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The Elegant Joint Measurement is Nonlocal in the Triangle Network

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Proving the nonlocality of a distribution in a general quantum network that goes beyond the Bell scenario is generally a difficult task, due to the non-convex nature of the problem. Only few examples of proven quantum nonlocality exist even in the simple triangle network. The Elegant Joint Measurement is a quantum measurement scheme that can be used to obtain an outcome distribution in the triangle network. This distribution has been conjectured to be nonlocal 6 years ago. In this work, we provide a computer-assisted proof of nonlocality for this distribution, thereby developing a toolkit to tackle general network nonlocality problems. The proof is based on the inflation technique for causal inference, but scaled to higher levels than what has generally been considered tractable. This is made possible by a number of optimization techniques, involving symmetry reductions, branch-and-bound optimization, and most importantly, the use of a Frank-Wolfe algorithm to bypass the need to call a standard linear program solver.

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