Day 2 (Poster C)

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Title:Prime Factorization with Fewer Qubits by Combining Quantum Annealing and Classical Algorithm

Abstract:
Conventional computers are hard to factor large integers efficiently, while quantum annealing devices may have potential to speed up factorization. Jiang et al. (Scientific Report 2018) developed a framework to map prime factorization problem onto Ising model, however which requires large number of qubits. In this study, to reduce qubits when factoring integers, the Hamiltonian is divided into several parts, and each part is solved by quantum annealing, then a classical algorithm is employed to combine the results and select the correct solutions. The core idea is to use quantum annealing to obtain possible solutions and correct answers are obtained by a classical algorithm. This idea can be generalized to other problems. The proposed method is tested using D-Wave's simulator qbsolv and the classical algorithm implemented in python. The results show that the proposal can factorize integers with fewer qubits than the previous method. We have applied to 15 semiprime instances, and the largest 20-bit instance 1, 005, 973 requires only 56 qubits. However , to obtain the correct solutions, several applications of quantum annealing are required. The proposal can also be combined with other ad hoc method to further decrease the number of qubits.

This work has been done with Shinji Kimura (Waseda University)