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Quantum learning robust to noise[1] JOHN SMOLIN, ANDREW CROSS, GRAEME SMITH, IBM T J Watson Res Ctr — Noise is often regarded as anathema to quantum computation, but in some settings it can be an unlikely ally. We consider the problem of learning the class of n-bit parity functions by making queries to a quantum example oracle. In the absence of noise, quantum and classical parity learning are easy and almost equally powerful, both information-theoretically and computationally. We show that in the presence of noise this story changes dramatically. Indeed, the classical learning problem is believed to be intractable, while the quantum version remains efficient. Depolarizing the qubits at the oracle's output at any constant nonzero rate does not increase the computational (or query) complexity of quantum learning more than logarithmically. However, the problem of learning from corresponding classical examples is the Learning Parity with Noise (LPN) problem, for which the best known algorithms have superpolynomial complexity. This creates the possibility of observing a quantum advantage with a few hundred noisy qubits. The presence of noise is essential for creating this quantum-classical separation.

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