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Expansion of the scope of quantum annealing

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Abstract

Developing calculators based on quantum mechanics is one of the attractive topics in quantum physics. Quantum annealing (QA), which can prepare a desired quantum state by using quantum real-time dynamics, is an important method on the calculators. A main application of QA is combinatorial optimization problems such as job scheduling and capacitated vehicle routing problem. To solve such problems by using QA, we need to represent the problems with Ising model. However, not all problems can be represented by Ising model. A typical example is black-box optimization problems. In the black-box optimization problems, cost functions are not given analytically. Hence, we need to estimate the cost function from properties of a target black-box optimization problem before optimizing it. Since the black-box optimization problems frequently appears in applications of optimization, expanding the range of application of QA to the black-box optimization problems is an important work. In this presentation, we start from a review of QA, and describe some applications of QA. Then, we see that QA can be applied to black-box optimization problems by using machine learning techniques. These techniques could pave the way to expand the scope of applications of quantum technologies.