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Finally Understanding Quantum Computing: And Why It Matters for the Future of Big Data

Quantum computers promise to tackle computational problems that classical systems struggle with, particularly in processing and analyzing the enormous datasets that define our big data era.

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Introduction

Imagine you are trying to find a single specific grain of sand on a massive beach. If you were a traditional computer, you will be acting very fast and checking each grain at a time. It's undoubtedly very quick as compared to if you were acting as a human trying to find it. But the Beach is very huge. The world today is just like a huge beach which has so much massive amounts of Big data both stocked and actively being generated every second from your netflix history to someone's hospital records. It is so big that even the fastest supercomputers have started to feel slow to manage this much big data.

Now this is exactly where quantum computing comes into the frame. If while finding that specific grain, you were able to act like quantum computer, instead of checking each grain one by one, rather you would have seen the whole beach at once. This is exactly what Quantum Computing is compared to Classical Computing.

Also in Pakistan, the struggle to achieve the benefits of this latest technology practically has already started. In February 2026, the National Centre for Physics hosted the Pakistan's first Quantum computing Hackathon in Islamabad in which 950+ individuals applied and from which 42 top finalists were selected to form 7 teams[1]. The first prize of Rs. 800,000 was awarded to a LUMS-led team for developing a quantum algorithm for early tuberculosis detection[2].

"Quantum computing isn't just about speed; it's about solving the 'impossible' problems that classical computers simply can't handle."

Technology Overview

To understand the working of a Quantum computer, we have to understand its building block which is **"Qubit"**. In classical computers like the laptop you might be reading this on, the building block is a **"bit"** which is just like a light switch, either ON or OFF. It is in single state only whereas the Qubit behaves differently and follows some strange laws of Quantum Physics. Let's have a look what these are...

Let's say you have a coin and you spin it on the table. While spinning, it is not "Heads" or "Tails". It's just blur of



both at the same time. This process is called **Superposition**. It means that one thing is representing both states at the same time. Unlike bit which is either 0 or 1 at a time, a Qubit follows the principle of Superposition enabling it to have both states of 0 and 1 at the same time. Thus a Quantum Computer can explore Millions of paths at the same time as compared to the classical computer which explore them one by one. [3]

Okay so the other thing which I personally call the "Main Superpower" of Quantum computing is the process of Entanglement between Qubits. To understand this process of Entanglement, imagine two magic dice. One is with you in Faisalabad and the 2nd is with your friend in Lahore or maybe Karachi. Irrespective of Distance, if you roll a '6' on your dice, the 2nd dice with your friend will also turn into a '6'. We can call this an instant magical connection. This instant connection between Qubits allow them to work together as a perfectly coordinated team enabling computers to find patterns in massive amounts of big data[3].

In simplest words, a Quantum Computer clears the "Traffic Jams" of data to be processed in order to be converted into useful insights.

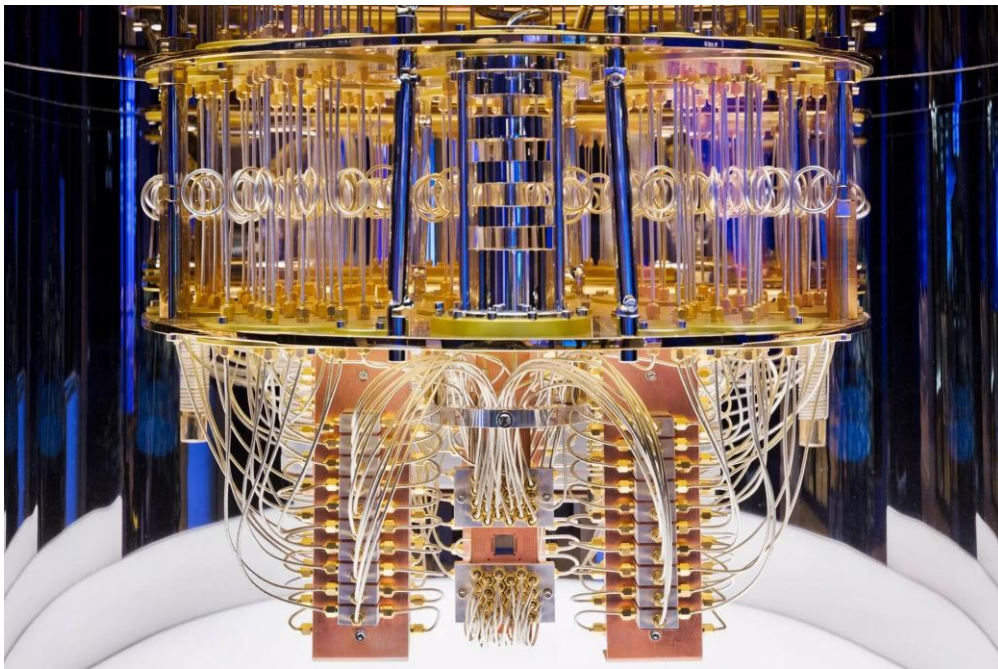


Figure 1: Cleveland Clinic and IBM Unveil First Quantum Computer Dedicated to Healthcare Research. Credits: Cleveland Clinic

Key Findings & Impact

In the past, the biggest problem with Quantum Computing was "Noise" which means errors that made calculations done by a Quantum Computer unreliable. However, Google's **Willow chip** recently made huge calculations with minimum errors which made a turning point proving that we can scale up the qubits while actually reducing the errors[3]. Basically it means that up until now quantum computing technology was only an experimental tool but now we can clearly say that Quantum Computers are reliable tools for fastest processing ever done with minimum errors.



The good thing is that Google is not alone in this race. **IBM** has recently updated its roadmap. It projects that they will hit the “**Quantum Advantage**” by the end of 2026[4]. **Quantum Advantage** is a point where Quantum systems will officially outperform the classical systems for specific business tasks.

Microsoft has also been exploring “**Hybrid Computing**” where Quantum Processors work alongside the AI that is already being used to model complex molecules for new medicines. And you know what, this process used to take years but now it can be simulated in days[5].

Advancements in Quantum technology globally has also massive local implications. Right here in Pakistan, students at the National Center for Physics (NCP) recently created a shortcut for diagnosing diseases like TB in record time using quantum technology[2].

Quantum Technology has also generated severe security threats. Due to high processing power and usage of principles like superposition and entanglement, quantum computers are capable of breaking current encryption methods like RSA and ECC which protect everything from banking transactions to government communications to yours and mine identities, passwords, social logins etc... Some hackers with smart brains are using “Harvest now, Decrypt later” strategy which means that they are intercepting to store the encrypted data as it is for now and when the Quantum technology gets mature enough, they are gonna use it to decrypt the saved encrypted data[6]

Quantum Computing is on the track to create massive economical value as well. Financial experts estimate that quantum computing could become somewhere between \$1.3 trillion- \$2.7 trillion industry by 2035[7]. It is already \$2 billion market right now[8].

What's Next?

Well, up until recently the quantum technology was just a “scientific discovery”, but at the current pace of R&D in this domain, it will become a “practical utility” in the next two to five years. An interesting thing to note is that the bigger tech giants are no longer competing for more qubits, but for better and efficient ones. By late 2026, the industry expects to deploy modular quantum processors that can be linked together literally like LEGO bricks which will allow business to scale up or down the computing power as per their data needs[9].

For our dear Pakistan, the most immediate shift will be in **Quantum Security**. As the quantum systems have been capable of breaking the currently used encryption methods, the government of Pakistan has already started to explore the **Post Quantum Cryptography (PQC)** to secure the country's digital assets as soon as possible[10]. In this regard, government has launched a specific project named “**Quantum Communications**” which is an initiative under the bigger vision of **Uraan Pakistan**[11].

About the Author

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