Contribution ID: **8** Type: **not specified**

Faster classical sampling from distributions defined by quantum circuits

Saturday, 26 January 2019 11:30 (40 minutes)

The leading candidate task for benchmarking quantum computers against classical computers entails sampling from the output distribution defined by a random quantum circuit. We develop a massively-parallel simulation package that does not require inter-process communication (IPC) or proprietary hardware. We introduce two ways to trade circuit fidelity for computational speedups, so as to match the fidelity of a given quantum computer. Our software achieves massive speedups for the sampling task over prior software from Microsoft, IBM, Alibaba and Google, as well as supercomputer and GPU-based simulations. By using publicly available Google Cloud Computing, we price such simulations and enable comparisons by total cost across hardware platforms. We simulate approximate sampling from the output of a circuit with 7×8 qubits and depth 1+40+1 by producing one million bitstring probabilities with fidelity 0.5 percent, at an estimated cost of
USD 35184. Simulating circuits of depth to 1+48+1 would cost one million dollars.

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Session Classification: Foundations of Quantum Computing

Track Classification: Foundations of quantum computing