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Quantum (inspired) algorithms for combinatorial optimization and equational reasoning

Thursday 2 October 2025 12:00 (30 minutes)

Tensor network (TN) methods have emerged as a powerful tool for addressing high-dimensional problems, with applications spanning quantum many-body physics and machine learning. We show how combinatorial problems can be tackled through a synergy of quantum-inspired algorithms and novel quantum formulations. First, we address mission planning for Earth-observation satellites, mapping a constrained knapsack scheduling problem into a QUBO formulation and efficiently finding ground-state solutions with TN solvers. Second, we enhance Schnorr's algorithm for RSA factorization by using TN methods to solve closest vector problem (CVP) instances, achieving factorization of semiprimes up to 100 bits —the largest with this approach to date. Finally, we introduce a quantum computational framework for equational reasoning, encoding equivalence classes of symbolic expressions into Hamiltonian ground states to solve the word problem, count equivalent expressions, and analyze their structure.

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Session Classification: Invited Speakers