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Bit-flip error correction with superconducting Xmon qubits

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One of the outstanding challenges of quantum computation has been the realization of scalable qubits with high fidelity for all necessary operations. Here I discuss the design of a linear chain of 9 superconducting Xmon qubits that allows initialization, single and two qubit gates, and fast repetitive and simultaneous measurement with fidelity in the 99%-99.9% range. This performance has allowed us to perform bit-flip error correction with 8 repetition cycles that leads to improved lifetime of the state. The use of error correction based on the surface code enables all errors, both data and measurement, to be corrected to 1st and 2nd order.