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Overview of a Quantum Annealing Processor

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Quantum Adiabatic Evolution algorithms have been proposed as a potentially powerful set of methods to solve computationally hard problems.[1] One example of this approach is to find the ground state configuration of an Ising spin system with a transverse field using quantum annealing (QA).[2] I will present an overview of the architecture and operation of the D-Wave One, an end-to-end computing platform that performs QA by slowly decreasing the transverse field of a programmable Ising spin system. After a brief review of quantum annealing, I will describe how superconducting flux qubits are used to construct the programmable Ising spins.[3] I will then discuss some recent experiments performed to determine whether or not the processor behaves as intended. Toward this end, it is particularly useful to be able to measure the spectrum of single and multiple coupled qubits as they progress through the annealing algorithm.[4] Finally, since the primary measure of the efficacy of such a machine is how well it solves problems, I will conclude with a discussion of system performance and scaling.

[1]E. Farhi, *et al.*, SCIENCE **292**, pp. 472-476, 20 April 2001
[2]T. Kadowaki and H. Nishimori, Phys. Rev. E,**58**(5), pp. 5355-5363, (1998)
[3]R. Harris, *et al.*, Phys. Rev. B, **82**, 024511 (2010)
[4]A. J. Berkley, *et al.*, `arXiv:1210.6310v1`