

# Preface

This anthology of three papers is a fruitful product of the Research Project of RIMS (Research Institute for Mathematical Sciences, Kyoto University) on “Combinatorial Methods in Representation Theory” for the academic year 1998–99.

The authors were all participants of the above project and played active roles during that period. The following is a brief summary of the papers.

Prof. Stembridge’s paper gives a nice integrated survey on methods for actual computation of basic representation-theoretic data for semi-simple Lie algebras (over the complex numbers, say), such as weight multiplicities and tensor product decompositions, and related structural data for their Weyl groups. Prof. Stembridge has been engaged in developing packages of functions in MAPLE named “Coxeter” and “Weyl” to deal with these problems, and this article reflects his own experience in designing these programs. It also mentions connections with recent research interests.

Prof. Thibon’s paper is a survey of the theory of the noncommutative symmetric functions initiated by the author and others ( I.M. Gelfand, D. Krob, A. Lascoux, B. Leclerc, V. Retakh et al.). It covers many topics in such areas as combinatorics, Lie algebra, the symmetric groups, the Hecke algebra and the quantum group of type A and now the subject becomes one of the most active areas in combinatorics.

Prof. Thibon shows that the framework of the noncommutative symmetric functions leads us in a natural way to many noncommutative analogues and  $q$ -analogues of known and famous results in each of these field and this article conveys a good flavor of the theory.

Prof. van Leeuwen’s paper is a variation on the theme of the Littlewood-Richardson rule, which plays an important role both in combinatorics and representation theory of the classical groups. Prof. van Leeuwen presents a proof and a unified perspective of the Littlewood-Richardson rule based on the “modern” (post-1980) technology such as tableau switching, dual equivalence, and coplactic operations. Also in this article he tries to give proofs of some results which are hard to find in published literature, though they may be known to the experts. It makes this article an introductory and self-contained exposition of the Littlewood-Richardson rule and related combinatorial constructions.

All the articles are very pleasantly written and we hope the readers find in them some excellent examples of outcomes of a happy marriage of combinatorics and representation theory.

Masaki Kashiwara  
Kazuhiko Koike  
Soichi Okada  
Itaru Terada  
Hiro-Fumi Yamada

May 2001, Japan