THE COMING QUANTUM LEAP IN COMPUTING

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PUBLISHED ON
MAY 30, 2018

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Moore's Law goes bonkers, the potential is huge, but the hurdles remain high. When will quantum computing make its mark on business? Quite sooner than you think, and in ways far better than most people expect.

Quantum computing is not a replacement for the binary classical computing by a factor or two, but a quantum leap. Quantum computers can tackle certain problems, because quantum computers are quantum physics to simulate the physical world. Quantum physics that today's computers will never be able to simulate.

Not exclusively under this perspective, but the most promising one is simulating physical systems has immediate practical implications in pharmaceuticals, chemicals, and energy. Algorithms using quantum mechanics can be run on classical computers, but also on neuromorphic computers, or on quantum computers, and machine learning, in the future, hybrid systems consisting of classical computers and quantum computers in sentence will solve problems that are intractable today.

THE USE OF QUANTUM COMPUTERS TO MODEL PHYSICAL SYSTEMS HAS IMMEDIATE PRACTICAL IMPLICATIONS IN PHARMACEUTICAL, CHEMICAL, AND ENERGY

We expect quantum computing to develop toward maturity over three generations (generally the 5 year-ish time horizon) starting with very powerful machines to address practical business and R&D needs such as modeling of molecules for pharmaceuticals, chemicals, and energy applications (the "quantum chemistry" problem). While finding this potential, however, will be possible only when the technology can produce the number of "logical" qubits needed, which is quite a "ginormous" value calculation.

Today's is long ago as a quantum computer consists mostly about 100 logical qubits, each of which consists of attributes from ten to thousands of physical qubits. Quantum Supremacy, the demonstration of a problem that only the Powerful of the California Institute of Technology can solve, is the 2019 year, today's quantum processors use noisy physical qubits with error correction, and quantum algorithms that will be first should be coupled to a weighing more to some capable technologies, their primary use cases will be optimization problems, machine learning, and quantum simulation and applications will be in the cloud. Quantum computers, from complementary metrics to measure quantum processing's progress as "quantum volume" to the quantum "Kingdom" (quantum, classical, probabilistic, post-neumann) of a quantum computer's processing capabilities and quantum "Queen" (the quantum computer itself).

Bright physics per se, the real-world applications, and quantum processor and a simulator that can simulate up to 49 qubits, Google's Bristlecone processor, and the Chinese 50-qubit processor chip, a Tripartite processor. Other big tech companies and research institutions, including Intel, Microsoft, IBM, and Rigetti, are also in the race.

Here we offer a guide for business executives can think about quantum computing, quantum computing's value, the hurdles that should be overcome for development, several high-potential early applications, the current state of the technology and quantum computing's ecosystem, and what companies can take now to prepare for the advent of quantum computing.

THE QUBITS ARE COMING

Today we can primary programmers to practical business applications for quantum computing processors with enough qubits to run quantum algorithms that are beyond the capabilities of classical computers, and algorithms underlying the applications are in the business domain, fields such as cryptography and machine learning, the future, hybrid systems consisting of classical computers and quantum computers in sentence will solve problems that are intractable today.

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QUANTUM COMPUTERS WILL PROVIDE SOLUTIONS TO A PLURALITY OF PROBLEMS THAT STRETCH THAT COURT WORLD.

Significant Spread Advantage. Because classical computers work with binary bits, they must work through a lot of calculations to solve problems. For example, they have to work through many iterations long numbers into their primes, computers simply have to guess through trial and error. Quantum computers, on the other hand, can do many problems simultaneously with the number of digits. Quantum computers can solve problems exponentially, or thousands of times faster than classical computers, and they can do tasks that don't work. For certain problems, the reduction in time is significant.

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Quantum Simulation. Classical computing approaches solve adequately address problems involving complex operations or networks. For example, some optimization problems are well-suited to classical. Quantum computing methods could offer a speed advantage because quantum computers can simulate the underlying quantum nature of the problem. Quantum simulation is particularly well-suited to the use of near-term quantum computing because it requires fewer qubits than other approaches.

WHEN WILL THE QUBITS ARRIVE?

The technological challenge to achieve a fault-tolerant quantum computer with enough qubits to run meaningful quantum algorithms remains significant. Many of the quantum properties that enable quantum computing are very fragile, and the slightest interference can cause a loss of information. Quantum computers are very sensitive to noise, even to small amounts of heat, vibration, or electromagnetic signals. Many of the hardware challenges are being addressed by a number of companies around the world, but it will be a long time before we have a fault-tolerant quantum computer. Some experts estimate that it will take at least a few more years of research and development before we can expect to see the first fault-tolerant quantum computer with 100 logical qubits. Others are more optimistic, but even they don't expect quantum computers to be commercially available for at least a few years.

SOME APPLICATIONS MAY BE CLOSER THAN YOU THINK

While the bigger potential for quantum computing may be in the years and decade ahead, business leaders should monitor the first generation of developments—particularly those with a near-term horizon. Many experts expect companies to leverage such an chemicals in experiment with quantum computing in the near-term, focusing on applications in the modeling of molecules for pharmaceuticals, chemicals, and energy. Quantum computers are well-suited to simulate the underlying quantum nature of these compounds with large numbers of qubits. Companies can begin to explore how they might use quantum computing in the future, and they can begin to develop a quantum computing strategy. Some companies are already working with quantum computing providers to develop use cases and to experiment with problems that are intractable today.

THE QUANTUM COMPUTING ECOSYSTEM IS ALREADY BEGINNING TO TAKE SHAPE.

Several quantum technologies are racing to reach useful qubit thresholds. Near-term usable qubits are generally understood to be in the tens, slightly inspired by and superimposed. Trapped ions is widely viewed as the most mature approach, with the longest coherence times and high-fidelity gates, and therefore satisfying the quantum volume requirements. Both in time to market for key applications and capital cost. At the end of 2017, researchers reached a new benchmark, demonstrating a fully reconfigured 53 qubits in a photonic chipscaled operation with a logical error rate of 0.1 percent. Superconducting circuits are a leading approach and also and the IC-scale technology. Superconducting circuits have a vertical improvement to error correction; according to Microsoft's Mary Kathleen Horsman, superconducting circuits are the most developed of the three quantum architectures and have the most well-developed software stack.

That said, the need for error corrections is the biggest driver of storage requirements and has an outsized impact on scale and cost. Significant investment in error correction will be required to make the technology scalable to scale and cost-effective enough to be commercially viable. A study in 2016 by Microsoft is pursuing a quantum computing technology that would be inherently more stable than other approaches. Its approach is a leading prototype but its technology is still in the early stages. Its lifetime, trapped ion is well positioned to be first to market, but it will face many of the same challenges in scaling as other approaches.

Once technical feasibility is established, we expect to see Greater quantum portion, similar to the rate of classical computer adoption. Adoption for such applications will depend on the degree of the improvement in performance versus classical methods, the ease of integration into existing workflows, and the cost of quantum computing. Early quantum computing can operate in the mode of platforms-as-a-service, applications in which there is a significant classical component and only hard problems are run on the quantum processor. Quantum computing's ecosystem is in its infancy, but it is developing rapidly. Companies that want to be leaders for key applications and capital cost. At the end of 2017, researchers reached a new benchmark, demonstrating a fully reconfigured 53 qubits in a photonic chipscaled operation with a logical error rate of 0.1 percent. Superconducting circuits are a leading approach and also and the IC-scale technology. Superconducting circuits have a vertical improvement to error correction; according to Microsoft's Mary Kathleen Horsman, superconducting circuits are the most developed of the three quantum architectures and have the most well-developed software stack.

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THE QUANTUM STACK AND ITS BUSINESS MODELS

HOW SHOULD COMPANIES PREPARE FOR A QUANTUM LEAP?

Quantum computing won't be for everybody. But if your company is in a characteristic field or an industry where the ability to solve the problems of complex network functions and interactions is a practical element of your business, it may be time to begin to explore quantum computing. Companies can begin to explore quantum computing in several ways. Start by building quantum computing capabilities. A good first step is to launch an initiative to train and educate your business leaders and technical experts on experience using quantum computing platforms and tools provided by companies such as Google, Microsoft, and Rigetti. Companies can also use quantum computing companies such as Cybertech, QC Ware, and Zapata are working