Beyond Moore's Law?
Seeking Quantum Speedup Through Spin Glasses

講師 : Professor Helmut Katzgraber
Texas A&M University

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概要

Can quantum computers indeed meet the promise of doing complex calculations faster than classical computers based on transistor technologies? While the holy grail of a programmable universal quantum computer will probably still take decades to reach, one can already begin to answer this question by testing programmable quantum annealing machines that are currently being built. These machines, such as D-Wave Two, use a non-mainstream method known as adiabatic quantum annealing to perform optimization tasks. After a brief introduction to optimization methods, I summarize recent progress in the design and construction of quantum annealing machines. Unfortunately, to date, a conclusive detection of quantum speedup remains elusive. Based on insights from the study of spin glasses, combined with large-scale Monte Carlo simulations and data mining techniques, in this talk I present ideas on how to construct tunable hard benchmark problems that work around the intrinsic noise and technical constraints of current quantum optimization machines. Our results show that a careful design of the hardware architecture and benchmark problems is key when building quantum annealers.

Work done in collaboration with F. Hamze (D-Wave Systems Inc), H. Munoz-Bauza (Texas A&M University), A. Ochoa (Texas A&M University), S. Schnabel (Leipzig University) Z. Zhu (Texas A&M University)

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