DESIGN AUTOMATION CONFERENCE 59

FROM CHIPS TO SYSTEMS — LEARN TODAY, CREATE TOMORROW

2022 DAC Tutorial

Scalable Design-Program-Compilation Optimizations for Quantum Algorithms

1:30 PM - 5:00 PM PDT
July 11, 2022

Abstract

The fast growing on the number of qubits in recent years has brought new challenges in designing, programming, synthesizing, and mapping applications to quantum computers at scale:

(1) how to synthesize and map the logical circuit to physical qubits;

(2) how to program applications to adapt to quantum computing;

(3) how to design a quantum circuit for Q learning with Q advantage?

This tutorial is composed of three sessions to address all these issues. All attendees will leave with code examples that they can use as the backbone implementation to their own projects

Organizer

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Tutorial Sessions

Session 1 Qubit Mapping and Scheduling: Gap Analysis and Optimal Solutions

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Session 2 Enabling Deeper Quantum Compiler Optimization at High Level

Yufei Ding,
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Gushu Li,
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Session 3 Towards Quantum Learning Democratization

—— Start from Building a Quantum Neural Network Design Stack

Weiwen Jiang,
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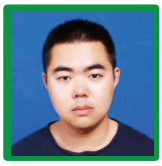

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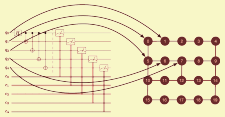
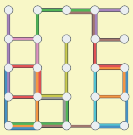
Topics



Mapper
OLSQ

OLSQ refers to the optimal layout synthesis which maps a quantum program to a real quantum computer under its hardware constraints

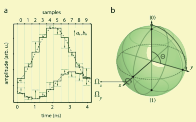


Compilation
Paulihedral

Paulihedral is a block-wise compiler framework that can deeply optimize the quantum simulation kernels.

Design & Program
QuantumFlow

QuantumFlow focuses on design and optimize quantum learning algorithms toward near-term quantum computers

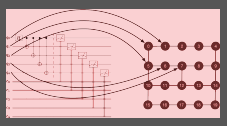


Quantum Pulse
VQP

Learning from variational quantum circuits to variational quantum pulse

Resources & References

Session 1 Qubit Mapping and Scheduling: Gap Analysis and Optimal Solutions



https://github.com/UCLA-VAST/OLSQ (Source Code of OLSQ)

https://arxiv.org/pdf/2007.15671.pdf (OLSQ)

https://arxiv.org/pdf/2109.06445.pdf (OLSQ-GA)

https://arxiv.org/pdf/2002.09783.pdf (QUEKO)

Session 2 Enabling Deeper Quantum Compiler Optimization at High Level

https://zenodo.org/record/5780204 (Paulihedral Artifact)

https://dl.acm.org/doi/pdf/10.1145/3503222.3507715 (Paulihedral)

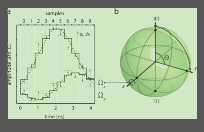
https://dl.acm.org/doi/abs/10.1145/3470496.3527381 (QEC Compiler)

Session 3 Towards Quantum Learning Democratization —— Start from Building a Quantum Neural Network Design Stack

https://github.com/JQub/qfnn (Source Code of QFNN API & Place to post Issues)

https://jqub.ece.gmu.edu/categories/QF/qfnn/ (QFNN Documents)

https://www.nature.com/articles/s41467-020-20729-5 (QuantumFlow Paper)



https://arxiv.org/pdf/2012.10360.pdf (Paper on How to Correct Map NN to Q)

https://arxiv.org/pdf/2109.03806.pdf (QF-Mixer)

https://arxiv.org/pdf/2109.03430.pdf (QF-RobustNN)

https://arxiv.org/pdf/2203.17267.pdf (VQP)