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APPROACHING A NEW ERA OF COMPUTING

Abstract. The way quantum computers operate is described. The advantages of quantum computers over conventional computers are presented. The examples of the use of computing devices based on the laws of quantum mechanics are considered.

Keywords: *quantum computing, qubits, commercial quantum computers, computing, superposition, IBM, Google, Summit, new era of computing.*

Introduction. We live in a very productive time. Every year, more and more inventions and technological innovations emerge. They are created to simplify our lives. This is especially true for anything related to computers. Computing is used in all industries and fields. The faster computers solve the technical problems better. Consequently, scientists are constantly perfecting the idea of a quantum computer.

Quantum computers are faster than conventional computers. They can be used, for example, in modeling of the complex biological and chemical processes that occur in organisms and the environment. This might help to bring about a major breakthrough in medicine, chemistry and other natural sciences. Nowadays, pharmaceuticals and technical materials are being developed by trial and error, so it is a laborious and expensive process. Quantum computers will soon be able to change that. They will significantly reduce product development cycles and reduce research and development costs. Quantum computation can also be applied to cryptography and artificial intelligence research. It has opened a new era in cryptography. This type of computer will be commercially distributed by 2025.

Quantum computer uses qubits instead of bits. A qubit (unlike a bit) can be in state $|0\rangle$ and $|1\rangle$, or in a linear combination of both states. This phenomenon is called superposition (bit and qubit are shown in Fig. 1). Therefore, quantum computer is a computing device that uses the phenomena of quantum superposition to transmit and process data.
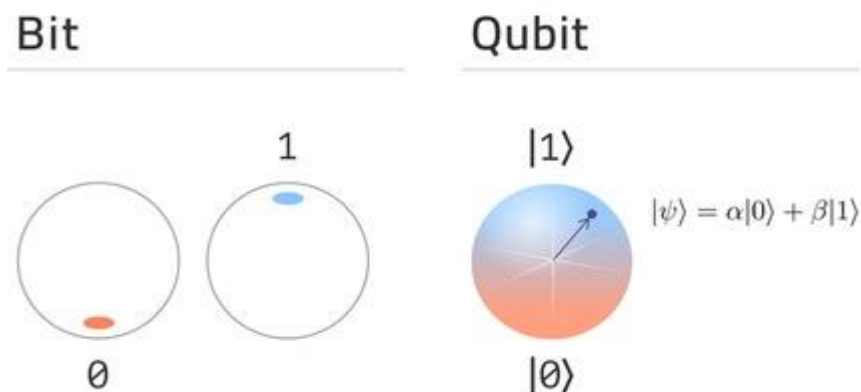

Fig. 1. Qubit and Bit states [4]

Google shared its advances in quantum computing, demonstrating the machine being able to calculate the most difficult task in 3 minutes and 20 seconds, while that would take 10,000 years for the world's fastest supercomputer Summit to solve the task. Therefore, this technology will be able to accelerate the world's progress millions of times.

The idea of quantum computing was first presented in the early 1980s. Then, there were numerous attempts to create a quantum computer, and the first working version was created in the early 2000s. It was not until 2019 that IBM introduced the world's first commercial version of a quantum computer.

The power and speed of computation of a quantum computer directly depends on the number of qubits used by the computer. Fig. 2 shows that over the last 20 years, the number of qubits in quantum computers has increased 64-fold through labor-intensive research by various large companies. Now many firms are working hard to create a personal quantum computer.

20 Years of Quantum Computing Growth

Quantum computing systems produced by organization(s) in qubits, between 1998 to 2019*

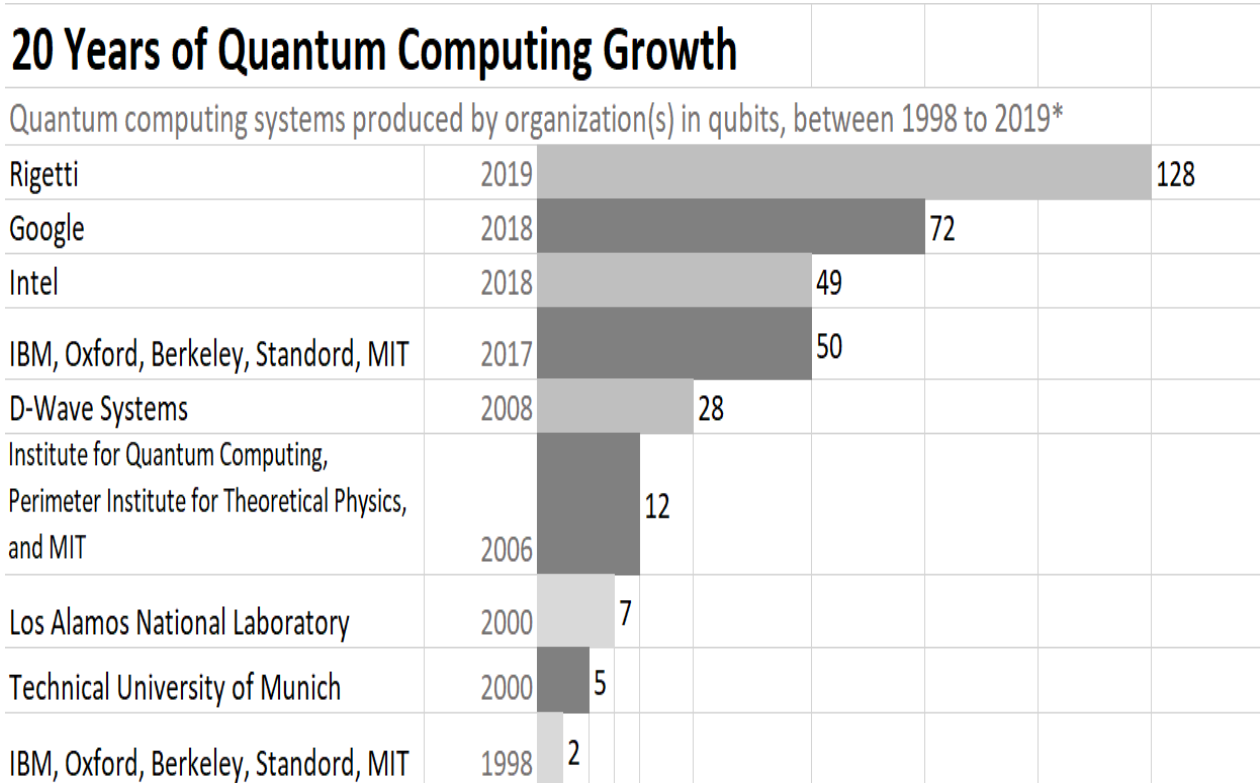| Organization	Year	Qubits
Rigetti	2019	128
Google	2018	72
Intel	2018	49
IBM, Oxford, Berkeley, Standord, MIT	2017	50
D-Wave Systems	2008	28
Institute for Quantum Computing, Perimeter Institute for Theoretical Physics, and MIT	2006	12
Los Alamos National Laboratory	2000	7
Technical University of Munich	2000	5
IBM, Oxford, Berkeley, Standord, MIT	1998	2

Fig. 2. Graph of Quantum Computing growth for last 20 years. (Adapted from [5])

Conclusions. Research and new discoveries in quantum computing will usher in a new era of computing. Quantum computers are capable of solving problems and computing millions of times faster than the most powerful supercomputers. Quantum computing can be used in a variety of fields, but primarily in chemistry, biology, physics, cryptography, and artificial intelligence research. Many companies are working hard to create a commercial quantum computer to spread this development around the world, and to use it in all areas where it is necessary to perform complex calculations in the shortest possible time.

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МОНІТОРИНГ НАСЛІДКІВ ЛІСОВИХ ПОЖЕЖ НА ОСНОВІ АНАЛІЗУ СУПУТНИКОВИХ ЗОБРАЖЕНЬ

Анотація. У роботі розглянуто основні методи обробки цифрових знімків та методики дешифрування й аналізу лісовкритих територій, які постраждали від пожеж. Встановлено ефективність використання мультиспектральних датчиків з середньою та високою роздільною здатністю, а саме датчиків, що встановлені на супутниках Sentinel 2 для дослідження вигорілого лісу. Запропонована в роботі методика ґрунтується на використанні багаторічних