

Tabu-driven Quantum Neighborhood Samplers

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Combinatorial optimization is an important application targeted by quantum computing. However, near-term hardware constraints make quantum algorithms unlikely to be competitive when compared to high-performing classical heuristics on large practical problems. One option to achieve advantages with near-term devices is to use them in combination with classical heuristics. In particular, we propose using quantum methods to sample from classically intractable distributions -- which is the most probable approach to attain a true provable quantum separation in the near-term -- which are used to solve optimization problems faster. We numerically study this enhancement by an adaptation of Tabu Search using the Quantum Approximate Optimization Algorithm (QAOA) as a neighborhood sampler. We show that QAOA provides a flexible tool for exploration-exploitation in such hybrid settings and can provide evidence that it can help in solving problems faster by saving many tabu iterations and achieving better solutions. This is demonstrated on instances of Quadratic Unconstrained Binary Optimization problems up to 500 variables that can express an exceptional variety of combinatorial optimization (CO) problems such as Quadratic Assignment, Constraint Satisfaction Problems, Graph Coloring, Maximum Cut.