weibel homological algebra

Weibel Homological Algebra: A Comprehensive Guide

Introduction:

Are you ready to delve into the fascinating world of abstract algebra? This comprehensive guide to Weibel's "An Introduction to Homological Algebra" will equip you with a solid understanding of this crucial area of mathematics. We'll navigate the key concepts, explore the book's structure, and provide you with the tools to tackle its challenging but rewarding content. Whether you're a graduate student embarking on your homological algebra journey or a seasoned mathematician looking for a refresher, this post will serve as your invaluable companion. We’ll cover everything from the foundational concepts to advanced techniques, making complex ideas accessible and understandable. Let's begin!

Chapter 1: Understanding the Fundamentals – Modules and Chain Complexes

Before diving into the intricacies of homological algebra, it’s crucial to grasp the fundamental building blocks: modules and chain complexes. Weibel's book meticulously lays out these concepts. Modules generalize the notion of vector spaces to more general rings, providing the context for many homological constructions. We'll explore the properties of modules, including free modules, projective modules, and injective modules – crucial for understanding various homological functors. Furthermore, we'll define chain complexes, which are sequences of modules connected by homomorphisms. Understanding these sequences is fundamental to defining homology and cohomology. We'll discuss the crucial concept of chain maps, which are morphisms between chain complexes, laying the groundwork for understanding homology groups.

Chapter 2: Homology and Cohomology – The Heart of Homological Algebra

The core of homological algebra lies in the concepts of homology and cohomology. Weibel expertly guides the reader through the construction of homology groups from chain complexes. We'll examine how these groups capture essential information about the underlying algebraic structure. The notion of homology is deeply connected to topological spaces, offering a powerful algebraic tool to study their properties. Similarly, cohomology provides a dual perspective, offering another set of invariants to study algebraic structures. We will explore how both homology and cohomology are calculated using various techniques, such as long exact sequences.

Chapter 3: Derived Functors – Extending Functors to Chain Complexes

Derived functors are powerful tools that extend the scope of ordinary functors to chain complexes. This extension allows us to study how functors behave on the homology groups of chain complexes, providing deeper insights into the algebraic structure. Weibel systematically explains the construction of left and right derived functors, focusing on their properties and applications. We will examine the crucial role of projective and injective resolutions in the construction of derived functors. Understanding derived functors is critical for comprehending many advanced results in homological algebra.

Chapter 4: Tor and Ext Functors – The Cornerstones of Homological Algebra

Tor and Ext functors are among the most important derived functors in homological algebra. Tor measures the "failure" of the tensor product to be exact, while Ext measures the "failure" of the Hom functor to be exact. Weibel dedicates significant space to these functors, demonstrating their crucial role in various algebraic contexts. We'll examine their properties, calculate specific examples, and explore their significance in applications, such as the study of group extensions and the classification of modules.

Chapter 5: Spectral Sequences – A Powerful Tool for Calculation

Spectral sequences are a powerful computational tool in homological algebra. They provide a systematic approach to calculating homology and cohomology groups in complex situations. Weibel introduces spectral sequences in a clear and accessible manner, illustrating their use through various examples. While demanding, understanding spectral sequences is a significant step towards mastering advanced homological algebra. We'll explore their properties, focusing on the crucial convergence criteria and illustrating their use in calculating homology groups.

Chapter 6: Applications of Homological Algebra – Beyond the Theory

Homological algebra isn't just a theoretical framework; it has profound applications in various areas of mathematics and beyond. Weibel hints at some of these applications throughout the book. We'll explore a few of these, highlighting its impact on algebraic topology, algebraic geometry, and even representation theory. This section will serve as a bridge between abstract theory and concrete applications, showing the practical significance of homological algebra.

Book Outline: Weibel's "An Introduction to Homological Algebra"

Introduction: Sets the stage, introducing basic concepts and motivations.
Chapter 1: Modules: Covers foundational concepts like modules, free modules, projective modules, and injective modules.
Chapter 2: Chain Complexes and Homology: Introduces chain complexes, homology and cohomology groups, and basic computations.
Chapter 3: Derived Functors: Discusses the construction and properties of derived functors, emphasizing Tor and Ext.
Chapter 4: Tor and Ext: Explores the detailed properties and computations of Tor and Ext functors.
Chapter 5: Spectral Sequences: Introduces the machinery of spectral sequences and their applications.
Chapter 6: Homological Dimension: Explores various dimensions (projective, injective, global) associated with modules.
Chapter 7: Applications: Briefly touches upon applications in algebraic topology, algebraic K-theory, and commutative algebra.
Appendix: Contains supplementary material and further reading.

Detailed Explanation of Each Chapter: (This section expands on the bullet points above, providing a more in-depth description of each chapter's content)

(Detailed explanations for each chapter would follow here, expanding on each point in the outline above. Due to the length constraint of this response, I cannot provide a full 1500-word expansion of each chapter. However, the above provides a strong framework for the full article.)

FAQs:

1. What prerequisites are needed to understand Weibel's book? A solid understanding of abstract algebra (groups, rings, modules) and some familiarity with category theory is essential.

2. Is Weibel's book suitable for self-study? While challenging, it is possible with dedication and supplementary resources.

3. Are there alternative textbooks on homological algebra? Yes, several other excellent textbooks cover similar topics.

4. What are the most important applications of homological algebra? Key applications include algebraic topology, algebraic geometry, and representation theory.

5. How does homological algebra relate to topology? Homology groups provide algebraic invariants of topological spaces.

6. What are derived functors and why are they important? Derived functors extend functors to chain complexes, allowing for the study of functors on homology.

7. What is the significance of Tor and Ext functors? They measure the "failure" of certain functors to be exact and have widespread applications.

8. How difficult is it to master spectral sequences? Spectral sequences are advanced tools requiring significant effort to master.

9. What are some good resources for learning more after reading Weibel? Look for advanced texts on specific applications or explore research papers.

Related Articles:

1. Homological Algebra and Algebraic Topology: Explores the deep connection between these two fields.

2. Tor Functors and Group Extensions: Details the use of Tor functors in understanding group extensions.

3. Ext Functors and Module Extensions: Focuses on the applications of Ext functors in classifying module extensions.

4. Spectral Sequences in Algebraic Topology: Shows how spectral sequences are used to compute homology groups of spaces.

5. Derived Categories and Triangulated Categories: Introduces more advanced categorical frameworks used in homological algebra.

6. Homological Algebra and Representation Theory: Explores applications in the representation theory of groups and algebras.

7. An Introduction to Sheaf Cohomology: Connects homological algebra to sheaf theory.

8. Homological Algebra in Commutative Algebra: Shows the use of homological techniques in commutative algebra.

9. Applications of Homological Algebra in Algebraic Geometry: Details applications in studying algebraic varieties.

This expanded outline provides a solid framework for a comprehensive blog post on Weibel's Homological Algebra. Remember to expand on each point with detailed explanations, examples, and clear language to create a truly valuable and engaging resource for your readers. The use of headings, subheadings, and bolded keywords will significantly improve SEO.

weibel homological algebra: An Introduction to Homological Algebra Charles A. Weibel, 1995-10-27 The landscape of homological algebra has evolved over the last half-century into a fundamental tool for the working mathematician. This book provides a unified account of homological algebra as it exists today. The historical connection with topology, regular local rings, and semi-simple Lie algebras are also described. This book is suitable for second or third year graduate students. The first half of the book takes as its subject the canonical topics in homological algebra: derived functors, Tor and Ext, projective dimensions and spectral sequences. Homology of group and Lie algebras illustrate these topics. Intermingled are less canonical topics, such as the derived inverse limit functor lim1, local cohomology, Galois cohomology, and affine Lie algebras. The last part of the book covers less traditional topics that are a vital part of the modern homological toolkit: simplicial methods, Hochschild and cyclic homology, derived categories and total derived functors. By making these tools more accessible, the book helps to break down the technological barrier between experts and casual users of homological algebra.

weibel homological algebra: *Methods of Homological Algebra* Sergei I. Gelfand, Yuri J. Manin, 2013-04-17 Homological algebra first arose as a language for describing topological prospects of geometrical objects. As with every successful language it quickly expanded its coverage and semantics, and its contemporary applications are many and diverse. This modern approach to homological algebra, by two leading writers in the field, is based on the systematic use of the language and ideas of derived categories and derived functors. Relations with standard cohomology theory (sheaf cohomology, spectral sequences, etc.) are described. In most cases complete proofs are given. Basic concepts and results of homotopical algebra are also presented. The book addresses people who want to learn about a modern approach to homological algebra and to use it in their work.

weibel homological algebra: A User's Guide to Spectral Sequences John McCleary, 2001 Spectral sequences are among the most elegant and powerful methods of computation in mathematics. This book describes some of the most important examples of spectral sequences and some of their most spectacular applications. The first part treats the algebraic foundations for this sort of homological algebra, starting from informal calculations. The heart of the text is an exposition of the classical examples from homotopy theory, with chapters on the Leray-Serre spectral sequence, the Eilenberg-Moore spectral sequence, the Adams spectral sequence, and, in this new edition, the Bockstein spectral sequence. The last part of the book treats applications throughout mathematics, including the theory of knots and links, algebraic geometry, differential geometry and algebra. This is an excellent reference for students and researchers in geometry, topology, and algebra.

weibel homological algebra: 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.

weibel homological algebra: An Introduction to Homological Algebra Northcott, 1960 Homological algebra, because of its fundamental nature, is relevant to many branches of pure mathematics, including number theory, geometry, group theory and ring theory. Professor Northcott's aim is to introduce homological ideas and methods and to show some of the results which can be achieved. The early chapters provide the results needed to establish the theory of derived functors and to introduce torsion and extension functors. The new concepts are then applied to the theory of global dimensions, in an elucidation of the structure of commutative Noetherian rings of finite global dimension and in an account of the homology and cohomology theories of monoids and groups. A final section is devoted to comments on the various chapters, supplementary notes and suggestions for further reading. This book is designed with the needs and problems of the beginner in mind, providing a helpful and lucid account for those about to begin research, but will also be a useful work of reference for specialists. It can also be used as a textbook for an advanced course.

weibel homological algebra: *Lecture Notes on Motivic Cohomology* Carlo Mazza, Vladimir Voevodsky, Charles A. Weibel, 2006 The notion of a motive is an elusive one, like its namesake the motif of Cezanne's impressionist method of painting. Its existence was first suggested by Grothendieck in 1964 as the underlying structure behind the myriad cohomology theories in Algebraic Geometry. We now know that there is a triangulated theory of motives, discovered by Vladimir Voevodsky, which suffices for the development of a satisfactory Motivic Cohomology theory. However, the existence of motives themselves remains conjectural. This book provides an account of the triangulated theory of motives. Its purpose is to introduce Motivic Cohomology, to develop its main properties, and finally to relate it to other known invariants of algebraic varieties and rings such as Milnor K-theory, etale cohomology, and Chow groups. The book is divided into lectures, grouped in six parts. The first part presents the definition of Motivic Cohomology, based upon the notion of presheaves with transfers. Some elementary comparison theorems are given in this part. The theory of (etale, Nisnevich, and Zariski) sheaves with transfers is developed in parts two, three, and six, respectively. The theoretical core of the book is the fourth part, presenting the triangulated category of motives. Finally, the comparison with higher Chow groups is developed in part five. The lecture notes format is designed for the book to be read by an advanced graduate student or an expert in a related field. The lectures roughly correspond to one-hour lectures given by Voevodsky during the course he gave at the Institute for Advanced Study in Princeton on this subject in 1999-2000. In addition, many of the original proofs have been simplified and improved so that this book will also be a useful tool for research mathematicians. Information for our distributors: Titles in this series are copublished with the Clay Mathematics Institute (Cambridge, MA).

weibel homological algebra: *An Introduction to Homological Algebra* Joseph J. Rotman, 2008-12-10 Graduate mathematics students will find this book an easy-to-follow, step-by-step guide to the subject. Rotman’s book gives a treatment of homological algebra which approaches the subject in terms of its origins in algebraic topology. In this new edition the book has been updated and revised throughout and new material on sheaves and cup products has been added. The author has also included material about homotopical algebra, alias K-theory. Learning homological algebra is a two-stage affair. First, one must learn the language of Ext and Tor. Second, one must be able to compute these things with spectral sequences. Here is a work that combines the two.

weibel homological algebra: An Introduction to Algebraic Topology Joseph J. Rotman, 2013-11-11 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.

weibel homological algebra: From Categories to Homotopy Theory Birgit Richter, 2020-04-16 Category theory provides structure for the mathematical world and is seen everywhere in modern mathematics. With this book, the author bridges the gap between pure category theory and its numerous applications in homotopy theory, providing the necessary background information to make the subject accessible to graduate students or researchers with a background in algebraic topology and algebra. The reader is first introduced to category theory, starting with basic definitions and concepts before progressing to more advanced themes. Concrete examples and exercises illustrate the topics, ranging from colimits to constructions such as the Day convolution product. Part II covers important applications of category theory, giving a thorough introduction to simplicial objects including an account of quasi-categories and Segal sets. Diagram categories play a central role throughout the book, giving rise to models of iterated loop spaces, and feature prominently in functor homology and homology of small categories.

weibel homological algebra: *Fibre Bundles* D. Husemöller, 2013-06-29 The notion of a fibre bundle first arose out of questions posed in the 1930s on the topology and geometry of manifolds. By the year 1950 the defini tion of fibre bundle had been clearly formulated, the homotopy classifica tion of fibre bundles achieved, and the theory of characteristic classes of fibre bundles developed by several mathematicians, Chern, Pontrjagin, Stiefel, and Whitney. Steenrod's book, which appeared in 1950, gave a coherent treatment of the subject up to that time. About 1955 Milnor gave a construction of a universal fibre bundle for any topological group. This construction is also included in Part I along with an elementary proof that the bundle is universal. During the five years from 1950 to 1955, Hirzebruch clarified the notion of characteristic class and used it to prove a general Riemann-Roch theorem for algebraic varieties. This was published in his Ergebnisse Monograph. A systematic development of characteristic classes and their applications to manifolds is given in Part III and is based on the approach of Hirze bruch as modified by Grothendieck.

weibel homological algebra: Local Fields Jean-Pierre Serre, 2013-06-29 The goal of this book is to present local class field theory from the cohomo logical point of view, following the method inaugurated by Hochschild and developed by Artin-Tate. This theory is about extensions-primarily abelian-of local (i.e., complete for a discrete valuation) fields with finite residue field. For example, such fields are obtained by completing an algebraic number field; that is one of the aspects of localisation. The chapters are grouped in parts. There are three preliminary parts: the first two on the general theory of local fields, the third on group coho mology. Local class field theory, strictly speaking, does not appear until the fourth part. Here is a more precise outline of the contents of these four parts: The first contains basic definitions and results on discrete valuation rings, Dedekind domains (which are their globalisation) and the completion process. The prerequisite for this part is a knowledge of elementary notions of algebra and topology, which may be found for instance in Bourbaki. The second part is concerned with ramification phenomena (different, discriminant, ramification groups, Artin representation). Just as in the first part, no assumptions are made here about the residue fields. It is in this setting that the norm map is studied; I have expressed the results in terms of additive polynomials and of multiplicative polynomials, since using the language of algebraic geometry would have led me too far astray.

weibel homological algebra: Differential Forms in Algebraic Topology Raoul Bott, Loring W. Tu, 2013-04-17 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.

weibel homological algebra: Cyclic Homology Jean-Louis Loday, 2013-06-29 This book is a comprehensive study of cyclic homology theory together with its relationship with Hochschild homology, de Rham cohomology, S1 equivariant homology, the Chern character, Lie algebra homology, algebraic K-theory and non-commutative differential geometry. Though conceived as a basic reference on the subject, many parts of this book are accessible to graduate students.

weibel homological algebra: An Introduction to Lie Groups and Lie Algebras Alexander A. Kirillov, 2008-07-31 This book is an introduction to semisimple Lie algebras. It is concise and informal, with numerous exercises and examples.

weibel homological algebra: Undergraduate Algebra Serge Lang, 2013-06-29 The companion title, Linear Algebra, has sold over 8,000 copies The writing style is very accessible The material can be covered easily in a one-year or one-term course Includes Noah Snyder's proof of the Mason-Stothers polynomial abc theorem New material included on product structure for matrices including descriptions of the conjugation representation of the diagonal group

weibel homological algebra: 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.

weibel homological algebra: Cohomology of Groups Kenneth S. Brown, 2012-12-06 Aimed at second year graduate students, this text introduces them to cohomology theory (involving a rich interplay between algebra and topology) with a minimum of prerequisites. No homological algebra is assumed beyond what is normally learned in a first course in algebraic topology, and the basics of the subject, as well as exercises, are given prior to discussion of more specialized topics.

weibel homological algebra: *Introduction to Lie Algebras and Representation Theory* J.E. Humphreys, 2012-12-06 This book is designed to introduce the reader to the theory of semisimple

Lie algebras over an algebraically closed field of characteristic 0, with emphasis on representations. A good knowledge of linear algebra (including eigenvalues, bilinear forms, euclidean spaces, and tensor products of vector spaces) is presupposed, as well as some acquaintance with the methods of abstract algebra. The first four chapters might well be read by a bright undergraduate; however, the remaining three chapters are admittedly a little more demanding. Besides being useful in many parts of mathematics and physics, the theory of semisimple Lie algebras is inherently attractive, combining as it does a certain amount of depth and a satisfying degree of completeness in its basic results. Since Jacobson's book appeared a decade ago, improvements have been made even in the classical parts of the theory. I have tried to incor porate some of them here and to provide easier access to the subject for non-specialists. For the specialist, the following features should be noted: (I) The Jordan-Chevalley decomposition of linear transformations is emphasized, with toral subalgebras replacing the more traditional Cartan subalgebras in the semisimple case. (2) The conjugacy theorem for Cartan subalgebras is proved (following D. J. Winter and G. D. Mostow) by elementary Lie algebra methods, avoiding the use of algebraic geometry.

weibel homological algebra: Commutative Algebra David Eisenbud, 2013-12-01 This is a comprehensive review of commutative algebra, from localization and primary decomposition through dimension theory, homological methods, free resolutions and duality, emphasizing the origins of the ideas and their connections with other parts of mathematics. The book gives a concise treatment of Grobner basis theory and the constructive methods in commutative algebra and algebraic geometry that flow from it. Many exercises included.

weibel homological algebra: Fourier-Mukai Transforms in Algebraic Geometry Daniel Huybrechts, 2006-04-20 This work is based on a course given at the Institut de Mathematiques de Jussieu, on the derived category of coherent sheaves on a smooth projective variety. It is aimed at students with a basic knowledge of algebraic geometry and contains full proofs and exercises that aid the reader.

weibel homological algebra: Homotopical Algebra Daniel G. Quillen, 2006-11-14

weibel homological algebra: Commutative Ring Theory Hideyuki Matsumura, 1989-05-25 This book explores commutative ring theory, an important a foundation for algebraic geometry and complex analytical geometry.

weibel homological algebra: Groups Acting on Graphs Warren Dicks, M. J. Dunwoody, 1989-03-09 Originally published in 1989, this is an advanced text and research monograph on groups acting on low-dimensional topological spaces, and for the most part the viewpoint is algebraic. Much of the book occurs at the one-dimensional level, where the topology becomes graph theory. Two-dimensional topics include the characterization of Poincare duality groups and accessibility of almost finitely presented groups. The main three-dimensional topics are the equivariant loop and sphere theorems. The prerequisites grow as the book progresses up the dimensions. A familiarity with group theory is sufficient background for at least the first third of the book, while the later chapters occasionally state without proof and then apply various facts which require knowledge of homological algebra and algebraic topology. This book is essential reading for anyone contemplating working in the subject.

weibel homological algebra: Algebraic Homotopy Hans J. Baues, 1989-02-16 This book gives a general outlook on homotopy theory; fundamental concepts, such as homotopy groups and spectral sequences, are developed from a few axioms and are thus available in a broad variety of contexts. Many examples and applications in topology and algebra are discussed, including an introduction to rational homotopy theory in terms of both differential Lie algebras and De Rham algebras. The author describes powerful tools for homotopy classification problems, particularly for the classification of homotopy types and for the computation of the group homotopy equivalences. Applications and examples of such computations are given, including when the fundamental group is non-trivial. Moreover, the deep connection between the homotopy classification problems and the cohomology theory of small categories is demonstrated. The prerequisites of the book are few: elementary topology and algebra. Consequently, this account will be valuable for non-specialists and experts alike. It is an important supplement to the standard presentations of algebraic topology, homotopy theory, category theory and homological algebra.

weibel homological algebra: *A Course in Homological Algebra* P.J. Hilton, U. Stammbach, 2013-03-09 In this chapter we are largely influenced in our choice of material by the demands of the rest of the book. However, we take the view that this is an opportunity for the student to grasp basic categorical notions which permeate so much of mathematics today, including, of course, algebraic topology, so that we do not allow ourselves to be rigidly restricted by our immediate objectives. A reader totally unfamiliar with category theory may find it easiest to restrict his first reading of Chapter II to Sections 1 to 6; large parts of the book are understandable with the material presented in these sections. Another reader, who had already met many examples of categorical formulations and concepts might, in fact, prefer to look at Chapter II before reading Chapter I. Of course the reader thoroughly familiar with category theory could, in principal, omit Chapter II, except perhaps to familiarize himself with the notations employed. In Chapter III we begin the proper study of homological algebra by looking in particular at the group ExtA(A, B), where A and Bare A-modules. It is shown how this group can be calculated by means of a projective presentation of A, or an injective presentation of B; and how it may also be identified with the group of equivalence classes of extensions of the quotient module A by the submodule B.

weibel homological algebra: Cellular Structures in Topology Rudolf Fritsch, Renzo A. Piccinini, 1990-09-27 This book describes the construction and the properties of CW-complexes. These spaces are important because firstly they are the correct framework for homotopy theory, and secondly most spaces that arise in pure mathematics are of this type. The authors discuss the foundations and also developments, for example, the theory of finite CW-complexes, CW-complexes in relation to the theory of fibrations, and Milnor's work on spaces of the type of CW-complexes. They establish very clearly the relationship between CW-complexes and the theory of simplicial complexes, which is developed in great detail. Exercises are provided throughout the book; some are straightforward, others extend the text in a non-trivial way. For the latter; further reference is given for their solution. Each chapter ends with a section sketching the historical development. An appendix gives basic results from topology, homology and homotopy theory. These features will aid graduate students, who can use the work as a course text. As a contemporary reference work it will be essential reading for the more specialized workers in algebraic topology and homotopy theory.

weibel homological algebra: *Introduction To Commutative Algebra* Michael F. Atiyah, I.G. MacDonald, 2018-03-09 First Published in 2018. This book grew out of a course of lectures given to third year undergraduates at Oxford University and it has the modest aim of producing a rapid introduction to the subject. It is designed to be read by students who have had a first elementary course in general algebra. On the other hand, it is not intended as a substitute for the more voluminous tracts such as Zariski-Samuel or Bourbaki. We have concentrated on certain central topics, and large areas, such as field theory, are not touched. In content we cover rather more ground than Northcott and our treatment is substantially different in that, following the modern trend, we put more emphasis on modules and localization.

weibel homological algebra: The Norm Residue Theorem in Motivic Cohomology Christian Haesemeyer, Charles A. Weibel, 2019-06-11 This book presents the complete proof of the Bloch-Kato conjecture and several related conjectures of Beilinson and Lichtenbaum in algebraic geometry. Brought together here for the first time, these conjectures describe the structure of étale cohomology and its relation to motivic cohomology and Chow groups. Although the proof relies on the work of several people, it is credited primarily to Vladimir Voevodsky. The authors draw on a multitude of published and unpublished sources to explain the large-scale structure of Voevodsky’s proof and introduce the key figures behind its development. They proceed to describe the highly innovative geometric constructions of Markus Rost, including the construction of norm varieties, which play a crucial role in the proof. The book then addresses symmetric powers of motives and motivic cohomology operations. Comprehensive and self-contained, The Norm Residue Theorem in Motivic Cohomology unites various components of the proof that until now were scattered across many sources of varying accessibility, often with differing hypotheses, definitions, and language.

weibel homological algebra: Six Lectures on Commutative Algebra J. Elias, J. M. Giral, Rosa M. Miró-Roig, Santiago Zarzuela, 2010-03-17 Interest in commutative algebra has surged over the past decades. In order to survey and highlight recent developments in this rapidly expanding field, the Centre de Recerca Matematica in Bellaterra organized a ten-days Summer School on Commutative Algebra in 1996. Lectures were presented by six high-level specialists, L. Avramov (Purdue), M.K. Green (UCLA), C. Huneke (Purdue), P. Schenzel (Halle), G. Valla (Genova) and W.V. Vasconcelos (Rutgers), providing a fresh and extensive account of the results, techniques and problems of some of the most active areas of research. The present volume is a synthesis of the lectures given by these authors. Research workers as well as graduate students in commutative algebra and nearby areas will find a useful overview of the field and recent developments in it. Reviews All six articles are at a very high level; they provide a thorough survey of results and methods in their subject areas, illustrated with algebraic or geometric examples. - Acta Scientiarum Mathematicarum Avramov lecture: ... it contains all the major results [on infinite free resolutions], it explains carefully all the different techniques that apply, it provides complete proofs (...). This will be extremely helpful for the novice as well as the experienced. - Mathematical reviews Huneke lecture: The topic is tight closure, a theory developed by M. Hochster and the author which has in a short time proved to be a useful and powerful tool. (...) The paper is extremely well organized, written, and motivated. - Zentralblatt MATH Schenzel lecture: ... this paper is an excellent introduction to applications of local cohomology. - Zentralblatt MATH Valla lecture: ... since he is an acknowledged expert on Hilbert functions and since his interest has been so broad, he has done a superb job in giving the readers a lively picture of the theory. - Mathematical reviews Vasconcelos lecture: This is a very useful survey on invariants of modules over noetherian rings, relations between them, and how to compute them. - Zentralblatt MATH

weibel homological algebra: *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.

weibel homological algebra: Modern Classical Homotopy Theory Jeffrey Strom, 2011-10-19 The core of classical homotopy theory is a body of ideas and theorems that emerged in the 1950s and was later largely codified in the notion of a model category. This core includes the notions of fibration and cofibration; CW complexes; long fiber and cofiber sequences; loop spaces and suspensions; and so on. Brown's representability theorems show that homology and cohomology are also contained in classical homotopy theory. This text develops classical homotopy theory from a modern point of view, meaning that the exposition is informed by the theory of model categories and that homotopy limits and colimits play central roles. The exposition is guided by the principle that it is generally preferable to prove topological results using topology (rather than algebra). The language and basic theory of homotopy limits and colimits make it possible to penetrate deep into the subject with just the rudiments of algebra. The text does reach advanced territory, including the Steenrod algebra, Bott periodicity, localization, the Exponent Theorem of Cohen, Moore, and Neisendorfer, and Miller's Theorem on the Sullivan Conjecture. Thus the reader is given the tools needed to understand and participate in research at (part of) the current frontier of homotopy theory. Proofs are not provided outright. Rather, they are presented in the form of directed problem sets. To the expert, these read as terse proofs; to novices they are challenges that draw them in and help them to thoroughly understand the arguments.

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