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11 QUBIT QUANTUM COMPUTERS WITH CLOUD COMPUTING ACCESS

Now in a new study, researchers have implemented Grover's algorithm with trapped atomic ions. The algorithm uses three qubits, which corresponds to a database of 8*23 items. When used to search the database for one or two items, the Grover algorithm's success probabilities were - as expected - significantly higher than the best theoretical success probabilities for classical computers.

The researchers, Caroline Figgatt et al., at the University of Maryland and the National Science Foundation, have published a paper on their results in a recent issue of Nature Communications: "This work is the first implementation of a 3qubit Grover search algorithm in a scalable quantum computing system"- Figgatt told Phys.org: "Additionally, this is the first implementation of the algorithm using Boolean oracles, which can be directly compared with a classical search".

The classical approach to searching a database is straightforward. Basically algorithm randomly guesses an item, or "solution". So, for example, for single search iteration on a database of 8 items, a classical algorithm makes one random query and, if that fails, it makes a second random guess - in total, guessing 2 out of 8 items, resulting in a 25% success rate.

Grover's algorithm, on the other hand, first initializes the system in a quantum superposition of all8 states and then uses a quantum function called an oracle to mark the correct solution. As, a result of these quantum strategies, for a single search iteration on an 8item database, the theoretical success rate increases

to 78%. With a higher success rate comes faster search times, as fewer queries are, needed on average to arrive at the correct answer.

In the implementation of Grover's algorithm reported here, the success rate was lower than the theoretical value – roughly 39% or 44%, depending on the oracle used –but still markedly higher than the classical success rate.

The researchers also tested Grover's algorithm on databases that have two correct solutions, in which case the theoretical success rates are 47% and 100% for classical and quantum computers, respectively. The implementation demonstrated here achieved success rates of 68% and 75% for the two oracle types-again, better than the highest theoretical value for classical computers.

The researchers expect that, in the future, this implementation of Grover's algorithm can be scaled up to larger databases. As the size of the database increases, the quantum advantage over classical computers grows even larger, which is where future applications will benefit.

"Moving forward, we plan to continue developing systems with improved control over more qubits", - Figgatt said and I can agree with him. [1]

Alibaba opened up access to an 11qubit system on its computer cloud. IBM has a 20qubit quantum computer available on its cloud. Users can now access the superconducting quantum computing cloud through Alibaba Cloud's quantum computing cloud platform to efficiently run and test custom-built quantum codes and download the results.

Dubbed the ultimate computing power of the Mother Nature, quantum computing is seen as a solution that can perform calculations at a rate far beyond that of traditional computers. With this groundbreaking quantum technology offered by CAS and Alibaba Cloud, users will be able to run and trial their quantum algorithms in order to learn more about the features and capabilities including the performance of the processor and any existing technological barriers. Understanding more about these considerations will further push the advancement of quantum technology.

Offering quantum computing services on cloud is another breakthrough by the two parties. This will enable wider participation in overcoming technological challenges and the sharing of ideas and knowledge that will move scientists towards full utilization of this powerful technology.

How dr. Shi Yaoyun, Chief Quantum Technology Scientist at Alibaba Cloud, said: "By introducing quantum computing services on cloud, we make it easier for the teams to experiment with quantum applications in a real environment to better understand the property and performance of the hardware, as well as leading the way in developing quantum tools and software globally. The user experience offered on cloud will, without doubt, help us further enhance our platform". [2]

Alibaba Cloud has made a significant commitment to quantum technology over recent years. In July 2015, Alibaba Cloud and CAS jointly established the first quantum computing laboratory in Asia, and shortly thereafter made a breakthrough in achieving the world's first cloud-based quantum cryptography method.

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