QUANTUM COMPUTERS

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A quantum computer is any device for computation that makes direct use of distinctively quantum mechanical phenomena, such as superposition and entanglement, to perform operations on data. In a classical (or conventional) computer, information is stored as bits; in a quantum computer, it is stored as qubits (quantum bits). The basic principle of quantum computation is that the quantum properties can be used to represent and structure data, and that quantum mechanisms can be devised and built to perform operations with this data. A classical computer has a memory made up of bits, where each bit holds either a one or a zero. A quantum computer maintains a sequence of qubits. A single qubit can hold a one, a zero, or, crucially, a quantum superposition of these, allowing for an infinite number of states. A quantum computer operates by manipulating those qubits with quantum logic gates. An example of an implementation of qubits for a quantum computer could start with the use of particles with two spin states: "up" and "down" .But in fact any system possessing an observable quantity A which is conserved under time evolution and such that A has at least two discrete and sufficiently spaced consecutive eigenvalues, is a suitable candidate for implementing a qubit. This is true because any such system can be mapped onto an effective spin-1/2. Although quantum computing is still in its infancy, experiments have been carried out in which quantum computational operations were executed on a very small number of qubits. Research in both theoretical and practical areas continues at a frantic pace, and many national government and military funding agencies support quantum computing research to develop quantum computers for both civilian and national security purposes, such as cryptanalysis. If large-scale quantum computers can be built, they will be able to solve certain problems much faster than any of our current classical computers (as Shor's algorithm). Quantum computers are different from other computers such as DNA computers and traditional computers based on transistors. Some computing architectures such as optical computers may use classical superposition of electromagnetic waves, but without some specifically quantum mechanical resources such as entanglement, hey have less potential for computational speed-up than quantum computers.

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