Combinatorial Optimization and QAOA

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Combinatorial optimization (CO) lies at the core of computer science, operations research, and many practical applications. The Quantum Approximate Optimization Algorithm (QAOA), introduced by Farhi, Goldstone, and Gutmann in 2014, is an AI-inspired quantum algorithm that has become a leading candidate for solving CO problems such as MAX-CUT on near-term quantum devices. The QAOA literature is already remarkably rich and forms a fertile ground where physics, theoretical computer science, and AI converge. In this talk, I will survey the key ideas underlying QAOA and highlight the open challenges that continue to drive research in the field. Finally, I will point to directions where insights from these different fields may shape the future of quantum optimization.