

Representation Theory of Finite Groups: Algebra and Arithmetic

Steven H. Weintraub

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Representation Theory Of Finite Groups Algebra And Arithmetic

Ambar N. Sengupta



Representation Theory Of Finite Groups Algebra And Arithmetic:

Representation Theory of Finite Groups: Algebra and Arithmetic Steven H. Weintraub, 2003 We explore widely in the valley of ordinary representations and we take the reader over the mountain pass leading to the valley of modular representations to a point from which s he can survey this valley but we do not attempt to widely explore it We hope the reader will be sufficiently fascinated by the scenery to further explore both valleys on his her own from the Preface Representation theory plays important roles in geometry algebra analysis and mathematical physics In particular representation theory has been one of the great tools in the study and classification of finite groups There are some beautiful results that come from representation theory Frobenius s Theorem Burnside s Theorem Artin s Theorem Brauer s Theorem all of which are covered in this textbook Some seem uninspiring at first but prove to be quite useful Others are clearly deep from the outset And when a group finite or otherwise acts on something else as a set of symmetries for example one ends up with a natural representation of the group This book is an introduction to the representation theory of finite groups from an algebraic point of view regarding representations as modules over the group algebra The approach is to develop the requisite algebra in reasonable generality and then to specialize it to the case of group representations Methods and results particular to group representations such as characters and induced representations are developed in depth Arithmetic comes into play when considering the field of definition of a representation especially for subfields of the complex numbers The book has an extensive development of the semisimple case where the characteristic of the field is zero or is prime to the order of the group and builds the foundations of the modular case where the characteristic of the field divides the order of the group The book assumes only the material of a standard graduate course in algebra It is suitable as a text for a year long graduate course The subject is of interest to students of algebra number theory and algebraic geometry The systematic treatment presented here makes the book also valuable as a reference

Representation Theory of Finite Groups Steven H. Weintraub, 2003 We explore widely in the valley of ordinary representations and we take the reader over the mountain pass leading to the valley of modular representations to a point from which s he can survey this valley but we do not attempt to widely explore it We hope the reader will be sufficiently fascinated by the scenery to further explore both valleys on his her own from the Preface Representation theory plays important roles in geometry algebra analysis and mathematical physics In particular it has been one of the great tools in the study and classification of finite groups The theory contains some particularly beautiful results Frobenius theorem Burnside s theorem Artin s theorem Brauer s theorem all of which are covered in this textbook Some seem uninspiring at first but prove to be quite useful Others are clearly deep from the outset And when a group finite or otherwise acts on something else as a set of symmetries for example one ends up with a natural representation of the group This book is an introduction to the representation theory of finite groups from an algebraic point of view regarding representations as modules over the group algebra The approach is to develop the requisite algebra in

reasonable generality and then to specialize it to the case of group representations. Methods and results particular to group representations such as characters and induced representations are developed in depth. Arithmetic comes into play when considering the field of definition of a representation especially for subfields of the complex numbers. The book has an extensive development of the semisimple case where the characteristic of the field is zero or is prime to the order of the group and builds the foundations of the modular case where the characteristic of the field divides the order of the group. The book assumes only the material of a standard graduate course in algebra. It is suitable as a text for a year long graduate course. The subject is of interest to students of algebra, number theory and algebraic geometry. The systematic treatment presented here makes the book also valuable as a reference.

Representation Theory of Finite Groups and Associative Algebras Charles W. Curtis, Irving Reiner, 1966

Representation Theory of Finite Groups: a Guidebook David A. Craven, 2019-08-30 This book provides an accessible introduction to the state of the art of representation theory of finite groups. Starting from a basic level that is summarized at the start, the book proceeds to cover topics of current research interest including open problems and conjectures. The central themes of the book are block theory and module theory of group representations which are comprehensively surveyed with a full bibliography. The individual chapters cover a range of topics within the subject from blocks with cyclic defect groups to representations of symmetric groups. Assuming only modest background knowledge at the level of a first graduate course in algebra, this guidebook intended for students taking first steps in the field will also provide a reference for more experienced researchers. Although no proofs are included, end of chapter exercises make it suitable for student seminars.

Representation Theory of Finite Groups Benjamin Steinberg, 2011-10-23 This book is intended to present group representation theory at a level accessible to mature undergraduate students and beginning graduate students. This is achieved by mainly keeping the required background to the level of undergraduate linear algebra, group theory and very basic ring theory. Module theory and Wedderburn theory as well as tensor products are deliberately avoided. Instead, we take an approach based on discrete Fourier Analysis. Applications to the spectral theory of graphs are given to help the student appreciate the usefulness of the subject. A number of exercises are included. This book is intended for a 3rd/4th undergraduate course or an introductory graduate course on group representation theory. However, it can also be used as a reference for workers in all areas of mathematics and statistics.

Representing Finite Groups Ambar N. Sengupta, 2011-12-09 This graduate textbook presents the basics of representation theory for finite groups from the point of view of semisimple algebras and modules over them. The presentation interweaves insights from specific examples with development of general and powerful tools based on the notion of semisimplicity. The elegant ideas of commutant duality are introduced along with an introduction to representations of unitary groups. The text progresses systematically and the presentation is friendly and inviting. Central concepts are revisited and explored from multiple viewpoints. Exercises at the end of the chapter help reinforce the material. Representing

Finite Groups A Semisimple Introduction would serve as a textbook for graduate and some advanced undergraduate courses in mathematics. Prerequisites include acquaintance with elementary group theory and some familiarity with rings and modules. A final chapter presents a self-contained account of notions and results in algebra that are used. Researchers in mathematics and mathematical physics will also find this book useful. A separate solutions manual is available for instructors.

Modular Representation Theory of Finite Groups Peter Schneider, 2012-11-27 Representation theory studies maps from groups into the general linear group of a finite dimensional vector space. For finite groups the theory comes in two distinct flavours. In the semisimple case, for example over the field of complex numbers, one can use character theory to completely understand the representations. This by far is not sufficient when the characteristic of the field divides the order of the group. Modular Representation Theory of finite Groups comprises this second situation. Many additional tools are needed for this case. To mention some, there is the systematic use of Grothendieck groups leading to the Cartan matrix and the decomposition matrix of the group as well as Green's direct analysis of indecomposable representations. There is also the strategy of writing the category of all representations as the direct product of certain subcategories, the so-called blocks of the group. Brauer's work then establishes correspondences between the blocks of the original group and blocks of certain subgroups, the philosophy being that one is thereby reduced to a simpler situation. In particular, one can measure how nonsemisimple a category a block is by the size and structure of its so-called defect group. All these concepts are made explicit for the example of the special linear group of two by two matrices over a finite prime field. Although the presentation is strongly biased towards the module theoretic point of view, an attempt is made to strike a certain balance by also showing the reader the group theoretic approach. In particular, in the case of defect groups, a detailed proof of the equivalence of the two approaches is given. This book aims to familiarize students at the masters level with the basic results, tools, and techniques of a beautiful and important algebraic theory. Some basic algebra together with the semisimple case are assumed to be known, although all facts to be used are restated without proofs in the text. Otherwise, the book is entirely self-contained.

The Arcata Conference on Representations of Finite Groups, Part 1 Paul Fong, 1987 The papers in these proceedings of the 1986 Arcata Summer Institute bear witness to the extraordinarily vital and intense research in the representation theory of finite groups. The confluence of diverse mathematical disciplines has brought forth work of great scope and depth. Particularly striking is the influence of algebraic geometry and cohomology theory in the modular representation theory and the character theory of reductive groups over finite fields and in the general modular representation theory of finite groups. The continuing developments in block theory and the general character theory of finite groups is noteworthy. The expository and research aspects of the Summer Institute are well represented by these papers. **Geometric and Topological**

Aspects of the Representation Theory of Finite Groups Jon F. Carlson, Srikanth B. Iyengar, Julia Pevtsova, 2018-10-04 These proceedings comprise two workshops celebrating the accomplishments of David J. Benson on the occasion of his

sixtieth birthday The papers presented at the meetings were representative of the many mathematical subjects he has worked on with an emphasis on group representations and cohomology The first workshop was titled Groups Representations and Cohomology and held from June 22 to June 27 2015 at Sabhal M r Ostaig on the Isle of Skye Scotland The second was a combination of a summer school and workshop on the subject of Geometric Methods in the Representation Theory of Finite Groups and took place at the Pacific Institute for the Mathematical Sciences at the University of British Columbia in Vancouver from July 27 to August 5 2016 The contents of the volume include a composite of both summer school material and workshop derived survey articles on geometric and topological aspects of the representation theory of finite groups The mission of the annually sponsored Summer Schools is to train and draw new students and help Ph D students transition to independent research

A Journey Through Representation Theory Caroline Gruson, Vera Serganova, 2018-10-23 This text covers a variety of topics in representation theory and is intended for graduate students and more advanced researchers who are interested in the field The book begins with classical representation theory of finite groups over complex numbers and ends with results on representation theory of quivers The text includes in particular infinite dimensional unitary representations for abelian groups Heisenberg groups and SL_2 and representation theory of finite dimensional algebras The last chapter is devoted to some applications of quivers including Harish Chandra modules for SL_2 Ample examples are provided and some are revisited with a different approach when new methods are introduced leading to deeper results Exercises are spread throughout each chapter Prerequisites include an advanced course in linear algebra that covers Jordan normal forms and tensor products as well as basic results on groups and rings

Representation Theory of Finite Groups and Related Topics Irving Reiner, American Mathematical Society, 1971 This symposium on Representation Theory of Finite Groups and Related Topics was held in conjunction with a sectional meeting of the American Mathematical Society and in honor of professor Richard Brauer Dr Brauer's fundamental work in representation theory is at the heart of many further developments in the topic These proceedings contain the articles of participants based on their symposium presentations and indicate the scope of current research in representation theory

Representation Theory of Finite Groups and Finite-Dimensional Algebras 3Island Press, 1991-04-01 **Representing Finite Groups** Ambar N. Sengupta, 2011-12-08 This graduate textbook presents the basics of representation theory for finite groups from the point of view of semisimple algebras and modules over them The presentation interweaves insights from specific examples with development of general and powerful tools based on the notion of semisimplicity The elegant ideas of commutant duality are introduced along with an introduction to representations of unitary groups The text progresses systematically and the presentation is friendly and inviting Central concepts are revisited and explored from multiple viewpoints Exercises at the end of the chapter help reinforce the material Representing Finite Groups A Semisimple Introduction would serve as a textbook for graduate and some advanced undergraduate courses in mathematics Prerequisites

include acquaintance with elementary group theory and some familiarity with rings and modules A final chapter presents a self contained account of notions and results in algebra that are used Researchers in mathematics and mathematical physics will also find this book useful A separate solutions manual is available for instructors Finite Groups II B. Huppert,N. Blackburn,2012-12-06 17 t L It CIFDr wei unsre Weisheit Einfalt ist From Lohengrin Richard Wagner At the time of the appearance of the first volume of this work in 1967 the tempestuous development of finite group theory had already made it virtually impossible to give a complete presentation of the subject in one treatise The present volume and its successor have therefore the more modest aim of giving descriptions of the recent development of certain important parts of the subject and even in these parts no attempt at completeness has been made Chapter VII deals with the representation theory of finite groups in arbitrary fields with particular attention to those of non zero charac teristic That part of modular representation theory which is essentially the block theory of complex characters has not been included as there are already monographs on this subject and others will shortly appear Instead we have restricted ourselves to such results as can be obtained by purely module theoretical means **Blocks of Finite Groups and Their Invariants** Benjamin Sambale,2014-11-19 Providing a nearly complete selection of up to date methods and results on block invariants with respect to their defect groups this book covers the classical theory pioneered by Brauer the modern theory of fusion systems introduced by Puig the geometry of numbers developed by Minkowski the classification of finite simple groups and various computer assisted methods In a powerful combination these tools are applied to solve many special cases of famous open conjectures in the representation theory of finite groups Most of the material is drawn from peer reviewed journal articles but there are also new previously unpublished results In order to make the text self contained detailed proofs are given whenever possible Several tables add to the text s usefulness as a reference The book is aimed at experts in group theory or representation theory who may wish to make use of the presented ideas in their research **Character Theory of Finite Groups** I. Martin Isaacs,1994-01-01 The book is a pleasure to read There is no question but that it will become and deserves to be a widely used textbook and reference Bulletin of the American Mathematical Society Character theory provides a powerful tool for proving theorems about finite groups In addition to dealing with techniques for applying characters to pure group theory a large part of this book is devoted to the properties of the characters themselves and how these properties reflect and are reflected in the structure of the group Chapter I consists of ring theoretic preliminaries Chapters 2 to 6 and 8 contain the basic material of character theory while Chapter 7 treats an important technique for the application of characters to group theory Chapter 9 considers irreducible representations over arbitrary fields leading to a focus on subfields of the complex numbers in Chapter 10 In Chapter 15 the author introduces Brauer s theory of blocks and modular characters Remaining chapters deal with more specialized topics such as the connections between the set of degrees of the irreducible characters and structure of a group Following each chapter is a selection of carefully thought out problems including exercises examples further results and

extensions and variations of theorems in the text Prerequisites for this book are some basic finite group theory the Sylow theorems elementary properties of permutation groups and solvable and nilpotent groups Also useful would be some familiarity with rings and Galois theory In short the contents of a first year graduate algebra course should be sufficient preparation

Representation Theory of Finite Groups and Finite-dimensional Algebras Gerhard Michler, Claus Michael Ringel, 1991

The Theory of Finite Groups Hans Kurzweil, Bernd Stellmacher, 2003-11-06 From reviews of the German Edition This is an exciting text and a refreshing contribution to an area in which challenges continue to flourish and to captivate the viewer Even though representation theory and constructions of simple groups have been omitted the text serves as a springboard for deeper study in many directions One who completes this text not only gains an appreciation of both the depth and the breadth of the theory of finite groups but also witnesses the evolutionary development of concepts that form a basis for current investigations This is accomplished by providing a thread that permits a natural flow from one concept to another rather than compartmentalizing Operators on sets and groups are introduced early and used effectively throughout The bibliography provides excellent supplemental support H Bechtell Mathematical Reviews Altogether we have a well written book which gives an introduction into the field and furthermore shows us one of the most active recent areas of research This is the first book which shows us the amalgam method and moreover shows us how it works Maybe it can get the same influence on group theory today as Gorenstein's famous book got in the late sixties and seventies This book should be in any library G Stroth Zentralblatt

Linear Representations of Finite Groups Jean-Pierre Serre, 2012-12-06 This book consists of three parts rather different in level and purpose The first part was originally written for quantum chemists It describes the correspondence due to Frobenius between linear representations and characters This is a fundamental result of constant use in mathematics as well as in quantum chemistry or physics I have tried to give proofs as elementary as possible using only the definition of a group and the rudiments of linear algebra The examples Chapter 5 have been chosen from those useful to chemists The second part is a course given in 1966 to second year students of l'Ecole Normale It completes the first on the following points a degrees of representations and integrality properties of characters Chapter 6 b induced representations theorems of Artin and Brauer and applications Chapters 7-11 c rationality questions Chapters 12 and 13 The methods used are those of linear algebra in a wider sense than in the first part group algebras modules noncommutative tensor products semisimple algebras The third part is an introduction to Brauer theory passage from characteristic 0 to characteristic p and conversely I have freely used the language of abelian categories projective modules Grothendieck groups which is well suited to this sort of question The principal results are a The fact that the decomposition homomorphism is surjective all irreducible representations in characteristic p can be lifted virtually i.e. in a suitable Grothendieck group to characteristic 0

Integral Representations I. Reiner, K.W. Roggenkamp, 2006-11-15

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Table of Contents Representation Theory Of Finite Groups Algebra And Arithmetic

1. Understanding the eBook Representation Theory Of Finite Groups Algebra And Arithmetic
 - The Rise of Digital Reading Representation Theory Of Finite Groups Algebra And Arithmetic
 - Advantages of eBooks Over Traditional Books
2. Identifying Representation Theory Of Finite Groups Algebra And Arithmetic
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Representation Theory Of Finite Groups Algebra And Arithmetic
 - User-Friendly Interface
4. Exploring eBook Recommendations from Representation Theory Of Finite Groups Algebra And Arithmetic
 - Personalized Recommendations
 - Representation Theory Of Finite Groups Algebra And Arithmetic User Reviews and Ratings
 - Representation Theory Of Finite Groups Algebra And Arithmetic and Bestseller Lists
5. Accessing Representation Theory Of Finite Groups Algebra And Arithmetic Free and Paid eBooks
 - Representation Theory Of Finite Groups Algebra And Arithmetic Public Domain eBooks
 - Representation Theory Of Finite Groups Algebra And Arithmetic eBook Subscription Services
 - Representation Theory Of Finite Groups Algebra And Arithmetic Budget-Friendly Options

6. Navigating Representation Theory Of Finite Groups Algebra And Arithmetic eBook Formats
 - ePub, PDF, MOBI, and More
 - Representation Theory Of Finite Groups Algebra And Arithmetic Compatibility with Devices
 - Representation Theory Of Finite Groups Algebra And Arithmetic Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Representation Theory Of Finite Groups Algebra And Arithmetic
 - Highlighting and Note-Taking Representation Theory Of Finite Groups Algebra And Arithmetic
 - Interactive Elements Representation Theory Of Finite Groups Algebra And Arithmetic
8. Staying Engaged with Representation Theory Of Finite Groups Algebra And Arithmetic
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Representation Theory Of Finite Groups Algebra And Arithmetic
9. Balancing eBooks and Physical Books Representation Theory Of Finite Groups Algebra And Arithmetic
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Representation Theory Of Finite Groups Algebra And Arithmetic
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Representation Theory Of Finite Groups Algebra And Arithmetic
 - Setting Reading Goals Representation Theory Of Finite Groups Algebra And Arithmetic
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Representation Theory Of Finite Groups Algebra And Arithmetic
 - Fact-Checking eBook Content of Representation Theory Of Finite Groups Algebra And Arithmetic
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

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