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Sharp bounds for sums associated to graphs of matrices

We provide a simple algorithm for finding the optimal upper bound for sums of products of matrix entries of the form $S(N) := \sum_{j_1,\ldots,j_{2m}=1}^{N} t_{j_1 j_2} t_{j_3 j_4} \cdots t_{j_{2m-1} j_{2m}}$ where some of the summation indices are constrained to be equal. The upper bound is easily obtained from a graph associated to the constraints in the sum.