

Functional Decomposition Theorems for Symbolic Polynomials

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Abstract

We consider the ring of symbolic Laurent polynomials, which are multivariate polynomials whose exponents are themselves integer-valued polynomials rather than integers. Earlier work has presented algorithms to compute gcds and factorizations of such symbolic polynomials. The present work shows how to extend the notion of univariate polynomial decomposition to symbolic polynomials and presents an algorithm to compute these decompositions. For example, the symbolic polynomial $f(X) = 2X^{n^2+n} - 4X^{n^2} + 2X^{n^2-n} + 1$ can be decomposed as $f = g \circ h$, where $g(X) = 2X^2 + 1$ and $h(X) = X^{n^2/2+n/2} - X^{n^2/2-n/2}$.