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Sparse Polynomial Arithmetic using Heaps

We present some old and seemingly forgotten algorithms for multiplying and dividing sparse polynomials using heaps. The algorithms do an n-ary merge of all partial products using only a heap of pointers into the input, constructing exactly the terms that appear in the result. The amount of memory required is linear in the size of the smaller input for multiplication or in the quotient or the divisor for division. We also constructed a variant of the division algorithm that is linear time in the size of the quotient, something which is not possible for algorithms based on merging. As a result, some common cases of exact division can be done an order of magnitude faster using an order of magnitude less memory than with a divide and conquer strategy, such as geobuckets. We plan to integrate our C library into the next release of Maple.

This is joint work with Dr. Michael Monagan at Simon Fraser University.