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Bang-Bang control of Classical and Quantum Optimization Algorithms

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The problem of finding the global minimum of a given function over a large (but finite) search space—also known as combinatorial optimization—has been analyzed both in the classical and quantum setting. The so-called meta-heuristic approach seeks to find the best heuristic for minimizing the given function quickly but approximately. Classically, many meta-heuristic strategies exist, and some, such as simulated annealing, are motivated by natural processes. On the other hand, the quantum adiabatic algorithm has received much attention and has been shown to have exponential speedup over simulated annealing for certain problem instances. Here, we show that a different, “bang-bang” strategy solves one such problem classically in polynomial time. More generally, we argue that by using what is known as the Pontryagin Minimum Principle, one could potentially design optimal, bang-bang classical and quantum optimization algorithms.