



Dissertation Defense

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Towards the First Practical Applications of Quantum Computers

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ABSTRACT: Noisy, intermediate-scale quantum (NISQ) computers are coming online. The lack of error-correction in these devices prevents them from realizing the full potential of fault-tolerant quantum computation, a technology that is known to have significant practical applications, but which is years, if not decades, away. A major open question is whether NISQ devices will have practical applications.

In this thesis, we explore and implement proposals for using NISQ devices to achieve practical applications. In particular, we develop and execute variational quantum algorithms for solving problems in combinatorial optimization and quantum chemistry. We also execute a prototype of a protocol for generating certified random bits. We perform our experiments on a superconducting qubit processor developed at Google. While we do not perform any quantum computations that are beyond the capabilities of classical computers, we address many implementation challenges that must be overcome to succeed in such an endeavor. Our results are a promising indication that NISQ devices will indeed deliver practical applications.

Chairs: Profs. Christopher Peikert and Yaoyun Shi