University of Pittsburgh | School of Computing and Information

Dissertation Defense

Doctor of Philosophy in Computer Science

"**Towards Effective Qubit Mapping for Noisy Intermediate-Scale Quantum Devices**" by **Chi Zhang**

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Abstract:
Today, quantum devices are comprised of qubits ranging from dozens to hundreds in number. There is a class of problems that cannot be solved using classical computing. Whereas, it's expected that these tasks can be solved by the current and the future quantum devices achieving supremacy over classical computing. However, the current state-of-the-art quantum computing is riddled with qubit mapping problem. CNOT gates, that take two logical qubits as input, can only be mapped to a physical qubit pair, adjacent to each other. But the physical layout of the current quantum hardware is normally irregular. This renders executing quantum programs directly on current quantum devices infeasible. Moreover, the available quantum error correction is not adequate. This leads the state of quantum computing to the Noisy Intermediate-Scale Quantum (NISQ) era, yielding the need of smaller sized quantum circuits to be mapped onto the hardware. This requires thorough investigations into designing solutions to achieve effective mapping strategy between logical and physical qubits.

In this proposal, we are looking into three strategies to partially address the qubit mapping problem namely – (i) a depth-aware and a slack-based SWAP insertion scheme, (ii) a time-optimal qubit mapping solution, and (iii) a crosstalk-aware decoherence-mitigating qubit mapping compilation framework.