Quantum Science & Engineering Center

Quantum Computing Seminar Series

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Enabling Deeper Quantum Compiler Optimizations at High Level

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Abstract

A quantum compiler is one essential and critical component in a quantum computing system to deploy and optimize the quantum programs onto the underlying physical quantum hardware platforms. Yet, today's quantum compilers are still far from optimal. One reason is that most optimizations in today's quantum compilers are local program transformations over very few qubits and gates. In general, it is highly non-trivial for a compiler that runs on a classical computer to automatically derive large-scale program optimizations at the gate-level.

In this talk, we will discuss how we can systematically enhance the quantum compilers by introducing high-level program optimizations in the quantum software/compiler infrastructure. Instead of optimizing the quantum programs at the gate level, we design new quantum programming language primitives and intermediate representations that can maintain high-level properties of the programs. These high-level properties can then be leveraged to derive new large-scale quantum compiler optimizations beyond the capabilities of gate-level optimizations. In particular, we will introduce optimizing quantum simulation programs over a Pauli string based intermediate representation, mapping surface code onto superconducting architectures, and quantum program testing/error mitigation through projection-based quantum assertions. We believe that the high-level optimization approach can also be applicable to other quantum application domains and algorithmic properties.

Meeting Information: https://go.gmu.edu/qcseminar

About the Seminar Series

The Quantum Computing Seminar Series are a series of working seminars organized and hosted by QSEC's quantum computing subgroup on Mondays. These events are free and open to the public. More information is available on QSEC's Computing Events and Mathematical Sciences Department's Quantum Computing Seminars. For any questions, contact qsec@gmu.edu.