Quantum computing is an emergent field of cutting-edge computer science harnessing the unique qualities of quantum mechanics to solve problems beyond the ability of even the most powerful classical computers.

The field of quantum computing contains a range of disciplines, including quantum hardware and quantum algorithms. While still in development, quantum technology will soon be able to solve complex problems that supercomputers can’t solve, or can’t solve fast enough.

By taking advantage of quantum physics, fully realized quantum computers would be able to process massively complicated problems at orders of magnitude faster than modern machines. For a quantum computer, challenges that might take a classical computer thousands of years to complete might be reduced to a matter of minutes.

The study of subatomic particles, also known as quantum mechanics, reveals unique and fundamental natural principles. Quantum computers harness these fundamental phenomena to compute probabilistically and quantum mechanically.

**Four key principles of quantum mechanics**

Understanding quantum computing requires understanding these four key principles of quantum mechanics:

* **Superposition:** Superposition is the state in which a quantum particle or system can represent not just one possibility, but a combination of multiple possibilities.
* **Entanglement:** Entanglement is the process in which multiple quantum particles become correlated more strongly than regular probability allows.
* **Decoherence:** Decoherence is the process in which quantum particles and systems can decay, collapse or change, converting into single states measurable by classical physics.
* **Interference:** Interference is the phenomenon in which entangled quantum states can interact and produce more and less likely probabilities.

**Qubits**

While classical computers rely on binary bits (zeros and ones) to store and process data, quantum computers can encode even more data at once using [quantum bits, or qubits](https://www.ibm.com/topics/qubit), in superposition.

A qubit can behave like a bit and store either a zero or a one, but it can also be a weighted combination of zero and one at the same time. When combined, qubits in superposition can scale exponentially. Two qubits can compute with four pieces of information, three can compute with eight, and four can compute with sixteen.

However, each qubit can only output a single bit of information at the end of the computation. Quantum algorithms work by storing and manipulating information in a way inaccessible to classical computers, which can provide speedups for certain problems.

As silicon chip and superconductor development has scaled over the years, it is distinctly possible that we might soon reach a material limit on the computing power of classical computers. Quantum computing could provide a path forward for certain important problems.

With leading institutions such as IBM, Microsoft, Google and Amazon joining eager startups such as Rigetti and Ionq in investing heavily in this exciting new technology, quantum computing is estimated to become a USD 1.3 trillion industry by 2035.[1](https://www.ibm.com/topics/quantum-computing#1)