Google's quantum computer flunks landmark speed test

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Google's quantum revolution is still in the slow lane. A milestone speed test of the D-Wave Two, a commercial quantum computer recently purchased by the internet giant, suggests that the machine performs no better than an ordinary PC.

The test marks the first head-to-head comparison of the D-Wave Two and a conventional computer running an optimised algorithm. Critics say the D-Wave machine is simply not able to exploit quantum mechanics to calculate faster than a regular computer. But the latest test only looked at one specific type of computing problem, and some experts think D-Wave might still show improvements in other areas.

Quantum computers offer the promise of much quicker solutions to certain problems, such as factoring numbers or searching large databases, using the principles of quantum mechanics. Instead of using either 1s or 0s to store information, quantum machines use quantum bits, or qubits, that can be both 0 and 1 at the same time. But the quantum devices developed so far in academic labs can support just a handful of qubits, limiting their speed.

The computers made by commercial firm D-Wave of Burnaby in British Columbia, Canada, have many more qubits – 500 or so – but use an alternative model known as adiabatic quantum computing that has not yet been proven to give a quantum power boost. Nevertheless, Google splashed out on a D-Wave Two machine last year, which is now housed at a NASA research centre. The company has so far used it to design blink-detection algorithms for its upcoming Glass headset.

Need for speed

Last year Catherine McGeoch at Amherst College in Massachusetts, a consultant for D-Wave, tested the D-Wave Two against a desktop computer. She concluded that the quantum machine was 3600 times faster. But that test was not a direct comparison because the desktop computer's algorithm had not been optimised to solve the particular problem used.

Now a team led by Matthias Troyer of ETH Zurich in Switzerland has tested a D-Wave Two computer against a conventional, "classical" machine running an optimised algorithm – and they have found no evidence of superior performance in the D-Wave machine.

Troyer's team ran their tests on a D-Wave Two owned by Lockheed Martin and operated by the University of Southern California in Los Angeles. There were certain instances in which the D-Wave computer was up to 10 times faster at problem solving, but in other instances it was one-hundredth the speed of the classical computer. D-Wave's advantage also tended to disappear when the team added in the time needed to configure the D-Wave Two to solve the problem, a step that is not necessary on regular PCs.

The findings don't worry Google: "At this stage we're mainly interested in understanding better what limits and what enhances the performance of quantum hardware to inform future hardware designs," says Google spokesman Jason Freidenfelds. He says Google is also more focused on problems with different structures than the one used in Troyer's test, such as machine-learning problems like the Glass blink-detection algorithm.

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Buried planets

Even as they continue to test out the hardware, teams at NASA are developing algorithms for D-Wave to help with astrophysics, including the hunt for exoplanets. At an astronomy meeting last week, NASA contractor Randall Correll of RRC Research in Arlington, Virginia, presented the results of tests run on data from the Kepler mission, which spent four years looking for planets that cross in front of their stars, from Earth's perspective. These transits create a tiny, regular dip in starlight that reveals an orbiting planet. The bigger the world or the dimmer the star, the more noticeable the dip.

Combing the Kepler data has so far resulted in the discovery of 238 planets and thousands more candidates, most of them either bigger than Earth or orbiting stars smaller than the sun. But Kepler should have been able to spot Earth-sized planets around bright, sun-like stars too.

Correll's team hopes that quantum processing can dig deeper into the Kepler data and pick out these worlds buried in the background noise. So far their D-Wave algorithm can match current efforts and identify known Kepler worlds, but they have not been able to find any new planets hidden in the data.

Quantum check-up

Troyer's study notes that this kind of research on other problem types could help answer whether D-Wave's computers are faster than PCs. And a more definitive answer may arrive later this year, as D-Wave is scheduled to release a new version of its quantum chip, this time with 1000 qubits.

But critics argue that the latest work is already a sign of defeat. "Bottom line: I think it's consistent with the picture that's been emerging of no good evidence for better scaling behaviour," says Scott Aaronson of the Massachusetts Institute of Technology. "I see no reason why simply increasing from 500 to 1000 qubits should be expected to change anything."

And speed may not even be the main issue, says Alexandre Zagoskin of Loughborough University in the UK. He co-founded D-Wave and still own shares but has not been involved with the company since 2005. In a recent paper, he argues that new tools are needed to determine whether D-Wave computers are operating as quantum-mechanically as they should be. "The question about how fast this thing works is secondary," he says.

D-Wave remains optimistic about its machine's potential. "Our customers are interested in solving real-world problems that classical computers are less suited for and are often more complex than what we glean from a straightforward benchmarking test," says D-Wave's Jeremy Hilton. He adds that D-Wave's upcoming 1000-qubit processor should improve benchmark results and that the company expect to surpass state-of-the-art traditional computers in the next few years. "We haven't yet seen any fundamental limits to performance that cannot be improved with design changes."

Update: *Since this article was first posted on 15 January 2014, a comment from D-Wave has been added to it.*

Journal references: arxiv.org/abs/1401.2910, arxiv.org/abs/1401.2870

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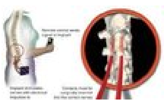

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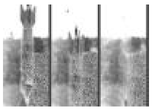

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