The Knapsack Problem for Automatic Semigroups is Undecidable

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We reduce from Hilbert's tenth problem, over natural numbers. Fix a polynomial $P(x_1, \ldots x_n)$ such that the question "is there a solution to $P(x_1, \ldots x_n) = a$" is undecidable.

Take P and separate it into P_+ and P_-, the positive and negative parts of P. Consider the equation $P_+ = P_-$.