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A Quasisymmetric Function for Matroids

Abstract for the Combinatorics Seminar 2006 November 14

I describe a new isomorphism invariant of matroids that is a quasisymmetric function. This invariant

1. defines a Hopf morphism from the Hopf algebra of matroids to the quasisymmetric functions, which is surjective if one uses rational coefficients,
2. is a multivariate generating function for integer weight vectors that give minimum total weight to a unique base of the matroid,
3. is equivalent, via the Hopf antipode, to a generating function for integer weight vectors which keeps track of how many bases minimize the total weight,
4. behaves simply under matroid duality,
5. has a simple expansion in terms of P-partition enumerators, and
6. is a valuation on decompositions of matroid base polytopes.

This last property leads to an interesting application: it can sometimes be used to prove that a matroid base polytope has no decompositions into smaller matroid base polytopes. From work of Lafforgue, the lack of such a decomposition implies the matroid has only a finite number of vector representations up to projective equivalence.

This is joint work with Ning Jia and Victor Reiner.

The paper is accessible at <http://arxiv.org/abs/math.CO/0606646>.

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Last update: **2020/01/29 19:03**

