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New methods for encoding SAT for an adiabatic quantum computer

While quantum annealing (QA) offers the hope of solving hard discrete optimization and satisfaction problems faster than any classical algorithm, current implementations of QA are restricted to solving quadratic unconstrained boolean optimization problems (QUBOs) with a limited number of variables and sparse interactions. In this presentation we expand upon previous techniques and algorithms for encoding SAT effectively and efficiently into this restricted class of QUBOs that fit the QA hardware architecture. In particular, we present 1) a new technique for encoding small Boolean functions based on off-line usage of Satisfiability and Optimization Modulo Theories, in a way that identifies an optimal mapping of variables to qubits; and 2) a new method for decomposing SAT problems or boolean combinational circuits into minimal sets of efficiently encodable Boolean functions, based on classical technology mapping. Some preliminary empirical results using a D-Wave 2000Q system support the feasibility of this approach. This is joint work with Zhengbing Bian, Fabian Chudak, William Macready, Aidan Roy, and Roberto Sebastiani.