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Quantum annealing for polynomial systems of equations

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Numerous fields require numerically solving a system of linear equations. For equations stemming from large, sparse matrices, this is classically done with iterative methods and judicious preconditioning. Convergence of such algorithms can be highly variable and depends in part, on the condition number of the matrix. With the arrival of quantum computing in the Noisy Intermediate-Scale Quantum era, we present a quantum annealing algorithm which directly solves systems of linear equations with favorable scaling with respect to condition number. The algorithm can also be extended to solve systems of polynomial equations. We discuss the theoretical framework for this method and perform experiments of the algorithm with a quantum annealer. Scaling with respect to matrix rank, condition number, and search precision is studied. Finally, we define an iterative annealing process and demonstrate its efficacy in solving a linear system to a tolerance of 10−8.

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