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Quantum Supremacy: Checking A Quantum Computer With A Classical Supercomputer

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A key step in the roadmap to build a scientifically or commercially useful quantum computer will be to demonstrate its exponentially growing computing power. I will explain how a 7 by 7 array of superconducting xmon qubits with nearest-neighbor coupling, and with programmable single- and two-qubit gate with errors of about 0.1%, can execute a modest depth quantum computation that fully entangles the 49 qubits. Sampling of the resulting output can be checked against a classical simulation to demonstrate proper operation of the quantum computer and compare its system error rate with predictions. With a computation space of $2^{49} = 5.6 \times 10^{14}$ STATES, THE QUANTUM COMPUTATION CAN ONLY BE CHECKED USING THE BIGGEST SUPERCOMPUTERS. WITH MODEST IMPROVEMENTS IN QUBIT PERFORMANCE, WE PLAN TO DEMONSTRATE THIS EXPERIMENT IN 2017.