Video Transcription and Summary

Transcription:

A quantum computer is a computer that exploits quantum mechanical phenomena. On small scales, physical matter exhibits properties of both particles and waves, and quantum computing takes advantage of this behavior using specialized hardware. Classical physics cannot explain the operation of these quantum devices, and a scalable quantum computer could perform some calculations exponentially faster[a] than any modern "classical" computer. Theoretically a large-scale quantum computer could break some widely used encryption schemes and aid physicists in performing physical simulations; however, the current state of the art is largely experimental and impractical, with several obstacles to useful applications.

The basic unit of information in quantum computing, the qubit (or "quantum bit"), serves the same function as the bit in classical computing. However, unlike a classical bit, which can be in one of two states (a binary), a qubit can exist in a superposition of its two "basis" states, a state that is in an abstract sense "between" the two basis states. When measuring a qubit, the result is a probabilistic output of a classical bit. If a quantum computer manipulates the qubit in a particular way, wave interference effects can amplify the desired measurement results. The design of quantum algorithms involves creating procedures that allow a quantum computer to perform calculations efficiently and quickly.

Quantum computers are not yet practical for real-world applications. Physically engineering high-quality qubits has proven to be challenging. If a physical qubit is not sufficiently isolated from its environment, it suffers from quantum decoherence, introducing noise into calculations. National governments have invested heavily in experimental research aimed at developing scalable qubits with longer coherence times and lower error rates. Example implementations include superconductors (which isolate an electrical current by eliminating electrical resistance) and ion traps (which confine a single atomic particle using electromagnetic fields).

In principle, a classical computer can solve the same computational problems as a quantum computer, given enough time. Quantum advantage comes in the form of time complexity rather than computability, and quantum complexity theory shows that some quantum algorithms are exponentially more efficient than the best-known classical algorithms. A large-scale quantum computer could in theory solve computational problems that are not solvable within a reasonable timeframe for a classical computer. This concept of additional ability has been called "quantum supremacy". While such claims have drawn significant attention to the discipline, near-term practical use cases remain limited.

Summary:

A quantum computer is a computer that exploits quantum mechanical phenomena. A large-scale quantum computer could break some widely used encryption schemes. The current state of the art is largely experimental and impractical, with several obstacles to useful applications. Quantum computers are not yet practical for real-world applications. When measuring a qubit, the result is a probabilistic output of a classical bit. National governments have invested heavily in experimental research aimed at developing scalable qubits. In principle, a classical computer can solve the same computational problems as a quantum computer, given enough time. Quantum advantage comes in the form of time complexity rather than computability. Some quantum algorithms are exponentially more efficient than the best-known classical algorithms.