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Effective optimization using sample persistence: a case study on quantum annealers, simulated annealing and simulated quantum annealing

We present and apply a general-purpose multi-start algorithm for improving the performance of low-energy samplers used for solving optimization problems. The algorithm iteratively fixes the value of a large portion of the variables to values that have a high probability of being optimal. The resulting problems are smaller and less connected, and samplers tend to give better low-energy samples for these problems. The algorithm is trivially parallelizable, since each start in the multi-start algorithm is independent, and could be applied to any heuristic solver which can be run multiple times to give a sample. We present results for several hard problem classes solved using simulated annealing (SA), path-integral quantum Monte Carlo (QMC) and a quantum annealer, and show that not only are success metrics improved substantially, but the scaling is as well. When combined with this algorithm, we observed that the quantum annealer outperformed SA and QMC on native Chimera problems. We also observed that with this algorithm the scaling of the time to solution of the quantum annealer is comparable to HFS on the weak-strong cluster problems.