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IBM Invites Scientific Community to Test-Drive Its Universal Quantum Computer

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IDC's Quick Take

IBM recently announced that it was making its universal quantum computer freely available to the general public to encourage a broad range of potential innovators to explore and possibly even develop new quantum applications; the system will be accessible through an IBM cloud software development environment specifically designed to facilitate such innovation and expand the potential pool of scientists experimenting with the system. Although giving access to leading-edge IBM prototypes of advanced quantum systems is a critical step forward in garnering support for the field, the success of this initiative will be judged primarily by its ability to build a broad base of scientific interest that leads to the creation of a portfolio of quantum computing use cases and a robust quantum computing application development community.

News Highlights

IBM announced last week that it was making a universal quantum computer available to the general public to encourage a broad range of potential innovators and — perhaps in the long run — users to explore, and possibly even develop, new applications for this system. The quantum processor is composed of five superconducting qubits, housed at the IBM T.J. Watson Research Center in New York, and it represents the latest advancement in IBM's quantum architecture development program in what some believe is the leading approach toward building a universal quantum computer. A universal quantum computer has the most general-purpose functionality of the various quantum computing options currently under development including quantum annealers and analog quantum systems, but universal quantum systems' ability to address a wide class of applications presents proportionate technical difficulties and increased manufacturing complexities.

In general, quantum computers work fundamentally differently from the class of traditional computers that are almost universally used today. Whereas these traditional so-called binary computers embody data as a series of bits, each bit representing a zero or one, a quantum computer uses a quantum bit (or qubit) that can represent not only a zero or a one but both simultaneously. It is this capability and other related quantum effects that enable quantum computer operations that can be vastly faster on specific types of calculations than their binary counterparts. IBM stated that as the ability of traditional binary computers to offer ever-increasing performance will slow in the coming decade — the so-called end of Moore's law — quantum computers will be one of the newer technologies stepping forward to drive a fresh wave of innovation across a wide range of industries including pharmaceuticals, material science, and artificial intelligence.

To encourage, and ultimately enable, new quantum-based applications for their experimental systems, IBM announced that it was also providing an applications interface for quantum software development specifically designed to allow students, researchers, and others interested in the technology to run

algorithms and experiments on the quantum system as well as explore tutorials and simulations to test the boundaries of new quantum computing applications. This will be done through an IBM cloud–based software development environment, the IBM Quantum Experience, specifically designed to facilitate such innovation without requiring a significant overhead of deep quantum computing theory or expertise, expanding the potential pool of scientists experimenting with the system. IBM indicated that going forward, users will have the opportunity to contribute and review their results to their IBM Quantum Experience, and IBM scientists will be directly engaged to offer more research and insights on new advances. IBM plans to add more qubits and different processor arrangements to the IBM Quantum Experience over time so users can expand their experiments and help uncover new applications for the technology.

IDC's Point of View

Even the most optimistic quantum computing supporters admit that constructing a working universal quantum computer is a technically demanding task and that a full-scale universal system is not expected for at least another decade. However, the potential performance of quantum computers on specific applications can be quite dramatic compared with traditional binary computers used today as well as those envisioned for the next decade and beyond. This promise of unprecedented performance, in some cases well beyond the capability of any binary computer no matter how capable, will continue to generate interest and drive funding for many forms of quantum computing research for the foreseeable future.

Building a working universal quantum computer, however, represents only a portion of the challenges facing the field in the coming years. To date, quantum computers have suffered from a lack of algorithms that can take advantage of their unique architectures, and indeed, there are only a few notable quantum algorithms today, with the main emphasis centered on cryptographic problems.

IBM has taken a bold step forward here by working to make quantum computing more accessible to a wide range of developers in hopes of expanding the scope of new quantum-based algorithms and related applications. To that end, a free, readily accessible and, perhaps most important, easy-to-use quantum computer interface may be the most important element of this recent announcement. Ultimately, the success of this IBM initiative will be judged by its ability to garner a broad base of scientific interest that leads to the creation of a portfolio of quantum computing use cases and a robust quantum computing research community that not only drives individual innovation but builds a much-needed technical foundation for a new quantum computing application development.

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