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Foreword

Special Issue In Memory of Jeff Remmel

Part 2 of the double issue

This is the second of two special issues of *Journal of Combinatorics* commemorating the life and legacy of Professor Jeffrey Brian Remmel (October 12, 1948–September 29, 2017). The breadth, depth, and sheer quantity of Jeff Remmel's cumulative mathematical output is truly astounding. Jeff produced over three hundred refereed journal articles in the fields of logic, combinatorics, computer science, and hybrid control theory. Even now, Jeff's total publication count continues to increase as his many coauthors finish ongoing joint research projects. In this very issue, you will find a new article coauthored by Jeff on symmetric functions.

Before getting too enthralled by Jeff's elegant mathematical pursuits, we must pay our respects to the human impact of such a great mentor, teacher, and friend. Jeff Remmel trained 32 Ph.D. students, inspired hundreds of graduate students, and taught thousands of undergraduates during his 43 years of service in the Mathematics Department of the University of California at San Diego. He worked tirelessly and enthusiastically with over 100 collaborators throughout his long career as a research mathematician. He leaves behind many colleagues who admire him, friends who miss him, and a family who loves him dearly. His tragic and untimely passing in September 2017 saddened us all.

Though Jeff is no longer with us, we take comfort from the fact that his mathematical achievements and discoveries will last forever. To celebrate and memorialize Jeff's work, many of his students, coauthors, and colleagues have contributed original research articles on a variety of combinatorial topics. This issue starts with four papers on symmetric functions, a central research area in modern algebraic combinatorics. Symmetric functions provide a bridge linking representation theory and algebraic geometry to concrete combinatorial structures such as tableaux, permutations, and lattice paths. Many interesting symmetric functions can be built from the famous Macdonald polynomials using the nabla operator ∇ and its generalizations, the delta operators Δ_f. Ever since Jim Haglund's pioneering work in 2003 interpreting q,t-Catalan numbers in terms of weighted Dyck paths, there has been enormous progress on the question of finding combinatorial models for various symmetric functions.

Carlsson and Mellit recently proved the so-called Shuffle Conjecture of Haglund, Haiman, Loehr, Remmel, and Ulyanov. This special issue showcases some exciting new developments on the more general Delta Conjectures of Haglund, Remmel, and Wilson. In "A proof of the 4-variable Catalan polynomial of the Delta Conjecture," Mike Zabrocki proves a compositional version of one of these conjectures, which interprets certain Schur coefficients in the symmetric function $\Delta_{h_\ell}\nabla C_\alpha$ as weighted sums of decorated Dyck paths. In "Exploring a Delta Schur Conjecture," Adriano Garsia, Jeffrey Liese, Jeff Remmel, and Meesue Yoo investigate the Schur expansion of the $t = 0$ specialization of $\Delta'_{s_\nu}(e_n)$. The authors show how the combinatorial version of this expansion can be derived from first principles by looking at the coefficients in the Hall–Littlewood expansion of a plethystic version of Δ'_{s_ν}. This paper complements an independent proof by Haglund, Rhoades, and Shimozono and gives new insights into the earlier proof of the $t = 0$ version of the Delta Conjecture (due to Garsia, Haglund, Remmel, and Yoo). The next article, "Some new symmetric function tools and their applications" by Garsia, Haglund, and Romero, uses a remarkable special case of Macdonald–Koornwinder reciprocity to give a unified treatment of many scalar product identities involving delta operators and related symmetric functions. This leads to interesting connections to bigraded S_n-modules, q,t-Narayana numbers, and Kreweras numbers.

The fourth paper on symmetric functions is "A family of symmetric functions associated with Stirling permutations" by Rafael González D'León. Rafael proves formulas for the multiplicative inverse and the compositional inverse of "generic" exponential generating functions whose coefficients are the complete symmetric functions h_n. The inverse generating functions are built from elementary symmetric functions using novel combinatorial statistics on permutations and Stirling permutations. The author obtains some equidistribution results for these statistics and their generalizations to r-Stirling permutations.

The final two papers illuminate further connections between permutation statistics and other algebraic, geometric, and combinatorial structures. In "A polyhedral proof of a wreath product identity," Robert Davis and Bruce Sagan give a neat new proof of a formula of Biagioli and Zeng involving permutation statistics for the wreath product $\mathbb{Z}_r \wr S_n$. This new proof reveals a way to understand these statistics in terms of discrete polyhedral geometry, extending the applicability of the geometric approach to such identities originally due to Beck and Braun. In "Signature Catalan combinatorics" by Cesar Ceballos and Rafael González D'León, the authors assign a composition to each planar rooted tree by listing the degrees of its internal nodes in preorder. By restricting bijections to act on trees with a given composition signature, the authors obtain interesting subclasses of combinatorial objects such as rational Dyck paths, 312-avoiding Stirling permutations, noncrossing partitions, and matchings.

In closing, I would like to extend my heartfelt thanks and appreciation to all the authors, anonymous referees, editors, and other journal staff who made this special issue possible. I particularly acknowledge the efforts of principal *JOC* editors Fan Chung Graham and Jennifer Morse. I am certain that Jeff Remmel would be proud of all the work everyone has done to honor him. With humility and respect, I dedicate this issue to his memory.

Guest editor
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