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Intel Editorial: The Race to Commercially-Viable Quantum Computing Is a Marathon, Not a Sprint

Recent Findings Should be Celebrated, but Practical Realities are the Real Test

SANTA CLARA, Calif.--(BUSINESS WIRE)-- The following is an opinion editorial from Rich Uhlig of Intel Corporation.

This press release features multimedia. View the full release here: https://www.businesswire.com/news/home/20191023005699/en/

Rich Uhlig is an Intel senior fellow, vice president of the Technology, Systems Architecture & Client Group, and managing director of Intel Labs. (Credit: Intel Corporation)

Quantum computing receives a lot of attention due to its potential to take on problems beyond the reach of today's computers, such as new drug discovery, financial modeling and exploring how the universe works.

Universities, governments and technology companies around the world are striving to achieve a commercially-viable quantum computing system. While the collective progress is real – and is getting noticed – the field is still at mile one of what will be a marathon toward quantum computing's commercialization.

That said, important milestones along this journey should be recognized, celebrated and built upon.

More Promising Results

As researchers at Intel and across the globe are discovering, quantum computing has the potential to tackle problems that conventional computing – even the world's most powerful supercomputers – can't quite handle.

Today, it was confirmed that researchers from Google had demonstrated the extraordinary speed of quantum, as compared to traditional supercomputers, with a benchmark test known as "quantum supremacy." The Google team designed an algorithm that could run an analysis in 200 seconds on a small quantum processor, a 53-qubit superconducting test chip, that would take the most powerful supercomputer approximately 10,000 years to perform.

For this demonstration, we congratulate the team at Google.

The Road to Commercial Relevance

Bolstered by this exciting news, we should now turn our attention to the steps it will take to build a system that will enable us to address intractable challenges — in other words, to demonstrate "quantum practicality." To get a sense of what it would take to achieve quantum practicality, Intel researchers used our high-performance quantum simulator to predict the point at which a quantum computer could outpace a supercomputer in solving an optimization problem called Max-Cut. We chose Max-Cut as a test case because it is widely used in everything from traffic management to electronic design, and because it is an algorithm that gets exponentially more complicated as the number of variables increases.

In our study, we compared a noise-tolerant quantum algorithm with a state-of-the-art classical algorithm on a range of Max-Cut problems of increasing size. After extensive simulations, our research suggests it will take at least hundreds, if not thousands, of qubits working reliably before quantum computers will be able to solve practical problems faster than supercomputers.

In other words, it may be years before the industry can develop a functional quantum processor of this size, so there is still work to be done.

At Intel, we work with our partners and the research community to speed advancement across the complete quantum computing stack so every mile marker passed in this marathon will bring us closer to true quantum practicality.

We're very excited about our progress in advancing a technology known as spin qubits in silicon. We believe spin qubits have a major scaling advantage over superconducting qubits, because they are much smaller than their counterparts.

In fact, spin qubits resemble a single electron transistor, a technology Intel has spent the past 50 years manufacturing. Because of this resemblance, we were able to take our learnings from transistor manufacturing and apply it at scale to quantum computing research. Today, we're manufacturing spin qubits on 300 mm silicon wafers in the same facilities and with the same processes that we use to produce our state-of-the-art Intel processors. And, to further speed our research and feedback cycles, we have designed a new tool, called the cryoprober (Cryogenic Wafer Prober), to test and characterize these 300mm silicon spin qubit wafers at scale.

As these discoveries and ongoing research demonstrate, quantum computing will be a transformational technology. However, we will continue to overcome many challenges – and pass many mile markers – on this incredible journey of discovery before this technology will change your life or mine.

So, let's applaud this scientific moment and the researchers, and set our sights on what we will achieve at the finish line much further down the road: quantum practicality.

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More: Intel Quantum Computing Press Kit | Intel's 49 Qubit Processor | Quantum Cryogenic Wafer Prober (Cryoprober)

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