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On the ideals of general binary orbits

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Let us identify $\mathbb{P}^d$ with the set of binary forms

$$A = \sum_{i=0}^{d} a_i \, x_1^{d-i} x_2^i, \qquad (a_i \in \mathbf{C})$$

of order d (distinguished up to scalars). The special linear group SL_2 acts on $\mathbb{P}^d$ via a change of variables in $\{x_1, x_2\}$. Given a *general* binary d-ic A, let $X_A \subseteq \mathbb{P}^d$ denote the closure of its SL_2-orbit. One should like to know the (equivariant) minimal generators for the defining ideal of the variety X_A.
This problem seems to be very difficult for general d, but I have succeeded in arriving at a computational solution for all $d \leq 8$. I will explain the classical invariant theory involved in the solution, as well as a curious phenomenon called 'combinatorially invisible generators'.
