

# Flag Sums of Squares for Sidorenko's Conjecture

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Sidorenko's conjecture can be formulated as "Of all the graphs with edge density  $\rho$ , the graph with edges chosen uniformly at random (with probability  $\rho$ ) contains the fewest bipartite subgraphs." This conjecture, first formulated in 1991 by Sidorenko, has received considerable attention over the last decades, and yet remains open in the general case. We provide a new approach based on Razborov's flag algebra method. While it was recently shown [Blekherman, Raymond, Singh, Thomas, 2020] that flag-sums-of-squares are not enough to prove even small, known cases of the conjecture, we provide a strengthening of the hierarchy, based on novel derivatives of subgraph density functions, which can handle some of these cases.