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Topic: Quantum Information
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Title: Finding Quantum Solutions to Classical Problems: How Quantum Mechanics Can Solve Problems That Are Classically Impossible To Solve

Abstract:

The branch of mathematics known as Game Theory places bounds to the optimal outcome of scenarios where two or more parties have a conflict of interest but also to collaborative scenarios where communication is limited or constrained, either by physical separation (maybe a fraction of a light-second on planet earth) or by secrecy and lack of a secure communication channel.

The optimal strategy for game-theoretical scenarios are usually sustained by classical logic reasoning and some may be overcome by the use of quantum resources. Entanglement and the non-local correlation two parties can achieve without communication is an example that is forbidden classically (by Bell's theorem). Even if the information cannot travel faster than light, two independent parties sharing entanglement can make decisions blessed by super classical correlations that will provide an advantage when compared (see video).

With this high-school research project, we aim to prove through a direct comparison and a proof of contradiction that two players, classically, are limited and cannot generate any long run strategy for a specific set of tailor made games. Secondly, we show that through quantum mechanics, these players can generate a valid quantum strategy that has a clear advantage when compared to a classical approach.