraic topology (spectra and generalized homology), as well as preparation for more advanced topics such as algebraic K-theory and the s-cobordism theorem. A unique feature of the book is the inclusion, at the end of each chapter, of several projects that require students to present proofs of substantial theorems and to write notes accompanying their explanations. Working on these projects allows students to grapple with the ``big picture'', teaches them how to give mathematical lectures, and prepares them for participating in research seminars. The book is designed as a textbook for graduate students studying algebraic and geometric topology and homotopy theory. It will also be useful for students from other fields such as differential geometry, algebraic geometry, and homological algebra. The exposition in the text is clear; special cases are presented over complex general statements.

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.

Developed from a first-year graduate course in algebraic topology, this text is an informal introduction to some of the main ideas of contemporary homotopy and cohomology theory. The materials are structured around four core areas: de Rham theory, the Cech-de Rham complex, spectral sequences, and characteristic classes. By using the de Rham theory of differential forms as a prototype of cohomology, the machineries of algebraic topology are made easier to assimilate. With its stress on concreteness, motivation, and readability, this book is equally suitable for self-study and as a one-semester course in topology.

A Concise Course in Algebraic Topology

An Introduction

An Intuitive Approach

Homology theory is a powerful algebraic tool that is at the centre of current research in topology and its applications. This accessible textbook will appeal to mathematics students interested in the application of algebra to geometrical problems, specifically the study of surfaces (sphere, torus, Mobius band, Klein bottle). In this introduction to simplicial homology - the most easily digested version of homology theory - the author studies interesting geometrical problems, such as the structure of two-dimensional surfaces and the embedding of graphs in surfaces, using the minimum of algebraic machinery and including a version of Lefschetz duality. Assuming very little mathematical knowledge, the book provides a complete account of the algebra needed (abelian groups and presentations), and the development of the material is always carefully explained with proofs given in full detail. Numerous examples and exercises are also included, making this an ideal text for undergraduate courses or for self-study.

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 Homotropy theory, including basic facts about homotropy groups and applications to obstruction theory.

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 Mobius strip, the Klein bottle, closed surfaces, cell complexes and vector bundles.

This self-contained introduction to algebraic topology is suitable for a number of topology courses. It consists of about one quarter 'general topology' (without its usual pathologies) and three quarters 'algebraic topology' (centred around the fundamental group, a readily grasped topic which gives a good idea of what algebraic topology is). The book has emerged from courses given at the University of Newcastle-upon-Tyne to senior undergraduates and beginning postgraduates. It has been written at a level which will enable the reader to use it for self-study as well as a course book. The approach is leisurely and a geometric flavour is evident throughout. The many illustrations and over 350 exercises will prove invaluable as a teaching aid. This account will be welcomed by advanced students of pure mathematics at colleges and universities.

Introduction to Differential and Algebraic Topology

Graphs, Surfaces and Homology

Algebraic Topology

An Introduction to Algebraic Topology

This self-contained treatment begins with three chapters on the basics of point-set topology, after which it proceeds to homology groups and continuous mapping, barycentric subdivision, and simplicial complexes. 1961 edition.

Differential Forms in Algebraic Topology