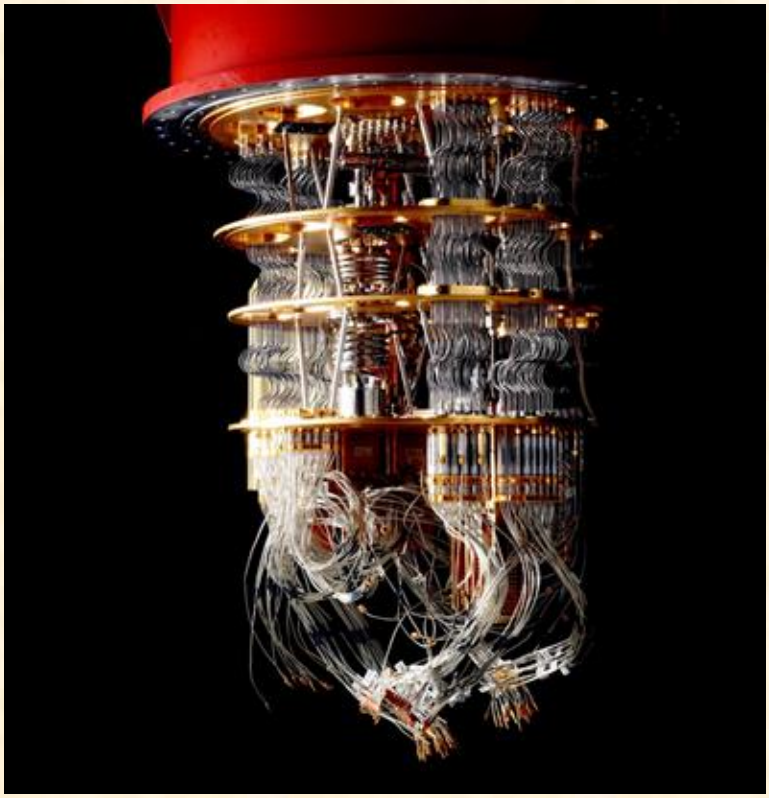
Quantum Computing



Quantum computing is an area of computing focused on developing computer technology based on the principles of quantum theory (which explains the behaviour of energy and material on the atomic and subatomic levels). Computers used today can only encode information in bits that take the value of 1 or 0—restricting their ability.

Quantum computing, on the other hand, uses quantum bits or qubits. It harnesses the unique ability of subatomic particles that allows them to exist in more than one state (i.e., a 1 and a 0 at the same time).

Superposition and entanglement are two features of quantum physics on which these supercomputers are based. This empowers quantum computers to handle operations at speeds exponentially higher than conventional computers and at much lesser energy consumption.

The field of quantum computing started in the 1980s. It was then discovered that certain computational problems could be tackled more efficiently with quantum algorithms than with their classical counterparts.

Quantum computing could contribute greatly in the fields of finance, military affairs and intelligence, drug design and discovery, aerospace designing, utilities (nuclear fusion), polymer design, machine learning and artificial intelligence (AI) and Big Data search, and digital manufacturing.

Its potential and projected market size have engaged some of the most prominent technology companies to work in the field of quantum computing, including IBM, Microsoft, Google, D-Waves Systems, Alibaba, Nokia, Intel, Airbus, HP, Toshiba, Mitsubishi, SK Telecom, NEC, Raytheon, Lockheed Martin, Rigetti, Biogen, Volkswagen, and Amgen.

Quantum computers process information differently. Classical computers use transistors, which are either 1 or 0. Quantum computers use qubits, which can be 1 or 0 at the same time. The number of qubits linked together increases the quantum computing power exponentially. Meanwhile, linking together more transistors only increases power linearly.

Classical computers are best for everyday tasks that need to be completed by a computer. Meanwhile, quantum computers are great for running simulations and data analyses, such as for chemical or drug trials. These computers must be kept ultra-cold, however. They are also much more expensive and difficult to build.

Classical computing advances include adding memory to speed up computers. Meanwhile, quantum computers help solve more complicated problems. While quantum computers might not run Microsoft Word better or faster, they can run complex problems faster.

For example, Google's quantum computer that's in development could help with many processes, such as speed up machine-learning training or help create more energy-efficient batteries.

Quantum computing has a number of other applications, including securely sharing information. Other methods include fighting cancer and various health concerns, such as cancer and developing new drugs. As well, quantum computers can help improve radars and their ability to detect such things as missiles and aircraft. Other areas include the environment and using quantum computing to keep the water clean with chemical sensors.

Google (GOOG) is spending billions of dollars on its plan to build its quantum computer by 2029. The company has opened a campus in California, called Google AI, to help it meet its goal. Google has been investing in this technology for years. As well, so have other companies, such as Honeywell International (HON) and International Business Machine (IBM). IBM expects to hit major quantum computing milestones in the coming years.

While some companies have built personal (although expensive) quantum computers, there is still nothing available on the commercial side. And there's interest in quantum computing and its technology, with JPMorgan Chase and Visa looking into the technology. Once developed, Google could launch a quantum computing service via the cloud.

Companies can also gain access to quantum technology without having to build a quantum computer. IBM plans to have a 1,000-quibit quantum computer in place by 2023. For now, IBM allows access to its machines if they're part of its Quantum Network. Those that are part of the network include research organizations, universities, and laboratories.

Microsoft also offers companies access to quantum technology via the Azure Quantum platform. This is unlike Google, which doesn't sell access to its quantum computers.

-Zhil Vora