Shot Branching Optimization of Multiple-Shots Quantum Circuit Simulations

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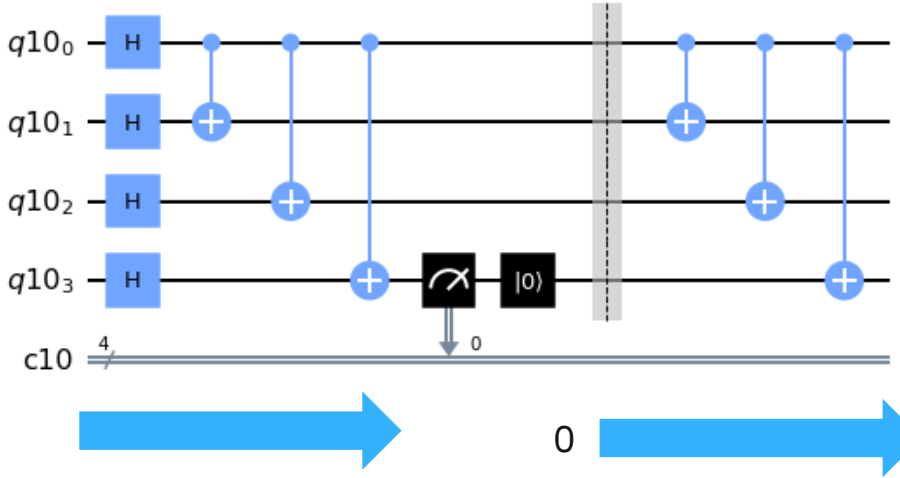
IBM **Quantum**

Motivation

Multiple-shots simulation takes long time

Because of operations with randomness (measure/reset/noises), each shot is simulated independently

(Sampling measures for multi-shots can not be applied)



All shots have same state

0

1

State is varied depending on measure

But can state be shared with some shots?

Shot-Branching Optimization

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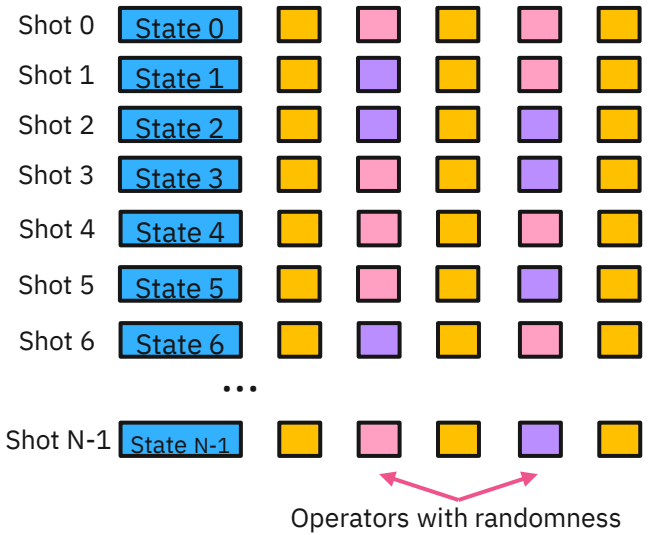
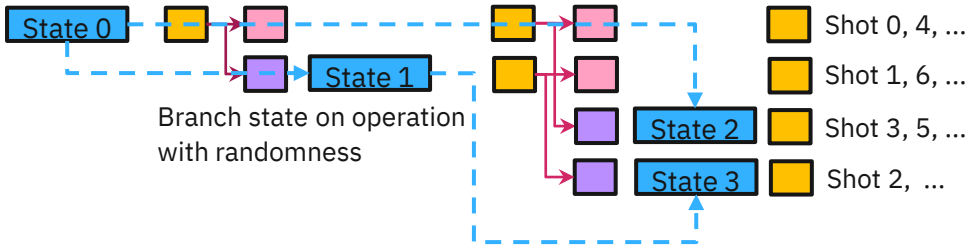
Conventional implementation of multi-shots simulation

Simulating all the shots independently



Shot-branching optimization of multi-shots simulation

Starting Simulation with 1 shared state

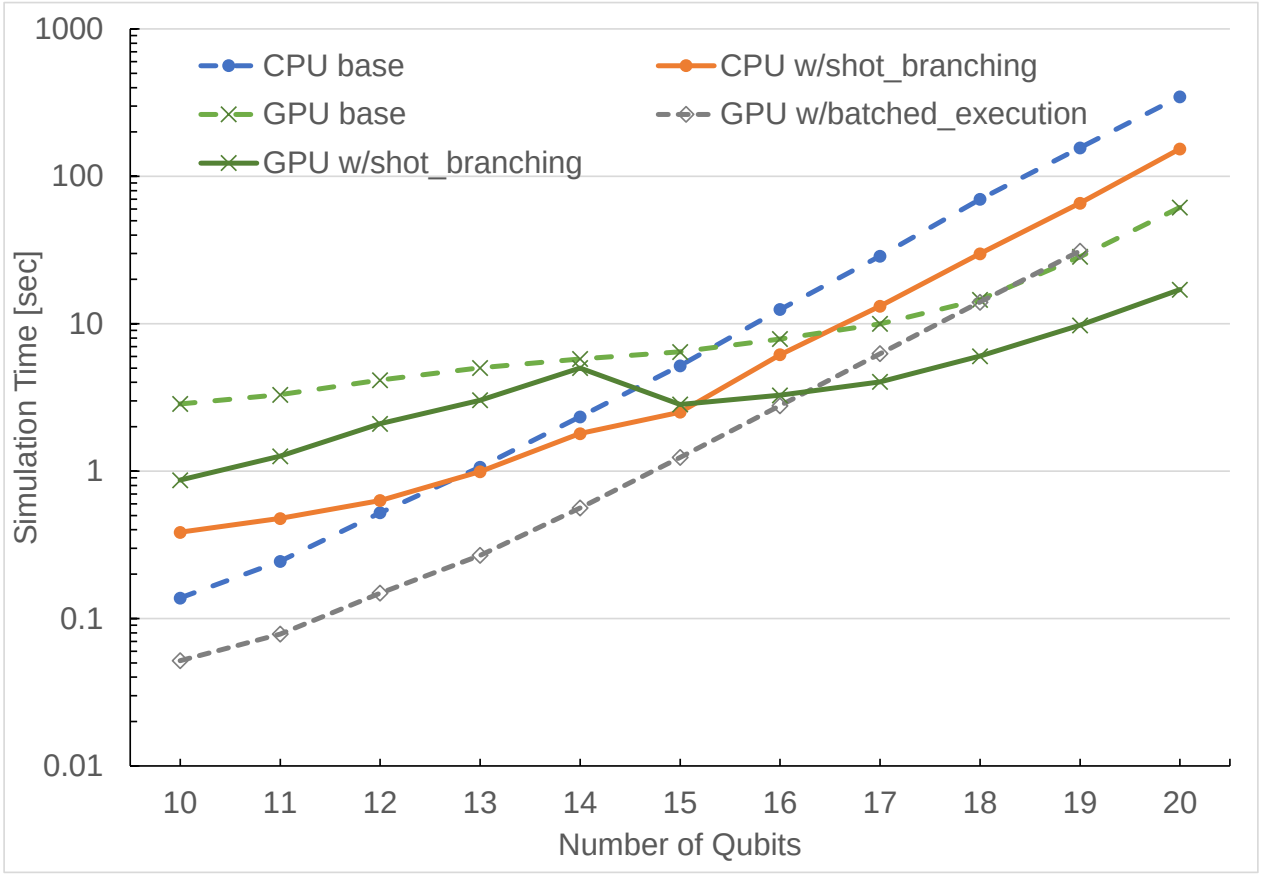


Number of simulations can be decreased by shot branching

Supported methods:

- statevector
- density_matrix
- unitary

Performance of Noise Simulation



QFT with 1% of Kraus noise

1000 shots