

Dieter Blessenohl • Manfred Schocker

NONCOMMUTATIVE
CHARACTER THEORY
OF THE
SYMMETRIC GROUP

Imperial College Press

Noncommutative Character Theory Of The Symmetric Group

Pierre-Loic Meliot



Noncommutative Character Theory Of The Symmetric Group:

Noncommutative Character Theory Of The Symmetric Group Dieter Blessenohl, Manfred Schocker, 2005-01-27 A new approach to the character theory of the symmetric group has been developed during the past fifteen years which is in many ways more efficient more transparent and more elementary In this approach to each permutation is assigned a class function of the corresponding symmetric group Problems in character theory can thereby be transferred into a completely different setting and reduced to combinatorial problems on permutations in a natural and uniform way This is the first account in book form entirely devoted to the new noncommutative method As a modern and comprehensive survey of the classical theory the book contains such fundamental results as the Murnaghan Nakayama and Littlewood Richardson rules as well as more recent applications in enumerative combinatorics and in the theory of the free Lie algebra But it is also an introduction to the vibrant theory of certain combinatorial Hopf algebras such as the Malvenuto Reutenauer algebra of permutations The three detailed appendices on group characters the Solomon descent algebra and the Robinson Schensted correspondence makes the material self contained and suitable for undergraduate level Students and researchers alike will find that noncommutative character theory is a source of inspiration and an illuminating approach to this versatile field of algebraic combinatorics a

Representations of Finite Dimensional Algebras and Related Topics in Lie Theory and Geometry Vlastimil Dlab, Claus Michael Ringel, 2004 These proceedings are from the Tenth International Conference on Representations of Algebras and Related Topics ICRA X held at The Fields Institute In addition to the traditional instructional workshop preceding the conference there were also workshops on Commutative Algebra Algebraic Geometry and Representation Theory Finite Dimensional Algebras Algebraic Groups and Lie Theory and Quantum Groups and Hall Algebras These workshops reflect the latest developments and the increasing interest in areas that are closely related to the representation theory of finite dimensional associative algebras Although these workshops were organized separately their topics are strongly interrelated The workshop on Commutative Algebra Algebraic Geometry and Representation Theory surveyed various recently established connections such as those pertaining to the classification of vector bundles or Cohen Macaulay modules over Noetherian rings coherent sheaves on curves or ideals in Weyl algebras In addition methods from algebraic geometry or commutative algebra relating to quiver representations and varieties of modules were presented The workshop on Finite Dimensional Algebras Algebraic Groups and Lie Theory surveyed developments in finite dimensional algebras and infinite dimensional Lie theory especially as the two areas interact and may have future interactions The workshop on Quantum Groups and Hall Algebras dealt with the different approaches of using the representation theory of quivers and species in order to construct quantum groups working either over finite fields or over the complex numbers In particular these proceedings contain a quite detailed outline of the use of perverse sheaves in order to obtain canonical bases The book is recommended for graduate students and researchers in algebra and geometry

Coxeter Groups and Hopf

Algebras Marcelo Aguiar, 2006 An important idea in the work of G C Rota is that certain combinatorial objects give rise to Hopf algebras that reflect the manner in which these objects compose and decompose Recent work has seen the emergence of several interesting Hopf algebras of this kind which connect diverse subjects such as combinatorics algebra geometry and theoretical physics This monograph presents a novel geometric approach using Coxeter complexes and the projection maps of Tits for constructing and studying many of these objects as well as new ones The first three chapters introduce the necessary background ideas making this work accessible to advanced graduate students The later chapters culminate in a unified and conceptual construction of several Hopf algebras based on combinatorial objects which emerge naturally from the geometric viewpoint This work lays a foundation and provides new insights for further development of the subject *An Introduction to Quasisymmetric Schur Functions* Kurt Luoto, Stefan Mykytiuk, Stephanie van Willigenburg, 2013-06-19 An Introduction to Quasisymmetric Schur Functions is aimed at researchers and graduate students in algebraic combinatorics The goal of this monograph is twofold The first goal is to provide a reference text for the basic theory of Hopf algebras in particular the Hopf algebras of symmetric quasisymmetric and noncommutative symmetric functions and connections between them The second goal is to give a survey of results with respect to an exciting new basis of the Hopf algebra of quasisymmetric functions whose combinatorics is analogous to that of the renowned Schur functions *Representations of the Infinite Symmetric Group* Alexei Borodin, Grigori Olshanski, 2017 An introduction to the modern representation theory of big groups exploring its connections to probability and algebraic combinatorics **Representation Theory of Symmetric Groups** Pierre-Loic Meliot, 2017-05-12 Representation Theory of Symmetric Groups is the most up to date abstract algebra book on the subject of symmetric groups and representation theory Utilizing new research and results this book can be studied from a combinatorial algorithmic or algebraic viewpoint This book is an excellent way of introducing today's students to representation theory of the symmetric groups namely classical theory From there the book explains how the theory can be extended to other related combinatorial algebras like the Iwahori Hecke algebra In a clear and concise manner the author presents the case that most calculations on symmetric group can be performed by utilizing appropriate algebras of functions Thus the book explains how some Hopf algebras symmetric functions and generalizations can be used to encode most of the combinatorial properties of the representations of symmetric groups Overall the book is an innovative introduction to representation theory of symmetric groups for graduate students and researchers seeking new ways of thought

Bimonoids for Hyperplane Arrangements Marcelo Aguiar, Swapneel Mahajan, 2020-03-19 The goal of this monograph is to develop Hopf theory in a new setting which features centrally a real hyperplane arrangement The new theory is parallel to the classical theory of connected Hopf algebras and relates to it when specialized to the braid arrangement Joyal's theory of combinatorial species ideas from Tits theory of buildings and Rota's work on incidence algebras inspire and find a common expression in this theory The authors introduce notions of monoid comonoid bimonoid and Lie monoid relative to a fixed

hyperplane arrangement They also construct universal bimonoids by using generalizations of the classical notions of shuffle and quasishuffle and establish the Borel Hopf Poincaré Birkhoff Witt and Cartier-Milnor-Moore theorems in this setting This monograph opens a vast new area of research It will be of interest to students and researchers working in the areas of hyperplane arrangements semigroup theory Hopf algebras algebraic Lie theory operads and category theory **Handbook**

of Algebra M. Hazewinkel, 2009-07-08 Algebra as we know it today consists of many different ideas concepts and results A reasonable estimate of the number of these different items would be somewhere between 50 000 and 200 000 Many of these have been named and many more could and perhaps should have a name or a convenient designation Even the nonspecialist is likely to encounter most of these either somewhere in the literature disguised as a definition or a theorem or to hear about them and feel the need for more information If this happens one should be able to find enough information in this Handbook to judge if it is worthwhile to pursue the quest In addition to the primary information given in the Handbook there are references to relevant articles books or lecture notes to help the reader An excellent index has been included which is extensive and not limited to definitions theorems etc The Handbook of Algebra will publish articles as they are received and thus the reader will find in this third volume articles from twelve different sections The advantages of this scheme are two fold accepted articles will be published quickly and the outline of the Handbook can be allowed to evolve as the various volumes are published A particularly important function of the Handbook is to provide professional mathematicians working in an area other than their own with sufficient information on the topic in question if and when it is needed Thorough and practical source of information Provides in depth coverage of new topics in algebra Includes references to relevant articles books and lecture notes **Classical Hopf Algebras and Their Applications** Pierre Cartier, Frédéric Patras, 2021-09-20

This book is dedicated to the structure and combinatorics of classical Hopf algebras Its main focus is on commutative and cocommutative Hopf algebras such as algebras of representative functions on groups and enveloping algebras of Lie algebras as explored in the works of Borel Cartier Hopf and others in the 1940s and 50s The modern and systematic treatment uses the approach of natural operations illuminating the structure of Hopf algebras by means of their endomorphisms and their combinatorics Emphasizing notions such as pseudo coproducts characteristic endomorphisms descent algebras and Lie idempotents the text also covers the important case of enveloping algebras of pre Lie algebras A wide range of applications are surveyed highlighting the main ideas and fundamental results Suitable as a textbook for masters or doctoral level programs this book will be of interest to algebraists and anyone working in one of the fields of application of Hopf algebras

Algebras, Rings and Modules Michiel Hazewinkel, Nadezhda Mikhailovna Gubareni, Vladimir V. Kirichenko, 2010 Presenting an introduction to the theory of Hopf algebras the authors also discuss some important aspects of the theory of Lie algebras This book includes a chapters on the Hopf algebra of symmetric functions the Hopf algebra of representations of the symmetric groups the Hopf algebras of the nonsymmetric and quasisymmetric functions and the Hopf algebra of

permutations

Topics in Hyperplane Arrangements Marcelo Aguiar, Swapneel Mahajan, 2017-11-22 This monograph studies the interplay between various algebraic geometric and combinatorial aspects of real hyperplane arrangements. It provides a careful organized and unified treatment of several recent developments in the field and brings forth many new ideas and results. It has two parts each divided into eight chapters and five appendices with background material. Part I gives a detailed discussion on faces, flats, chambers, cones, gallery intervals, lunes and other geometric notions associated with arrangements. The Tits monoid plays a central role. Another important object is the category of lunes which generalizes the classical associative operad. Also discussed are the descent and lune identities, distance functions on chambers and the combinatorics of the braid arrangement and related examples. Part II studies the structure and representation theory of the Tits algebra of an arrangement. It gives a detailed analysis of idempotents and Peirce decompositions and connects them to the classical theory of Eulerian idempotents. It introduces the space of Lie elements of an arrangement which generalizes the classical Lie operad. This space is the last nonzero power of the radical of the Tits algebra. It is also the socle of the left ideal of chambers and of the right ideal of Lie elements. Lie elements generalize the classical Lie idempotents. They include Dynkin elements associated to generic half spaces which generalize the classical Dynkin idempotent. Another important object is the lune incidence algebra which marks the beginning of noncommutative Möbius theory. These ideas are also brought upon the study of the Solomon descent algebra. The monograph is written with clarity and in sufficient detail to make it accessible to graduate students. It can also serve as a useful reference to experts.

Representation Theory and Noncommutative Harmonic Analysis II A.A. Kirillov, 2013-03-09 At first only elementary functions were studied in mathematical analysis. Then new functions were introduced to evaluate integrals. They were named special functions: integral sine, logarithms, the exponential function, the probability integral and so on. Elliptic integrals proved to be the most important. They are connected with rectification of arcs of certain curves. The remarkable idea of Abel to replace these integrals by the corresponding inverse functions led to the creation of the theory of elliptic functions. They are doubly periodic functions of a complex variable. This periodicity has led to consideration of the lattice of periods and to linear fractional transformations of the complex plane which leave this lattice invariant. The group of these transformations is isomorphic to the quotient group of the group $GL(2, \mathbb{Z})$ of unimodular matrices of the second order with integral elements with respect to its center. Investigation of properties of elliptic functions led to the study of automorphic functions and forms. This gave the first connection between the theory of groups and this important class of functions. The further development of the theory of automorphic functions was related to geometric concepts connected with the fact that the group of linear fractional transformations with real elements can be realized as the group of motions of the Lobachevskij plane. We also note that at the beginning of the 19th century Gauss used the group $GL(2, \mathbb{Z})$ in his papers on the theory of indeterminate quadratic forms.

Coxeter Algebras Marcelo Aguiar, Swapneel Mahajan, 2022-11-17 The goal of this monograph is to develop Hopf theory in the setting of a real

reflection arrangement The central notion is that of a Coxeter bialgebra which generalizes the classical notion of a connected graded Hopf algebra The authors also introduce the more structured notion of a Coxeter bimonoid and connect the two notions via a family of functors called Fock functors These generalize similar functors connecting Hopf monoids in the category of Joyal species and connected graded Hopf algebras This monograph opens a new chapter in Coxeter theory as well as in Hopf theory connecting the two It also relates fruitfully to many other areas of mathematics such as discrete geometry semigroup theory associative algebras algebraic Lie theory operads and category theory It is carefully written with effective use of tables diagrams pictures and summaries It will be of interest to students and researchers alike Abstracts

of Papers Presented to the American Mathematical Society American Mathematical Society,2008 *Asymptotic*

Combinatorics with Applications to Mathematical Physics Anatoly M. Vershik,2003-07-03 At the Summer School Saint Petersburg 2001 the main lecture courses bore on recent progress in asymptotic representation theory those written up for this volume deal with the theory of representations of infinite symmetric groups and groups of infinite matrices over finite fields Riemann Hilbert problem techniques applied to the study of spectra of random matrices and asymptotics of Young diagrams with Plancherel measure the corresponding central limit theorems the combinatorics of modular curves and random trees with application to QFT free probability and random matrices and Hecke algebras **Representation**

Discovery using Harmonic Analysis Sridhar Mahadevan,2022-05-31 Representations are at the heart of artificial intelligence AI This book is devoted to the problem of representation discovery how can an intelligent system construct representations from its experience Representation discovery re parameterizes the state space prior to the application of information retrieval machine learning or optimization techniques facilitating later inference processes by constructing new task specific bases adapted to the state space geometry This book presents a general approach to representation discovery using the framework of harmonic analysis in particular Fourier and wavelet analysis Biometric compression methods the compact disc the computerized axial tomography CAT scanner in medicine JPEG compression and spectral analysis of time series data are among the many applications of classical Fourier and wavelet analysis A central goal of this book is to show that these analytical tools can be generalized from their usual setting in infinite dimensional Euclidean spaces to discrete finite dimensional spaces typically studied in many subfields of AI Generalizing harmonic analysis to discrete spaces poses many challenges a discrete representation of the space must be adaptively acquired basis functions are not pre defined but rather must be constructed Algorithms for efficiently computing and representing bases require dealing with the curse of dimensionality However the benefits can outweigh the costs since the extracted basis functions outperform parametric bases as they often reflect the irregular shape of a particular state space Case studies from computer graphics information retrieval machine learning and state space planning are used to illustrate the benefits of the proposed framework and the challenges that remain to be addressed Representation discovery is an actively developing field and the author hopes this book will

encourage other researchers to explore this exciting area of research Table of Contents Overview Vector Spaces Fourier
 Bases on Graphs Multiscale Bases on Graphs Scaling to Large Spaces Case Study State Space Planning Case Study
 Computer Graphics Case Study Natural Language Future Directions **Polynomial Representations of GL_n** James A.
 Green, 2006-11-30 The new corrected and expanded edition adds a special appendix on Schensted Correspondence and
 Littelmann Paths This appendix can be read independently of the rest of the volume and is an account of the Littelmann path
 model for the case gl_n The appendix also offers complete proofs of classical theorems of Schensted and Knuth New
Perspectives in Algebraic Combinatorics Louis J. Billera, 1999-09-28 This text contains expository contributions by respected
 researchers on the connections between algebraic geometry topology commutative algebra representation theory and convex
 geometry *Representation Theory of Symmetric Groups* Pierre-Loic Meliot, 2017-05-12 Representation Theory of
 Symmetric Groups is the most up to date abstract algebra book on the subject of symmetric groups and representation
 theory Utilizing new research and results this book can be studied from a combinatorial algorithmic or algebraic viewpoint
 This book is an excellent way of introducing today's students to representation theory of the symmetric groups namely
 classical theory From there the book explains how the theory can be extended to other related combinatorial algebras like
 the Iwahori Hecke algebra In a clear and concise manner the author presents the case that most calculations on symmetric
 group can be performed by utilizing appropriate algebras of functions Thus the book explains how some Hopf algebras
 symmetric functions and generalizations can be used to encode most of the combinatorial properties of the representations of
 symmetric groups Overall the book is an innovative introduction to representation theory of symmetric groups for graduate
 students and researchers seeking new ways of thought **Representation Theory of Finite Reductive Groups** Marc
 Cabanes, Michel Enguehard, 2004-01-29 Publisher Description

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