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When Do Integer Permutation Invariants Form a Free Module Over the Symmetric Polynomials? An Application of Combinatorics to Invariant Theory

Abstract for the Combinatorics Seminar 2018 February 27

A permutation group G acts on the integer polynomial ring $\mathbb{Z}[x_1, \dots, x_n]$ by permuting the x_i 's. The invariant ring for this action contains the symmetric polynomials as a subring. It is natural to ask if it is free as a module over this subring. Freeness turns out to be equivalent to the delicate ring-theoretic property of Cohen–Macaulayness, long a subject of interest to invariant theorists. This talk will report on recent work of Sophie Marques and the speaker that answers this question, characterizing groups for which the invariant ring is free. The proofs in the “if” and “only-if” directions are completely different, but both are combinatorial.

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