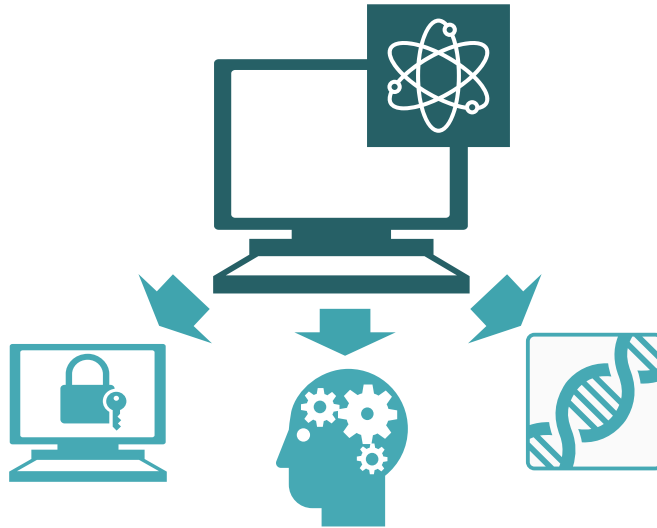


Evolution of society using “quantum” computers

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Imagine a computer that can solve complex problems in seconds, problems that would take today's fastest supercomputers thousands of years to crack. This is not science fiction—this is the promise of quantum computing. As we stand on the brink of a technological revolution, quantum computers hold the potential to transform our world in ways we are only beginning to understand, allowing us to tackle complex challenges in fields like medicine, cryptography, and artificial intelligence.

One of the most exciting open questions in the field of quantum computing is how we can create and maintain "quantum supremacy." This term refers to the point where quantum computers can solve problems that classical computers cannot. So, how can we achieve quantum supremacy? To do this, quantum computers utilize the strange principles that manifest at the nanoscale, known as "quantum mechanics." The most representative of these are "quantum superposition" and "quantum entanglement."

First, let me explain quantum superposition. In a classical computer, information is processed in units called "bits," and a bit can only be in one of two states, either 0 or 1. However, quantum computers use "quantum bits" or "qubits." A qubit can be in both the 0 and 1 states simultaneously. This condition is called quantum superposition. For example, consider a coin. Normally, you would see the coin as either a head (0) or tail (1). But in a quantum superposition, imagine the coin spinning. At that moment, the coin is in a state of being both heads and tails simultaneously. This allows quantum computers to perform many calculations at once.

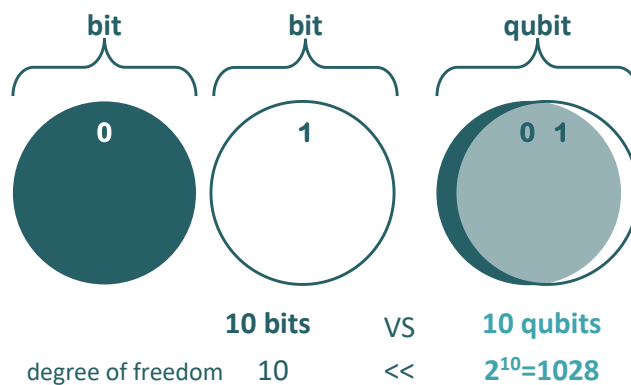


Fig1. The comparison of bits and qubits

Next, let me explain "quantum entanglement." Quantum entanglement is a state where two or more qubits are very strongly linked together. This linkage means that changing the state of one qubit will instantly change the state of the other qubit, regardless of the distance between them. For example, consider two coins. If these two coins are in a state of quantum entanglement, then as soon as you determine whether coin A is heads or tails, the state of coin B will also be determined. In other words, observing coin A instantly reveals the state of coin B. In quantum computers, this entangled qubit property allows for extremely fast information processing.

By effectively utilizing these concepts, quantum computers can solve problems that are extremely difficult for classical computers with remarkable efficiency.

However, this is no easy task. Quantum systems are incredibly delicate, and even the slightest disturbance can cause errors. Scientists around the world are working tirelessly to overcome these hurdles, developing new methods to build more stable and reliable quantum computers.

My journey into the world of quantum computing was sparked by a deep curiosity about the fundamental laws of nature. As a child, I was always fascinated by the mysteries of the universe—how things worked, from the tiniest particles to the vastness of space. This curiosity led me to study physics, where I discovered the incredible potential of quantum mechanics. The idea that particles could exist in multiple states at once, or that they could be entangled across vast distances, was mind-blowing. But what truly captivated me was the realization that these strange phenomena could be harnessed to solve real-world problems. Quantum computing has the potential to revolutionize industries, from pharmaceuticals to finance, by solving problems that are currently beyond our reach. The possibility of contributing to such groundbreaking advancements was irresistible.

Quantum computer development is often compared to mountain climbing. If reaching the summit represents completion, we are currently still at the first or second station, just at the very beginning of the ascent. However, in the next 10 to 20 years, I believe quantum computing will revolutionize various fields, including medicine, materials science, and cryptography. For example, in medicine, quantum computers could analyze vast amounts of genetic data to develop personalized treatments for diseases like cancer. This would not only improve treatment outcomes but also reduce

side effects by tailoring therapies to individual patients' genetic profiles. In materials science, quantum computing could lead to the discovery of new materials with extraordinary properties, such as superconductors that work at room temperature. This could transform energy storage and transmission, leading to more efficient power grids and reducing our reliance on fossil fuels. Moreover, quantum computing could revolutionize artificial intelligence, making it possible to develop more sophisticated algorithms that can learn and adapt in ways that current AI cannot. This could lead to smarter and more autonomous systems, from self-driving cars to intelligent personal assistants, transforming our daily lives and how we interact with technology.

In conclusion, the field of quantum computing is a beacon of hope and possibility. It promises to unlock new frontiers in science and technology, addressing some of the most pressing challenges of our time. My journey into this field was driven by deep curiosity and a desire to make a difference. I am confident that the advancements we achieve in quantum computing will transform industries and inspire future generations to explore the wonders of science. For young students today, the message is clear: the future is yours to shape, and with the power of quantum computing, the possibilities are limitless.

acknowledgement

I thank Dr. Kate Harris and Mr. Meng LYU for the careful proofreading of the manuscript

Tools

- **DeepL:** To find better English expressions
- **Grammarly:** To check the spelling and grammar
- **draw.io:** To create figures