Quantum leap in computing as Google claims 'supremacy' (Update)

October 23 2019, by Patrick Galey

Google's quantum supreme cryostat with Sycamore inside Photo Credit: Eric Lucero/Google, Inc.

Scientists claimed Wednesday to have achieved a near-mythical state of computing in which a new generation of machine vastly outperforms the world's fastest super-computer, known as "quantum supremacy".

A team of experts working on Google's Sycamore machine said their quantum system had executed a calculation in 200 seconds that would have taken a classic computer 10,000 years to complete.

A rival team at IBM has already expressed scepticism about their claim.

But if verified and harnessed, the Google device could make even the world's most powerful supercomputers—capable of performing thousands of trillions of calculations per second—look like an early 2000s flip-phone.

Regular computers, even the fastest, function in binary fashion: they carry out tasks using tiny fragments of data known as bits that are only ever either 1 or 0.

But fragments of data on a quantum computer, known as qubits, can be both 1 and 0 at the same time.

This property, known as superposition, means a quantum computer, made up of several qubits, can crunch an enormous number of potential outcomes simultaneously.

The computer harnesses some of the most mind-boggling aspects of quantum mechanics, including a phenomenon known as "entanglement"—in which two members of a pair of bits can exist in a single state, even if far apart.

Adding extra qubits therefore leads to an exponential boost in processing power.

In a study published in *Nature*, the international team designed the Sycamore quantum processer, made up of 54 qubits interconnected in a lattice pattern.

They used the machine to perform a task related to random-number generation, identifying patterns amid seemingly random spools of figures.

The Sycamore, just a few millimetres across, solved the task within 200 seconds, a process that on a regular machine would take 10,000 years—several hundreds of millions of times faster, in other words.

Google's CEO Sundar Pichai hailed the result as a sea change in computing.

"For those of us working in science and technology, it's the 'hello world' moment we've been waiting for—the most meaningful milestone to date in the quest to make quantum computing a reality," he wrote in a blog post.

John Martinis, from Google AI and a study author, told journalists his colleagues were "excited we can start talking" about their discovery.

"The physics was right... Physicists thought this would work, they had faith in quantum physics... and tech companies now will see that this technology is much closer than they thought," he said.

Not so fast?

Colleague Sergio Boixo described the discovery as "mind-blowing".

The quest for quantum supremacy is still far from over, however. The authors themselves acknowledge the need for better hardware and more

sophisticated monitoring techniques in order to truly harness the power of quantum.

Some immediate applications of quantum computing could be in encryption software and AI, but its calculations could eventually lead to more efficient solar panels, drug design and even smarter and better financial transactions.

Wednesday's announcement was not without controversy.

After a leaked draft of the Google lab's paper appeared online last month, chip-maker IBM, which runs its own quantum computing programme, said the boasts of the Sycamore computer's feats were exaggerated.

Instead of 10,000 years for an ordinary supercomputer to match Sycamore's performance, IBM scientists claimed it would be more like two-and-a-half days using the most sophisticated traditional processors.

"Because the original meaning of the term 'quantum supremacy'... was to describe the point where quantum computers can do things that classical computers can't, this threshold has not been met," they wrote on their blog.

More information: Quantum supremacy using a programmable superconducting processor, *Nature* (2019). DOI: 10.1038/s41586-019-1666-5 , nature.com/articles/s41586-019-1666-5