Basic Commutative Algebra

This textbook, set for a one or two semester course in commutative algebra, provides an introduction to commutative algebra at the postgraduate and research levels. The main prerequisites are familiarity with groups, rings and fields. Proofs are self-contained. The book will be useful to beginners and experienced researchers alike. The material is so arranged that the beginner can learn through self-study or by attending a course. For the experienced researcher, the book may serve to present new perspectives on some well-known results, or as a reference.

The central theme of this volume is commutative algebra, with emphasis on special graded algebras, which are increasingly of interest in problems of algebraic geometry, combinatorics and computer algebra. Most of the papers have partly survey character, but are research-oriented, aiming at classification and structural results.

Along the lines developed by Grothendieck, this book delves into the rich interplay between algebraic geometry and commutative algebra. With concise yet clear definitions and synopses a selection is made from the wealth of meterial in the disciplines including the Riemann-Roch theorem for arbitrary projective curves."--pub. desc.

There is no shortage of books on Commutative Algebra, but the present book is different. Most books are monographs, with extensive coverage. There is one notable exception: Atiyah and Macdonald’s 1969 classic. It is a clear, concise, and efficient textbook, aimed at beginners, with a good selection of topics. So it has remained popular. However, its age and flaws do show. So there is need for an updated and improved version, which the present book aims to be.

Computational Commutative Algebra 1

Introduction To Commutative Algebra

A Term of Commutative Algebra

Finite Projective Modules

(Mostly) Commutative Algebra

This book provides an introduction to the basics and recent developments of commutative algebra. A glance at the contents of the first five chapters shows that the topics covered are on usually are included in any commutative algebra text. However, the contents of this book differ significantly from most commutative algebra texts: namely, its treatment of the Dedekind–M formula, the (small) finitistic dimension of a ring, Gorenstein rings, valuation overrings and the valuative dimension, and Nagata rings. Going further, Chapter 6 presents w-modules over commutative rings as they can be most commonly used by torsion theory and multiplicative ideal theory. Chapter 7 deals with multiplicative ideal theory over integral domains. Chapter 8 various results of the pullbacks, especially Milnor squares and D+M constructions, which are probably the most important example-generating machines. In Chapter 9, coherent rings with weak global dimensions are probed, and the local ring of weak global dimension two is elaborated on by combining homological tricks and methods of star operation theory. Chapter 10 is devoted to the Grothendieck group of a commutative ring. In particular, the Bass–Quillen problem is discussed. Finally, Chapter 11 aims to introduce relative homological algebra, especi where the related concepts of integral domains which appear in classical ideal theory are defined and investigated by using the class of Gorenstein projective modules. Each section of th followed by a selection of exercises of varying degrees of difficulty. This book will appeal to a wide readership from graduate students to academic researchers who are interested in stud commutative algebra.

The second text in this two-book series extends the classical material of Volume I, which focuses on field theory and the ideal theory of Noetherian rings and Dedekind domains. The con Volume II's material to algebraic geometry is stressed throughout the presentation, making this book a practical introduction to some basic concepts and the arithmetical foundations of al geometry. The opening chapter deals with properties of places and is followed by a chapter that explores the classical properties of polynomial and power series rings and their applicatio algebraic geometry. The final chapter examines the theory of local rings, which provides the algebraic basis for the local study of algebraic and analytical varieties. Several helpful Appen conclude the text.

Introductory account of commutative algebra, aimed at students with a background in basic algebra.

This ACM volume deals with tackling problems that can be represented by data structures which are essentially matrices with polynomial entries, mediated by the disciplines of commuta algebra and algebraic geometry. The discoveries stem from an interdisciplinary branch of research which has been growing steadily over the past decade. The author covers a wide rang showing how to obtain deep heuristics in a computation of a ring, a module or a morphism, to developing means of solving nonlinear systems of equations - highlighting the use of advan techniques to bring down the cost of computation. Although intended for advanced students and researchers with interests both in algebra and computation, many parts may be read by a with a basic abstract algebra course.

Projective Modules Over Polynomial Rings and Dynamical Gröbner Bases

A Singular Introduction to Commutative Algebra

From the Viewpoint of Normalization
Commutative Algebra I
Commutative Algebra and Noncommutative Algebraic Geometry

This book can be understood as a model for teaching commutative algebra, and takes into account modern developments such as algorithmic and computational aspects. As soon as a new concept is introduced, the authors show how the concept can be worked on using a computer. The computations are exemplified with the computer algebra system Singular, developed by the authors. Singular is a special system for polynomial computation with many features for global as well as for local commutative algebra and algebraic geometry. The book includes a CD containing Singular as well as the examples and procedures explained in the book.

Algebraic Geometry and Commutative Algebra in Honor of Masayoshi Nagata presents a collection of papers on algebraic geometry and commutative algebra in honor of Masayoshi Nagata for his significant contributions to commutative algebra. Topics covered range from power series rings and rings of invariants of finite linear groups to the convolution algebra of distributions on totally disconnected locally compact groups. The discussion begins with a description of several formulas for enumerating certain types of objects, which may be tabular arrangements of integers called Young tableaux or some types of monomials. The next chapter explains how to establish these enumerative formulas, with emphasis on the role played by transformations of determinantal polynomials and recurrence relations satisfied by them. The book then turns to several applications of the enumerative formulas and universal identity, including including enumerative proofs of the straightening law of Doubilet-Rota-Stein and computations of Hilbert functions of polynomial ideals of certain determinantal loci. Invariant differentials and quaternion extensions are also examined, along with the moduli of Todorov surfaces and the classification problem of embedded lines in characteristic p. This monograph will be a useful resource for practitioners and researchers in algebra and geometry.

This book explores commutative ring theory, an important a foundation for algebraic geometry and complex analytical geometry.

Translated from the popular French edition, this book offers a detailed introduction to various basic concepts, methods, principles, and results of commutative algebra. It takes a constructive viewpoint in commutative algebra and studies algorithmic approaches alongside several abstract classical theories. Indeed, it revisits these traditional topics with a new and simplifying manner, making the subject both accessible and innovative. The algorithmic aspects of such naturally abstract topics as Galois theory, Dedekind rings, Prüfer rings, finitely generated projective modules, dimension theory of commutative rings, and others in the current treatise, are all analysed in the spirit of the great developers of constructive algebra in the nineteenth century. This updated and revised edition contains over 350 well-arranged exercises, together with their helpful hints for solution. A basic knowledge of linear algebra, group theory, elementary number theory as well as the fundamentals of ring and module theory is required. Commutative Algebra: Constructive Methods will be useful for graduate students, and also researchers, instructors and theoretical computer scientists.

Commutative Algebra
Basic Commutative Algebra
An Introductory Course in Commutative Algebra
An Introduction to Commutative Algebra
Algebras, Rings and Modules

This substantially enlarged second edition aims to lead a further stage in the computational revolution in commutative algebra. This is the first handbook/tutorial to extensively deal with SINGULAR. Among the book's most distinctive features is a new, completely unified treatment of the global and local theories. Another feature of the book is its breadth of coverage of theoretical topics in the portions of commutative algebra closest to algebraic geometry, with algorithmic treatments of almost every topic.

Written at a level appropriate to undergraduates, this book covers such topics as the Hilbert Basis Theorem, the Nullstellensatz, invariant theory, projective geometry, and dimension theory. Contains a new section on Axiom and an update about MAPLE, Mathematica and REDUCE.

From the Preface: "We have preferred to write a self-contained book which could be used in a basic graduate course of modern algebra. It is also with an eye to the student that we have tried to give full and detailed explanations in the proofs... We have also tried, this time with an eye to both the student and the mature mathematician, to give a many-sided treatment of our topics, not hesitating to offer several proofs of one and the same result when we thought that something might be learned, as to methods, from each of the proofs."

For those looking for an introduction to the area of commutative algebra, this book opens all the right doors and provides a clarity of understanding that all will welcome.

Constructive Commutative Algebra
Commutative Algebra, Volume II
For Graduate Students and Advanced Undergraduates
Ideals, Varieties, and Algorithms
Combinatorial Commutative Algebra

Basic Commutative AlgebraWorld Scientific

"The second volume of the authors' 'Computational commutative algebra'...covers on its 586 pages a wealth of interesting material with several unexpected applications. ... an encyclopedia on computational commutative algebra, a source for lectures on the subject as well as an inspiration for seminars. The text is recommended for all those who want to learn and enjoy an algebraic tool that becomes more and more relevant to different fields of applications."
--ZENTRALBLATT MATH
This textbook offers a thorough, modern introduction into commutative algebra. It is intented mainly to serve as a guide for a course of one or two semesters, or for self-study. The carefully selected subject matter concentrates on the concepts and results at the center of the field. The book maintains a constant view on the natural geometric context, enabling the reader to gain a deeper understanding of the material. Although it emphasizes theory, three chapters are devoted to computational aspects. Many illustrative examples and exercises enrich the text.
Recent developments are covered Contains over 100 figures and 250 exercises Includes complete proofs
The Use of Ultraproducts in Commutative Algebra
Foundations of Commutative Rings and Their Modules
Commutative Ring Theory
Introduction to Algebraic Geometry and Commutative Algebra

Algebraic geometry is a fascinating branch of mathematics that combines methods from both, algebra and geometry. It transcends the limited scope of pure algebra by means of geometric construction principles. Moreover, Grothendieck's schemes invented in the late 1950s allowed the application of algebraic-geometric methods in fields that formerly seemed to be far away from geometry, like algebraic number theory. The new techniques paved the way to spectacular progress such as the proof of Fermat's Last Theorem by Wiles and Taylor. The scheme-theoretic approach to algebraic geometry is explained for non-experts. More advanced readers can use the book to broaden their view on the subject. A separate part deals with the necessary prerequisites from commutative algebra. On a whole, the book provides a very accessible and self-contained introduction to algebraic geometry, up to a quite advanced level. Every chapter of the book is preceded by a motivating introduction with an informal discussion of the contents. Typical examples and an abundance of exercises illustrate each section. This way the book is an excellent solution for learning by yourself or for complementing knowledge that is already present. It can equally be used as a convenient source for courses and seminars or as supplemental literature.

Commutative algebra is a rapidly growing subject that is developing in many different directions. This volume presents several of the most recent results from various areas related to both Noetherian and non-Noetherian commutative algebra. This volume contains a collection of invited survey articles by some of the leading experts in the field. The authors of these chapters have been carefully selected for their important contributions to an area of commutative-algebraic research. Some topics presented in the volume include: generalizations of cyclic modules, zero divisor graphs, class semigroups, forcing algebras, syzygy bundles, tight closure, Gorenstein dimensions, tensor products of algebras over fields, as well as many others. This book is intended for researchers and graduate students interested in studying the many topics related to commutative algebra.

Originally published in 1985, this classic textbook is an English translation of Einführung in die kommutative Algebra und algebraische Geometrie. As part of the Modern Birkhäuser Classics series, the publisher is proud to make Introduction to Commutative Algebra and Algebraic Geometry available to a wider audience. Aimed at students who have taken a basic course in algebra, the goal of the text is to present important results concerning the representation of algebraic varieties as intersections of the least possible number of hypersurfaces and—a closely related problem—with the most economical generation of ideals in Noetherian rings. Along the way, one encounters many basic concepts of commutative algebra and algebraic geometry and proves many facts which can then serve as a basic stock for a deeper study of these subjects.

The purpose of this book is twofold: to present some basic ideas in commutative algebra and algebraic geometry and to introduce topics of current research, centered around the themes of Gröbner bases, resultants and syzygies. The presentation of the material combines definitions and proofs with an emphasis on concrete examples. The authors illustrate the use of software such as Mathematica and Singular. The design of the text in each chapter consists of two parts: the fundamentals and the applications, which make it suitable for courses of various lengths, levels, and topics based on the mathematical background of the students. The fundamentals portion of the chapter is intended to be read with minimal outside assistance, and to learn some of the most useful tools in commutative algebra. The applications of the chapter are to provide a glimpse of the advanced mathematical research where the topics and results are related to the material presented earlier. In the applications portion, the authors present a number of results from a wide range of sources without detailed proofs. The applications portion

of the chapter is suitable for a reader who knows a little commutative algebra and algebraic geometry already, and serves as a guide to some interesting research topics. This book should be thought of as an introduction to more advanced texts and research topics. Its novelty is that the material presented is a unique combination of the essential methods and the current research results. The goal is to equip readers with the fundamental classical algebra and geometry tools, ignite their research interests, and initiate some potential research projects in the related areas.

Algebraic Geometry and Commutative Algebra

Undergraduate Commutative Algebra

Non-commutative Algebras and Rings

An Introduction

Gršbner Bases in Commutative Algebra

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.

This book is a concise account of topics in commutative algebra. It combines elegant theory with applications to number theory, some problems of classical Greek geometry, and the theory of finite fields which has important uses in other branches of science. The material covered prepares the way for the study of more advanced abstract algebra, but could also form an entire course in itself.

This book provides a concise yet comprehensive and self-contained introduction to Grobner basis theory and its applications to various current research topics in commutative algebra. It especially aims to help young researchers become acquainted with fundamental tools and techniques related to Grobner bases which are used in commutative algebra and to arouse their interest in exploring further topics such as toric rings, Koszul and Rees algebras, determinantal ideal theory, binomial edge ideals, and their applications to statistics. The book can be used for graduate courses and self-study. More than 100 problems will help the readers to better understand the main theoretical results and will inspire them to further investigate the topics studied in this book.

This unique book on commutative algebra is divided into two parts in order to facilitate its use in several types of courses. The first introductory part covers the basic theory, connections with algebraic geometry, computational aspects, and extensions to module theory. The more advanced second part covers material such as associated primes and primary decomposition, local rings, M-sequences and Cohen-Macaulay modules, and homological methods.

with a View Toward Algebraic Geometry

Scratchpad's View of Algebra I

Proceedings of a Workshop held in Salvador, Brazil, Aug. 8-17, 1988

Commutative Algebra: Constructive Methods

An Introduction to Computational Algebraic Geometry and Commutative Algebra

Exploring ultraproducts of Noetherian local rings from an algebraic perspective, this volume illustrates the many ways they can be used in commutative algebra. The text includes an introduction to tight closure in characteristic zero, a survey of flatness criteria, and more.

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

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The theory of algebras, rings, and modules is one of the fundamental domains of modern mathematics. General algebra, more specifically non-commutative algebra, is poised for major advances in the twenty-first century (together with and in interaction with combinatorics), just as topology, analysis, and probability experienced in the twentieth century. This volume is a continuation and an in-depth study, stressing the non-

commutative nature of the first two volumes of Algebras, Rings and Modules by M. Hazewinkel, N. Gubareni, and V. V. Kirichenko. It is largely independent of the other volumes. The relevant constructions and results from earlier volumes have been presented in this volume.

Steps in Commutative Algebra
Computational Commutative Algebra 2
Basic Abstract Algebra
Introduction to Commutative Algebra and Algebraic Geometry
A Course in Commutative Algebra

Relations between groups and sets, results and methods of abstract algebra in terms of number theory and geometry, and noncommutative and homological algebra. Solutions. 2006 edition.

This book is the first to be devoted entirely to fuzzy abstract algebra. It presents an up-to-date version of fuzzy commutative algebra, and focuses on the connection between L-subgroups of a group, and L-subfields of a field. In particular, an up-to-date treatment of nonlinear systems of fuzzy intersection equations is given. Contents:L-Subsets and L-SubgroupsL-Subgroups of Abelian GroupsL-Subrings and L-IdealsL-SubmodulesL-SubfieldsStructure of L-Subrings and L-IdealsAlgebraic L-Varieties and Intersection EquationsL-SubspacesGalois Theory and Group L-Subalgebras Readership: Pure mathematicians. Keywords:Fuzzy Subsets;Fuzzy Subgroups;Fuzzy Subrings;Fuzzy Ideals;Fuzzy Submodules ;Fuzzy Subfields;Fuzzy Varieties;Fuzzy Subspaces;Fuzzy Galois Theory;Fuzzy Group SubalgebrasReviews: “The book is self-contained ... This will serve as a nice reference book for researchers in the field. It may also be used as a good text for an advanced graduate course. There are a good number of exercises at the end of each chapter of the book.” Mathematical Reviews

This book stems from lectures on commutative algebra for 4th-year university students at two French universities (Paris and Rennes). At that level, students have already followed a basic course in linear algebra and are essentially fluent with the language of vector spaces over fields. The topics introduced include arithmetic of rings, modules, especially principal ideal rings and the classification of modules over such rings, Galois theory, as well as an introduction to more advanced topics such as homological algebra, tensor products, and algebraic concepts involved in algebraic geometry. More than 300 exercises will allow the reader to deepen his understanding of the subject. The book also includes 11 historical vignettes about mathematicians who contributed to commutative algebra.

Designed for a one-semester course in mathematics, this textbook presents a concise and practical introduction to commutative algebra in terms of normal (normalized) structure. It shows how the nature of commutative algebra has been used by both number theory and algebraic geometry. Many worked examples and a number of problem (with hints) can be found in the volume. It is also a convenient reference for researchers who use basic commutative algebra.

In Honor of Masayoshi Nagata
Fuzzy Commutative Algebra
Six Lectures on Commutative Algebra
Computational Methods in Commutative Algebra and Algebraic Geometry
Noetherian and Non-Noetherian Perspectives

This introduction to polynomial rings, Gr ö bner bases and applications bridges the gap in the literature between theory and actual computation. It details numerous applications, covering fields as disparate as algebraic geometry and financial markets. To aid in a full understanding of these applications, more than 40 tutorials illustrate how the theory can be used. The book also includes many exercises, both theoretical and practical.

Abstract: "While computer algebra systems have dealt with polynomials and rational functions with integer coefficients for many years, dealing with more general constructs from commutative algebra is a more recent problem. In this paper we explain how one system solves this problem, what types and operators it is necessary to introduce and, in short, how one can construct a computational theory of commutative algebra. Of necessity, such a theory is rather different from the conventional, non-constructive, theory. It is also somewhat different from the theories of Seidenberg (1974) and his school, who are not particularly concerned with practical questions of efficiency."

The main goal of this book is to find the constructive content hidden in abstract proofs of concrete theorems in Commutative Algebra, especially in well-known theorems concerning projective modules over polynomial rings (mainly the Quillen-Suslin theorem) and syzygies of multivariate polynomials with coefficients in a valuation ring. Simple and constructive proofs of some results in the theory of projective modules over polynomial rings are also given, and light is cast upon recent progress on the Hermite ring and Gr ö bner ring conjectures. New conjectures on unimodular completion arising from our constructive approach to the unimodular completion problem are presented. Constructive algebra can be understood as a first preprocessing step for computer algebra that leads to the discovery of general algorithms, even if they are sometimes not efficient. From a logical point of view, the dynamical evaluation gives a constructive substitute for two highly nonconstructive tools of abstract algebra: the Law of Excluded Middle and Zorn's Lemma. For instance, these tools are required in order to construct the complete prime factorization of an ideal in a Dedekind ring, whereas the dynamical method reveals the computational content of this construction. These lecture notes follow this dynamical philosophy.