

Quantum Computing



A
glimpse
of
Future

Race
to
Progress



People Infinia

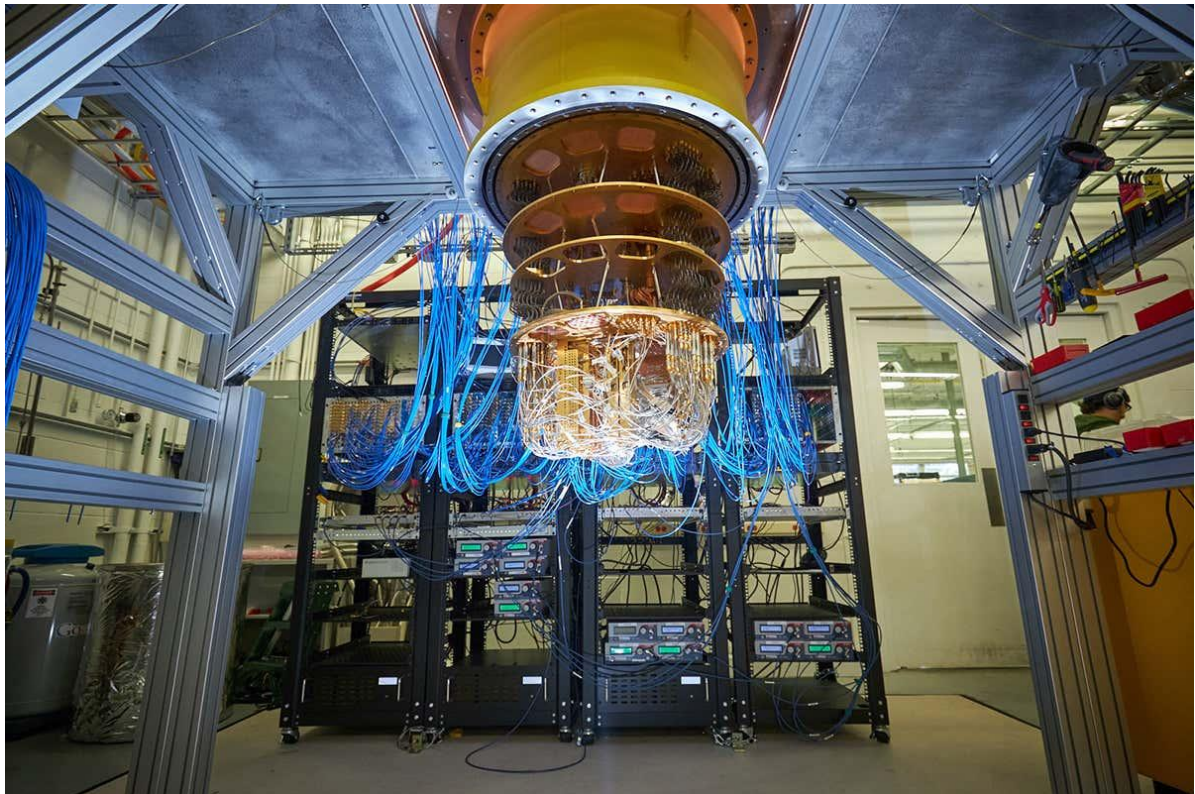
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What is quantum computing, and how does it work?

Quantum computing is a new technology that uses quantum physics to address issues that are too difficult for traditional computers to solve.

Thousands of developers now have access to IBM Quantum's true quantum hardware, which scientists just began to envisage three decades ago. At regular intervals, our engineers deploy ever-more powerful superconducting quantum computers, bringing us closer to the quantum computing speed and capacity required to revolutionise the world.

These devices are not like the traditional computers that have been around for almost half a century. Here's a crash course on this game-changing technology.



Leading companies are looking towards quantum computing, artificial intelligence, and blockchain as drivers for business transformation and intelligent change.

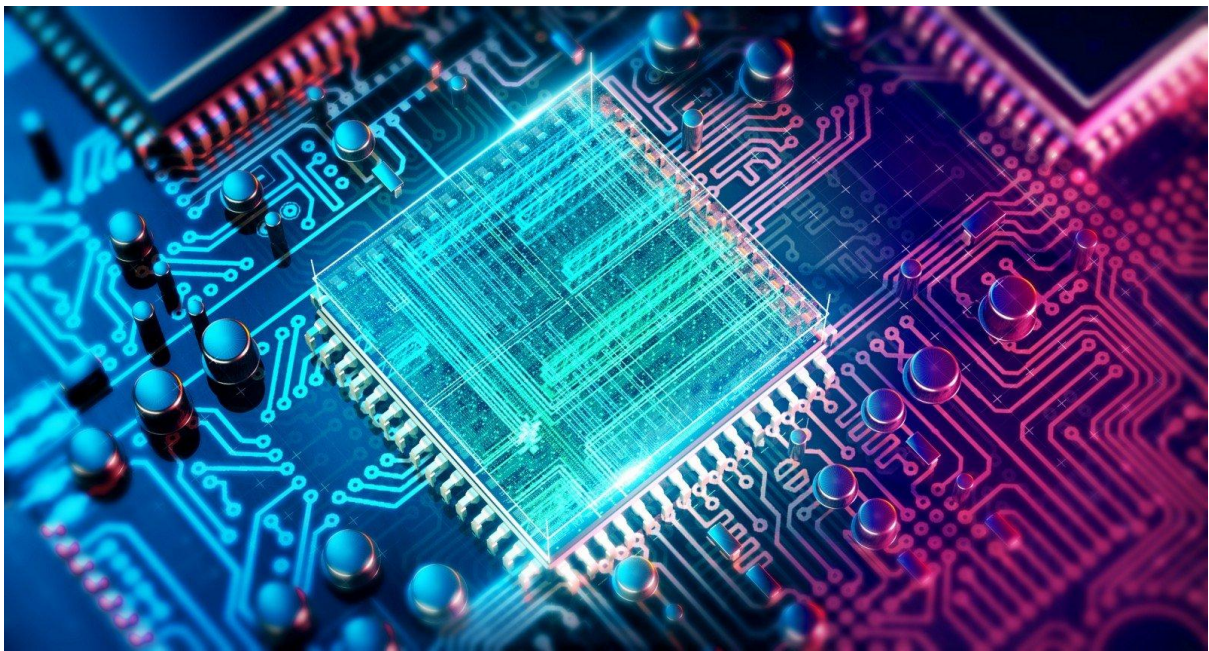
Traditional and supercomputers are unable to provide the simulations required to further enhance and deliver new developments to these industries, so quantum computing has the potential to address the computational needs of modern technological industry development in areas such as drug development and manufacturing.

Over 60 nations have created national AI plans and policies to encourage AI development and research, as well as to investigate the use of AI to mitigate risk.

In addition, blockchain-based distributed ledger technologies are assisting in the security of data and transactions in industries like as banking, government, energy, and transportation.

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Quantum computing, AI, and blockchain are all inherently linked since quantum computing will help offer new levels of processing power and efficiency to industrial solutions as data growth and accumulation increases. According to Gartner, by the end of 2024, roughly 75% of organisations will have operationalized AI, resulting in a 5x increase in streaming data and analytics infrastructures.



Why are quantum computers more efficient?



Consider the following scenario to see how quantum computers can thrive where traditional computers fail:

A supercomputer may be particularly useful for challenging tasks such as sifting through a large database of protein sequences. However, it will have difficulty detecting the small patterns in the data that affect how proteins act.

Proteins are lengthy chains of amino acids that fold into complicated forms to create helpful biological machineries. The difficulty of predicting how proteins will fold has major significance in biology and medicine.

A traditional supercomputer could try to fold a protein by brute force, using its numerous processors to check every potential method of bending the chemical chain before coming up with a solution. The supercomputer, however, stops as the protein sequences become longer and more complicated. A 100-amino-acid chain may hypothetically fold in any of billions of different ways. No computer has enough working memory to process all the conceivable fold combinations.

Quantum algorithms use a novel approach to solving these types of difficult issues by generating multidimensional spaces in which patterns linking individual data points emerge. In the case of a protein folding problem, such pattern may be the folds that need the least amount of energy to generate. The solution to the problem is that combination of folds.

Because traditional computers are unable to build new computational regions, they are unable to detect these patterns. In the case of proteins, there are already early quantum algorithms that can uncover folding patterns in whole new, more efficient ways, without the time-consuming checks that conventional computers require. As quantum technology improves and these algorithms improve, they may be able to solve protein folding issues that are too difficult for any supercomputer to solve.

How supercomputers are befuddled by complexity

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Complexity is embedded into quantum computers.

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What are quantum computers and how do they work?



Quantum computers are more elegant than supercomputers, as they are smaller and use less energy. An IBM Quantum processor is a wafer that's about the size of a laptops. A quantum

hardware system is around the size of a vehicle, with most of its components consisting of cooling devices to keep the superconducting processor at its ultra-low operating temperature.

Bits are used to conduct operations in a traditional processor. Qubits (CUE-bits) are used in quantum computers to conduct multidimensional quantum algorithms.

Superfluids

A fan is most usually used to keep your desktop computer cool enough to function. Our quantum processors must be extremely cold, around a tenth of a degree above absolute zero. To do so, we make superconductors using super-cooled superfluids.

Superconductors

Certain materials in our processors demonstrate another significant quantum mechanical feature at such ultra-low temperatures: electrons pass through them without resistance. As a result, they are referred to as "superconductors." When electrons flow through superconductors, they generate "Cooper pairs," which are pairs of electrons that match up. Quantum tunnelling is a method that allows these couples to transfer a charge over barriers or insulators. A Josephson junction is formed by two superconductors arranged on opposite sides of an insulator.

Control

As superconducting qubits, Josephson junctions are used in our quantum computers. We can regulate the behaviour of these qubits and get them to keep, modify, and read out individual units of quantum information by shooting microwave photons at them.

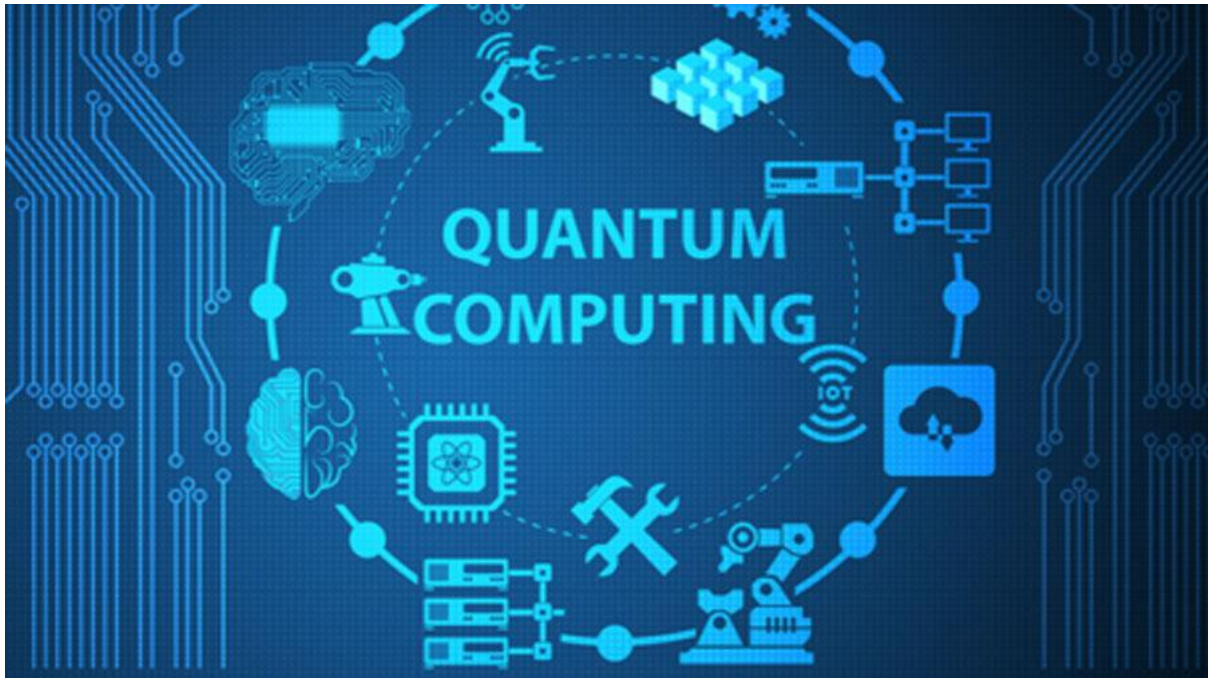
Superposition

A qubit isn't particularly helpful on its own. It can, however, perform a crucial trick by putting the quantum information it contains in a state of superposition, which represents a combination of all conceivable qubit configurations. Complex, multidimensional computing landscapes can be created by groups of qubits in superposition. In these settings, complex issues may be expressed in novel ways.

Entanglement

Entanglement is a quantum mechanical phenomenon in which the behaviour of two independent objects is linked. Changes to one qubit have a direct influence on the other when two qubits are entangled. Quantum algorithms take advantage of these connections to solve difficult issues.

What is the purpose of quantum computers?



Supercomputers aren't perfect for all issues.

Supercomputers are used by scientists and engineers to solve difficult problems. These are very powerful traditional computers with thousands of CPU and GPU cores. Even supercomputers, however, have difficulty solving some issues.

If a supercomputer becomes stumped, it's most likely because it was asked to handle a problem with a high level of complexity. When traditional computers fail, it's frequently due to their complexity.

Complex issues are those that include many variables interacting in complex ways. Because of all the various electrons interacting with one another, modelling the behaviour of individual atoms in a molecule is a difficult task. It's also difficult to figure out the best routes for a few hundred tankers in a worldwide shipping network.