algebraic k theory

Delving into the Depths of Algebraic K-Theory: A Comprehensive Guide

Introduction:

Have you ever wondered about the hidden symmetries and structures within seemingly abstract mathematical objects? Algebraic K-theory, a fascinating branch of mathematics, provides a powerful framework for precisely this exploration. It's a field that bridges algebra, topology, and geometry, offering profound insights into the structure of rings, groups, and other algebraic entities. This comprehensive guide will unravel the mysteries of algebraic K-theory, exploring its fundamental concepts, key applications, and connections to other areas of mathematics. We'll delve into its history, dissect crucial definitions, and illuminate its significance in modern research. Prepare to embark on an intellectual journey into the heart of this challenging yet rewarding field.

1. A Historical Perspective on Algebraic K-Theory:

The genesis of algebraic K-theory can be traced back to the work of Alexander Grothendieck in the 1950s. His groundbreaking contributions to algebraic geometry led him to define K_0 (pronounced "K-zero"), a group associated with the projective modules of a ring. This initial step sparked a cascade of further developments, with mathematicians like Hyman Bass, John Milnor, and Daniel Quillen significantly shaping the field. Early efforts focused on understanding the relationship between the algebraic structure of a ring and its associated K-groups. The development of higher K-groups (K_1, K_2, and beyond) proved significantly more challenging, demanding increasingly sophisticated topological and homological techniques. This historical overview helps us appreciate the evolutionary nature of K-theory and its deep roots in other mathematical disciplines.

1. Understanding the Fundamental Concepts: K_0, K_1, and Beyond:

Let's start with the basics. $K_0(R)$, for a ring R, essentially classifies the isomorphism classes of finitely generated projective R-modules. Think of it as a way to count the "building blocks" of these modules. These modules are generalizations of vector spaces, but instead of being defined over a field, they are defined over a ring. The group operation is induced by the direct sum operation on modules.

$K_1(R)$ captures information about the invertible matrices over R. Specifically, it’s constructed from the general linear group GL(R) of invertible matrices with entries in R. The elements of $K_1(R)$ represent the stable isomorphism classes of invertible matrices – essentially, how these matrices behave when you increase their size. The group structure here comes from matrix multiplication.

Higher K-groups (K_2, K_3, etc.) are significantly more complex to define. Their construction often relies on sophisticated techniques from algebraic topology, such as classifying spaces and homotopy theory. These higher K-groups reveal even deeper structural properties of the underlying ring. The definitions become increasingly abstract, but their power lies in capturing intricate relationships that are inaccessible through lower K-groups.

1. The Significance of Quillen's Work and the Plus Construction:

Daniel Quillen's work revolutionized algebraic K-theory. His groundbreaking contributions included the development of a powerful and general definition of higher K-groups using the plus construction. This construction takes a complicated topological space associated with the general linear group and transforms it into a simpler, better-behaved space, whose homotopy groups give the higher K-groups. Quillen's work provided a unifying framework for understanding K-theory, connecting it deeply with topology and opening up new avenues of research. This provided a crucial link between algebra and topology, making K-theory accessible to a wider range of mathematical tools and techniques.

1. Applications of Algebraic K-Theory:

Algebraic K-theory, despite its abstract nature, finds surprisingly diverse applications in various fields:

Algebraic Geometry: K-theory plays a vital role in understanding the structure of algebraic varieties. It provides tools for classifying vector bundles and studying the topology of these spaces.
Number Theory: K-theory is deeply intertwined with the arithmetic of number fields and their associated rings of integers. It helps in analyzing class groups, zeta functions, and other arithmetic invariants.
Operator Algebras: K-theory is used to classify operator algebras, which are essential in functional analysis and quantum mechanics.
Topology: The connections between K-theory and topology are fundamental, with K-theory providing powerful invariants for classifying topological spaces.
Physics: Emerging applications in string theory and other areas of theoretical physics are starting to reveal K-theory's unexpected relevance to fundamental physical phenomena.

1. Challenges and Future Directions:

Despite significant advancements, numerous challenges remain in algebraic K-theory. Calculating K-groups for specific rings is often incredibly difficult, even for relatively simple rings. The development of new computational techniques and algorithms is a crucial area of ongoing research. Further exploration of connections with other areas of mathematics and physics promises to yield even more exciting results in the future. Understanding the deeper structural implications of higher K-groups remains a significant open problem, attracting the attention of leading mathematicians worldwide.

Proposed Book Outline: "A Journey Through Algebraic K-Theory"

Introduction: A gentle introduction to the motivations and historical context of algebraic K-theory.
Chapter 1: Foundational Concepts: Definitions of rings, modules, projective modules, and basic constructions in category theory.
Chapter 2: K_0 and K_1: Detailed explanations of K_0 and K_1 with examples and computations.
Chapter 3: Higher K-Theory: Introduction to higher K-groups, including a discussion of Quillen's plus construction and other approaches.
Chapter 4: Connections to Topology: Exploration of the topological interpretations of K-theory, emphasizing the relationship between algebraic structures and topological spaces.
Chapter 5: Applications in Algebra and Geometry: Applications of K-theory in algebraic geometry, number theory, and related areas.
Chapter 6: Computational Aspects: A survey of computational methods and algorithms used to determine K-groups.
Chapter 7: Advanced Topics: A brief introduction to more advanced concepts, such as motivic K-theory and non-commutative K-theory.
Conclusion: A summary of key results, open problems, and future directions in algebraic K-theory research.

(The detailed explanation of each chapter would follow here, expanding on the bullet points above with substantial mathematical content and examples. Due to the length constraint, these detailed explanations are omitted here. Each chapter would be a substantial section of its own, potentially spanning several hundred words.)

FAQs:

1. What is the difference between K_0 and K_1? K_0 classifies projective modules, while K_1 deals with invertible matrices.

2. Why is Quillen's plus construction important? It provides a powerful and general definition of higher K-groups.

3. What are some applications of algebraic K-theory outside of pure mathematics? Emerging applications include string theory and condensed matter physics.

4. Is algebraic K-theory computationally difficult? Yes, calculating K-groups is often challenging, even for simple rings.

5. How does algebraic K-theory relate to topology? There are deep and fundamental connections, with K-groups serving as topological invariants.

6. What is motivic K-theory? It's an advanced extension of algebraic K-theory, incorporating geometric and motivic structures.

7. What are some open problems in algebraic K-theory? Calculating K-groups for specific rings and understanding the deeper meaning of higher K-groups are major open areas.

8. Who are some of the key contributors to algebraic K-theory? Alexander Grothendieck, Hyman

Bass, John Milnor, and Daniel Quillen are prominent figures.

9. Where can I find more information about algebraic K-theory? Numerous textbooks and research articles are available, and searching online resources will also yield relevant results.

Related Articles:

1. Introduction to Homological Algebra: A foundational understanding of homological algebra is crucial for grasping K-theory concepts.
2. The Theory of Rings and Modules: Provides the basic algebraic background needed for studying K-theory.
3. Algebraic Topology Primer: Explores the topological underpinnings of K-theory's constructions.
4. Classifying Spaces and Group Cohomology: Delves into topological techniques used in defining higher K-groups.
5. Vector Bundles and K-Theory: Explains the important role of vector bundles in algebraic geometry and topology.
6. The Plus Construction in Algebraic K-Theory: A deeper dive into Quillen's transformative plus construction.
7. Motivic K-Theory: An Overview: Introduces the broader context of motivic K-theory.
8. Non-commutative K-Theory: Explores the extension of K-theory to non-commutative rings.
9. Applications of K-Theory in Number Theory: Focuses on K-theory's applications in number-theoretic problems.

algebraic k theory: Algebraic K-Theory Vasudevan Srinivas, 2009-05-21 Algebraic K-Theory has become an increasingly active area of research. With its connections to algebra, algebraic geometry, topology, and number theory, it has implications for a wide variety of researchers and students in mathematics. This book is based on lectures given by the author at the Tata Institute in Bombay and elsewhere. This new edition includes an appendix on algebraic geometry that contains required definitions and results needed to understand the core of the book.

algebraic k theory: *The K-book* Charles A. Weibel, 2013-06-13 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

algebraic k theory: The Local Structure of Algebraic K-Theory Bjørn Ian Dundas, Thomas G. Goodwillie, Randy McCarthy, 2012-09-06 Algebraic K-theory encodes important invariants for several mathematical disciplines, spanning from geometric topology and functional analysis to number theory and algebraic geometry. As is commonly encountered, this powerful mathematical object is very hard to calculate. Apart from Quillen's calculations of finite fields and Suslin's calculation of algebraically closed fields, few complete calculations were available before the discovery of homological invariants offered by motivic cohomology and topological cyclic homology. This book covers the connection between algebraic K-theory and Bökstedt, Hsiang and Madsen's topological cyclic homology and proves that the difference between the theories are 'locally constant'. The usefulness of this theorem stems from being more accessible for calculations than K-theory, and hence a single calculation of K-theory can be used with homological calculations to obtain a host of 'nearby' calculations in K-theory. For instance, Quillen's calculation of the K-theory of finite fields gives rise to Hesselholt and Madsen's calculations for local fields, and Voevodsky's calculations for the integers give insight into the diffeomorphisms of manifolds. In addition to the proof of the full integral version of the local correspondence between K-theory and topological cyclic homology, the book provides an introduction to the necessary background in algebraic K-theory and highly structured homotopy theory; collecting all necessary tools into one common framework. It relies on simplicial techniques, and contains an appendix summarizing the methods widely used in the field. The book is intended for graduate students and scientists interested in algebraic K-theory, and presupposes a basic knowledge of algebraic topology.

algebraic k theory: Algebraic Topology and Algebraic K-theory William Browder, 1987-11-21 This book contains accounts of talks held at a symposium in honor of John C. Moore in October 1983 at Princeton University, The work includes papers in classical homotopy theory, homological algebra, rational homotopy theory, algebraic K-theory of spaces, and other subjects.

algebraic k theory: Algebraic K-Theory and Its Applications Jonathan Rosenberg, 2012-12-06 Algebraic K-Theory is crucial in many areas of modern mathematics, especially algebraic topology, number theory, algebraic geometry, and operator theory. This text is designed to help graduate students in other areas learn the basics of K-Theory and get a feel for its many applications. Topics include algebraic topology, homological algebra, algebraic number theory, and an introduction to cyclic homology and its interrelationship with K-Theory.

algebraic k theory: *Introduction to Algebraic K-theory* John Willard Milnor, 1971 Algebraic K-theory describes a branch of algebra that centers about two functors. K0 and K1, which assign to each associative ring ∧ an abelian group K0∧ or K1∧ respectively. Professor Milnor sets out, in the present work, to define and study an analogous functor K2, also from associative rings to abelian groups. Just as functors K0 and K1 are important to geometric topologists, K2 is now considered to have similar topological applications. The exposition includes, besides K-theory, a considerable amount of related arithmetic.

algebraic k theory: Algebraic K-theory , 1991

algebraic k theory: *Transformation Groups and Algebraic K-Theory* Wolfgang Lück, 2006-11-14 The book focuses on the relation between transformation groups and algebraic K-theory. The general pattern is to assign to a geometric problem an invariant in an algebraic K-group which determines the problem. The algebraic K-theory of modules over a category is studied extensively and appplied to the fundamental category of G-space. Basic details of the theory of transformation groups sometimes hard to find in the literature, are collected here (Chapter I) for the benefit of graduate students. Chapters II and III contain advanced new material of interest to researchers working in transformation groups, algebraic K-theory or related fields.

algebraic k theory: Algebraic K-Theory and Its Applications Jonathan Rosenberg, 1995-12-22 Algebraic K-Theory is crucial in many areas of modern mathematics, especially algebraic topology, number theory, algebraic geometry, and operator theory. This text is designed to help graduate students in other areas learn the basics of K-Theory and get a feel for its many applications. Topics include algebraic topology, homological algebra, algebraic number theory, and an introduction to cyclic homology and its interrelationship with K-Theory.

algebraic k theory: Algebraic K-Theory Richard G. Swan, 2006-11-14 From the Introduction: These notes are taken from a course on algebraic K-theory [given] at the University of Chicago in

1967. They also include some material from an earlier course on abelian categories, elaborating certain parts of Gabriel's thesis. The results on K-theory are mostly of a very general nature.

algebraic k theory: An Algebraic Introduction to K-Theory Bruce A. Magurn, 2002-05-20 This is an introduction to algebraic K-theory with no prerequisite beyond a first semester of algebra (including Galois theory and modules over a principal ideal domain). The presentation is almost entirely self-contained, and is divided into short sections with exercises to reinforce the ideas and suggest further lines of inquiry. No experience with analysis, geometry, number theory or topology is assumed. Within the context of linear algebra, K-theory organises and clarifies the relations among ideal class groups, group representations, quadratic forms, dimensions of a ring, determinants, quadratic reciprocity and Brauer groups of fields. By including introductions to standard algebra topics (tensor products, localisation, Jacobson radical, chain conditions, Dedekind domains, semi-simple rings, exterior algebras), the author makes algebraic K-theory accessible to first-year graduate students and other mathematically sophisticated readers. Even if your algebra is rusty, you can read this book; the necessary background is here, with proofs.

algebraic k theory: K-Theory Max Karoubi, 2009-11-27 From the Preface: K-theory was introduced by A. Grothendieck in his formulation of the Riemann- Roch theorem. For each projective algebraic variety, Grothendieck constructed a group from the category of coherent algebraic sheaves, and showed that it had many nice properties. Atiyah and Hirzebruch considered a topological analog defined for any compact space X, a group K{X) constructed from the category of vector bundles on X. It is this ''topological K-theory that this book will study. Topological K-theory has become an important tool in topology. Using K- theory, Adams and Atiyah were able to give a simple proof that the only spheres which can be provided with H-space structures are S1, S3 and S7. Moreover, it is possible to derive a substantial part of stable homotopy theory from K-theory. The purpose of this book is to provide advanced students and mathematicians in other fields with the fundamental material in this subject. In addition, several applications of the type described above are included. In general we have tried to make this book self-contained, beginning with elementary concepts wherever possible; however, we assume that the reader is familiar with the basic definitions of homotopy theory: homotopy classes of maps and homotopy groups.Thus this book might be regarded as a fairly self-contained introduction to a generalized cohomology theory.

algebraic k theory: *Mixed Motives and Algebraic K-Theory* Uwe Jannsen, 2006-11-14 The relations that could or should exist between algebraic cycles, algebraic K-theory, and the cohomology of - possibly singular - varieties, are the topic of investigation of this book. The author proceeds in an axiomatic way, combining the concepts of twisted Poincaré duality theories, weights, and tensor categories. One thus arrives at generalizations to arbitrary varieties of the Hodge and Tate conjectures to explicit conjectures on l-adic Chern characters for global fields and to certain counterexamples for more general fields. It is to be hoped that these relations ions will in due course be explained by a suitable tensor category of mixed motives. An approximation to this is constructed in the setting of absolute Hodge cycles, by extending this theory to arbitrary varieties. The book can serve both as a guide for the researcher, and as an introduction to these ideas for the non-expert, provided (s)he knows or is willing to learn about K-theory and the standard cohomology theories of algebraic varieties.

algebraic k theory: Higher Algebraic K-Theory: An Overview Emilio Lluis-Puebla, Jean-Louis Loday, Henri Gillet, Christophe Soule, Victor Snaith, 2006-11-14 This book is a general introduction to Higher Algebraic K-groups of rings and algebraic varieties, which were first defined by Quillen at the beginning of the 70's. These K-groups happen to be useful in many different fields, including topology, algebraic geometry, algebra and number theory. The goal of this volume is to provide graduate students, teachers and researchers with basic definitions, concepts and results, and to give a sampling of current directions of research. Written by five specialists of different parts of the subject, each set of lectures reflects the particular perspective ofits author. As such, this volume can serve as a primer (if not as a technical basic textbook) for mathematicians from many different fields of interest.

algebraic k theory: Algebraic K-Theory Hvedri Inassaridze, 2013-03-14 Algebraic K-theory is a modern branch of algebra which has many important applications in fundamental areas of mathematics connected with algebra, topology, algebraic geometry, functional analysis and algebraic number theory. Methods of algebraic K-theory are actively used in algebra and related fields, achieving interesting results. This book presents the elements of algebraic K-theory, based essentially on the fundamental works of Milnor, Swan, Bass, Quillen, Karoubi, Gersten, Loday and Waldhausen. It includes all principal algebraic K-theories, connections with topological K-theory and cyclic homology, applications to the theory of monoid and polynomial algebras and in the theory of normed algebras. This volume will be of interest to graduate students and research mathematicians who want to learn more about K-theory.

algebraic k theory: Algebraic K-Theory Victor Percy Snaith, Robert Wayne Thomason, 1997 The proceedings volume from the March 1996 conference is dedicated to the late Bob Thomason, one of the leading research mathematicians specializing in algebraic K-theory. Twelve contributions include research papers treated in the lectures at the conference, articles inspired by those lectures, an exposition of Thomason's famous result concerning the relationship between algebraic K-theory and etale cohomology, and an exposition explaining and elaborating upon unpublished work of O. Gabber on Bloch-Ogus-Gersten type resolutions in K-theory and algebraic geometry. Annotation copyrighted by Book News, Inc., Portland, OR

algebraic k theory: Algebraic K-Theory: Connections with Geometry and Topology John F. Jardine, V.P. Snaith, 2012-12-06 A NATO Advanced Study Institute entitled Algebraic K-theory: Connections with Geometry and Topology was held at the Chateau Lake Louise, Lake Louise, Alberta, Canada from December 7 to December 11 of 1987. This meeting was jointly supported by NATO and the Natural Sciences and Engineering Research Council of Canada, and was sponsored in part by the Canadian Mathematical Society. This book is the volume of proceedings for that meeting. Algebraic K-theory is essentially the study of homotopy invariants arising from rings and their associated matrix groups. More importantly perhaps, the subject has become central to the study of the relationship between Topology, Algebraic Geometry and Number Theory. It draws on all of these fields as a subject in its own right, but it serves as well as an effective translator for the application of concepts from one field in another. The papers in this volume are representative of the current state of the subject. They are, for the most part, research papers which are primarily of interest to researchers in the field and to those aspiring to be such. There is a section on problems in this volume which should be of particular interest to students; it contains a discussion of the problems from Gersten's well-known list of 1973, as well as a short list of new problems.

algebraic k theory: Representation Theory and Higher Algebraic K-Theory Aderemi Kuku, 2016-04-19 Representation Theory and Higher Algebraic K-Theory is the first book to present higher algebraic K-theory of orders and group rings as well as characterize higher algebraic K-theory as Mackey functors that lead to equivariant higher algebraic K-theory and their relative generalizations. Thus, this book makes computations of higher K-theory of grou

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algebraic k theory: *Handbook of K-Theory* Eric Friedlander, Daniel R. Grayson, 2005-07-18

This handbook offers a compilation of techniques and results in K-theory. Each chapter is dedicated to a specific topic and is written by a leading expert. Many chapters present historical background; some present previously unpublished results, whereas some present the first expository account of a topic; many discuss future directions as well as open problems. It offers an exposition of our current state of knowledge as well as an implicit blueprint for future research.

algebraic k theory: An Introduction to K-Theory for C*-Algebras M. Rørdam, Flemming Larsen, N. Laustsen, 2000-07-20 This book provides a very elementary introduction to K-theory for C*-algebras, and is ideal for beginning graduate students.

algebraic k theory: Algebraic K-Theory and Algebraic Topology P.G. Goerss, John F. Jardine, 2013-04-17 A NATO Advanced Study Institute entitled Algebraic K-theory and Algebraic Topology was held at Chateau Lake Louise, Lake Louise, Alberta, Canada from December 12 to December 16 of 1991. This book is the volume of proceedings for this meeting. The papers that appear here are representative of most of the lectures that were given at the conference, and therefore present a snapshot of the state ofthe K-theoretic art at the end of 1991. The underlying objective of the meeting was to discuss recent work related to the Lichtenbaum-Quillen complex of conjectures, fro~ both the algebraic and topological points of view. The papers in this volume deal with a range of topics, including motivic cohomology theories, cyclic homology, intersection homology, higher class field theory, and the former telescope conjecture. This meeting was jointly funded by grants from NATO and the National Science Foun dation in the United States. I would like to take this opportunity to thank these agencies for their support. I would also like to thank the other members of the organizing com mittee, namely Paul Goerss, Bruno Kahn and Chuck Weibel, for their help in making the conference successful. This was the second NATO Advanced Study Institute to be held in this venue; the first was in 1987. The success of both conferences owes much to the professionalism and helpfulness of the administration and staff of Chateau Lake Louise.

algebraic k theory: Representation Theory and Higher Algebraic K-Theory Aderemi Kuku, 2006-09-27 Representation Theory and Higher Algebraic K-Theory is the first book to present higher algebraic K-theory of orders and group rings as well as characterize higher algebraic K-theory as Mackey functors that lead to equivariant higher algebraic K-theory and their relative generalizations. Thus, this book makes computations of higher K-theory of group rings more accessible and provides novel techniques for the computations of higher K-theory of finite and some infinite groups. Authored by a premier authority in the field, the book begins with a careful review of classical K-theory, including clear definitions, examples, and important classical results. Emphasizing the practical value of the usually abstract topological constructions, the author systematically discusses higher algebraic K-theory of exact, symmetric monoidal, and Waldhausen categories with applications to orders and group rings and proves numerous results. He also defines profinite higher K- and G-theory of exact categories, orders, and group rings. Providing new insights into classical results and opening avenues for further applications, the book then uses representation-theoretic techniques-especially induction theory-to examine equivariant higher algebraic K-theory, their relative generalizations, and equivariant homology theories for discrete group actions. The final chapter unifies Farrell and Baum-Connes isomorphism conjectures through Davis-Lück assembly maps.

algebraic k theory: *Algebraic K-Theory, Commutative Algebra, and Algebraic Geometry* R. Keith Dennis, 1992 In the mid-1960's, several Italian mathematicians began to study the connections between classical arguments in commutative algebra and algebraic geometry, and the contemporaneous development of algebraic K-theory in the US. These connections were exemplified by the work of Andreotti-Bombieri, Salmon, and Traverso on seminormality, and by Bass-Murthy on the Picard groups of polynomial rings. Interactions proceeded far beyond this initial point to encompass Chow groups of singular varieties, complete intersections, and applications of K-theory to arithmetic and real geometry. This volume contains the proceedings from a US-Italy Joint Summer Seminar, which focused on this circle of ideas. The conference, held in June 1989 in Santa Margherita Ligure, Italy, was supported jointly by the Consiglio Nazionale delle Ricerche and the

National Science Foundation. The book contains contributions from some of the leading experts in this area.

algebraic k theory: The Lower Algebraic K-Theory of Virtually Cyclic Subgroups of the Braid Groups of the Sphere and of ZB4(S2) John Guaschi, Daniel Juan-Pineda, Silvia Millán López, 2018-11-03 This volume deals with the K-theoretical aspects of the group rings of braid groups of the 2-sphere. The lower algebraic K-theory of the finite subgroups of these groups up to eleven strings is computed using a wide variety of tools. Many of the techniques extend to the general case, and the results reveal new K-theoretical phenomena with respect to the previous study of other families of groups. The second part of the manuscript focusses on the case of the 4-string braid group of the 2-sphere, which is shown to be hyperbolic in the sense of Gromov. This permits the computation of the infinite maximal virtually cyclic subgroups of this group and their conjugacy classes, and applying the fact that this group satisfies the Fibred Isomorphism Conjecture of Farrell and Jones, leads to an explicit calculation of its lower K-theory. Researchers and graduate students working in K-theory and surface braid groups will constitute the primary audience of the manuscript, particularly those interested in the Fibred Isomorphism Conjecture, and the computation of Nil groups and the lower algebraic K-groups of group rings. The manuscript will also provide a useful resource to researchers who wish to learn the techniques needed to calculate lower algebraic K-groups, and the bibliography brings together a large number of references in this respect.

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algebraic k theory: *Algebraic K-theory and Algebraic Number Theory* Michael R. Stein, R. Keith Dennis, 1989 This volume contains the proceedings of a seminar on Algebraic K-theory and Algebraic Number Theory, held at the East-West Center in Honolulu in January 1987. The seminar, which hosted nearly 40 experts from the U.S. and Japan, was motivated by the wide range of connections between the two topics, as exemplified in the work of Merkurjev, Suslin, Beilinson, Bloch, Ramakrishnan, Kato, Saito, Lichtenbaum, Thomason, and Ihara. As is evident from the diversity of topics represented in these proceedings, the seminar provided an opportunity for mathematicians from both areas to initiate further interactions between these two areas.

algebraic k theory: Polytopes, Rings, and K-Theory Winfried Bruns, Joseph Gubeladze, 2009-06-12 This book examines interactions of polyhedral discrete geometry and algebra. What makes this book unique is the presentation of several central results in all three areas of the exposition - from discrete geometry, to commutative algebra, and K-theory.

algebraic k theory: Motivic Homotopy Theory Bjorn Ian Dundas, Marc Levine, P.A. Østvær, Oliver Röndigs, Vladimir Voevodsky, 2007-07-11 This book is based on lectures given at a summer school on motivic homotopy theory at the Sophus Lie Centre in Nordfjordeid, Norway, in August 2002. Aimed at graduate students in algebraic topology and algebraic geometry, it contains background material from both of these fields, as well as the foundations of motivic homotopy theory. It will serve as a good introduction as well as a convenient reference for a broad group of mathematicians to this important and fascinating new subject. Vladimir Voevodsky is one of the founders of the theory and received the Fields medal for his work, and the other authors have all done important work in the subject.

algebraic k theory: Cohomology of Groups and Algebraic K-theory Lizhen Ji, Kefeng Liu, Shing-Tung Yau, 2010 Cohomology of Groups and Algebraic K-theory --

algebraic k theory: Higher Regulators, Algebraic K-Theory, and Zeta Functions of Elliptic Curves Spencer J. Bloch, 2011 This is the long-awaited publication of the famous Irvine lectures. Delivered in 1978 at the University of California at Irvine, these lectures turned out to be an entry point to several intimately-connected new branches of arithmetic algebraic geometry, such as regulators and special values of L-functions of algebraic varieties, explicit formulas for them in terms of polylogarithms, the theory of algebraic cycles, and eventually the general theory of mixed motives which unifies and underlies all of the above (and much more).

algebraic k theory: K-theory Michael Atiyah, 2018-03-05 These notes are based on the course of lectures I gave at Harvard in the fall of 1964. They constitute a self-contained account of vector bundles and K-theory assuming only the rudiments of point-set topology and linear algebra. One of the features of the treatment is that no use is made of ordinary homology or cohomology theory. In fact, rational cohomology is defined in terms of K-theory.The theory is taken as far as the solution of the Hopf invariant problem and a start is mode on the J-homomorphism. In addition to the lecture notes proper, two papers of mine published since 1964 have been reproduced at the end. The first, dealing with operations, is a natural supplement to the material in Chapter III. It provides an alternative approach to operations which is less slick but more fundamental than the Grothendieck method of Chapter III, and it relates operations and filtration. Actually, the lectures deal with compact spaces, not cell-complexes, and so the skeleton-filtration does not figure in the notes. The second paper provides a new approach to K-theory and so fills an obvious gap in the lecture notes.

algebraic k theory: *Categories and Modules with K-Theory in View* A. J. Berrick, M. E. Keating, 2000-05-25 This book, first published in 2000, develops aspects of category theory fundamental to the study of algebraic K-theory. Ring and module theory illustrates category theory which provides insight into more advanced topics in module theory. Starting with categories in general, the text then examines categories of K-theory. This leads to the study of tensor products and the Morita theory. The categorical approach to localizations and completions of modules is formulated in terms of direct and inverse limits, prompting a discussion of localization of categories in general. Finally, local-global techniques which supply information about modules from their localizations and completions and underlie some interesting applications of K-theory to number theory and geometry are considered. Many useful exercises, concrete illustrations of abstract concepts placed in their historical settings and an extensive list of references are included. This book will help all who wish to work in K-theory to master its prerequisites.

algebraic k theory: Algebraic K-Theory Wayne Raskind, Charles A. Weibel, 1999 This volume presents the proceedings of the Joint Summer Research Conference on Algebraic K-theory held at the University of Washington in Seattle. High-quality surveys are written by leading experts in the field. Included is an up-to-date account of Voevodsky's proof of the Milnor conjecture relating the Milnor K-theory of fields to Galois cohomology. The book is intended for graduate students and research mathematicians interested in K-theory, algebraic geometry, and number theory.

algebraic k theory: K-theory of Forms Anthony Bak, 1981-11-21 The description for this book, K-Theory of Forms. (AM-98), Volume 98, will be forthcoming.

algebraic k theory: *Algebraic K-theory And Its Applications - Proceedings Of The School* Hyman Bass, Aderemi Oluyomi Kuku, C Pedrini, 1999-03-12 The Proceedings volume is divided into two parts. The first part consists of lectures given during the first two weeks devoted to a workshop featuring state-of-the-art expositions on 'Overview of Algebraic K-theory' including various constructions, examples, and illustrations from algebra, number theory, algebraic topology, and algebraic/differential geometry; as well as on more concentrated topics involving connections of K-theory with Galois, etale, cyclic, and motivic (co)homologies; values of zeta functions, and Arithmetics of Chow groups and zero cycles. The second part consists of research papers arising from the symposium lectures in the third week.

algebraic k theory: Algebraic K-Theory Vasudevan Srinivas, 2014-09-01

algebraic k theory: Triangulated Categories of Mixed Motives Denis-Charles Cisinski, Frédéric Déglise, 2019-11-09 The primary aim of this monograph is to achieve part of Beilinson’s program on mixed motives using Voevodsky’s theories of A1-homotopy and motivic complexes. Historically, this book is the first to give a complete construction of a triangulated category of mixed motives with rational coefficients satisfying the full Grothendieck six functors formalism as well as fulfilling Beilinson’s program, in particular the interpretation of rational higher Chow groups as extension groups. Apart from Voevodsky’s entire work and Grothendieck’s SGA4, our main sources are Gabber’s work on étale cohomology and Ayoub’s solution to Voevodsky’s cross functors theory. We also thoroughly develop the theory of motivic complexes with integral coefficients over general bases, along the lines of Suslin and Voevodsky. Besides this achievement, this volume provides a complete toolkit for the study of systems of coefficients satisfying Grothendieck' six functors formalism, including Grothendieck-Verdier duality. It gives a systematic account of cohomological descent theory with an emphasis on h-descent. It formalizes morphisms of coefficient systems with a view towards realization functors and comparison results. The latter allows to understand the polymorphic nature of rational mixed motives. They can be characterized by one of the following properties: existence of transfers, universality of rational algebraic K-theory, h-descent, étale descent, orientation theory. This monograph is a longstanding research work of the two authors. The first three parts are written in a self-contained manner and could be accessible to graduate students with a background in algebraic geometry and homotopy theory. It is designed to be a reference work and could also be useful outside motivic homotopy theory. The last part, containing the most innovative results, assumes some knowledge of motivic homotopy theory, although precise statements and references are given.

algebraic k theory: Noncommutative Motives Gonçalo Tabuada, 2015-09-21 The theory of motives began in the early 1960s when Grothendieck envisioned the existence of a universal cohomology theory of algebraic varieties. The theory of noncommutative motives is more recent. It began in the 1980s when the Moscow school (Beilinson, Bondal, Kapranov, Manin, and others) began the study of algebraic varieties via their derived categories of coherent sheaves, and continued in the 2000s when Kontsevich conjectured the existence of a universal invariant of noncommutative algebraic varieties. This book, prefaced by Yuri I. Manin, gives a rigorous overview of some of the main advances in the theory of noncommutative motives. It is divided into three main parts. The first part, which is of independent interest, is devoted to the study of DG categories from a homotopical viewpoint. The second part, written with an emphasis on examples and applications, covers the theory of noncommutative pure motives, noncommutative standard conjectures, noncommutative motivic Galois groups, and also the relations between these notions and their commutative counterparts. The last part is devoted to the theory of noncommutative mixed motives. The rigorous formalization of this latter theory requires the language of Grothendieck derivators, which, for the reader's convenience, is revised in a brief appendix.

algebraic k theory: K-Theory for Operator Algebras Bruce Blackadar, 2012-12-06 K -Theory has revolutionized the study of operator algebras in the last few years. As the primary component of the subject of noncommutative topol ogy, K -theory has opened vast new vistas within the structure theory of C* algebras, as well as leading to profound and unexpected applications of opera tor algebras to problems in geometry and topology. As a result, many topolo gists and operator algebraists have feverishly begun trying to learn each others' subjects, and it appears certain that these two branches of mathematics have become deeply and permanently intertwined. Despite the fact that the whole subject is only about a decade old, operator K -theory has now reached a state of relative stability. While there will undoubtedly be many more revolutionary developments and applications in the future, it appears the basic theory has more or less reached a final form. But because of the newness of the theory, there has so far been no comprehensive treatment of the subject. It is the ambitious goal of these notes to fill this gap. We will develop the K -theory of Banach algebras, the theory of extensions of C*-algebras, and the operator K -theory of Kasparov from scratch to its most advanced aspects. We will not treat applications in detail; however, we will outline the most striking of the applications to date in a section at the end, as well as mentioning others at suitable points in the text.

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