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Quantum Error Correction

As logic circuits become smaller and smaller, it makes sense to consider what happens once they become so small they start to behave according to quantum mechanics. What we get is a quantum computer, for which the state can be described as a vector in a finite-dimensional Hilbert space. Quantum computers offer the possibility of some dramatic computational speedups, the most famous being Shor's factoring algorithm. However, quantum states are very delicate, and we won't be able to realize the benefits of quantum computation without a way to correct errors. I will describe how to create quantum error-correcting codes which can protect even very large quantum states against noise and decoherence. The key to understanding a quantum error-correcting code lies in the stabilizer, a finite group encapsulating many of the symmetries of the code.