Rebooting supercomputers: a new start with qubits

" 640K ought to be enough for anybody," said Bill Gates, the creator ofMicrosoft, in 1981. 640 kilobytes is less than the amount of storage space on a flash drive. Today, computers have around 500 gigabytes (500, 000, 000 kilobytes) of storage space, and supercomputers have hundreds of times more. Bill Gates did not realize how much computing power people would use because in 1981 no one could imagine computer usage venturing further than calculating large mathematical equations for fields that would benefit from them. However, as people began representing objects and letters with equations, allowing computers to process words and images, computers needed more storage space. Today, scientists and doctors especially would appreciate computers with more storage space than even supercomputers have.

I learned about computers with that capacity through studying atoms. Atoms fascinated me when I first looked them up. Delving deeper into them I learned about electrons, quantum mechanics, and eventually, quantum computers, computers that use electrons to think instead of normal bits. Quantum computers have the potential to significantly advance the fields of medicine and science with their incredible computing ability. Quantum computers work very much like today's computers except for their unique characteristic of superposition.

Your computer uses a memory system based on pieces of data called bits. A bit has a value of either 1 or 0. Bits combine to make patterns of eight bits called bytes. There are 256 different bytes that can represent a figure, but your computer uses around 500 billion bytes to think. In a quantum computer instead of bits are quantum bits, or qubits. A qubit has the

property of superposition, which is the quality of being in two different states simultaneously.

Thus, unlike a bit that is either 1 or 0, a qubit can be both 1 and 0 concurrently. This extraordinary feature allows quantum computers' computing ability to be much greater than modern computers. Their memory grows exponentially, so two qubits are equal to four bits, three qubits are equal to eight, and so on. About forty qubits would be the equivalent to a modern supercomputer, and one can only imagine the potential of a quantum supercomputer. Quantum computers would be useful when modeling objects and systems.

Aspects of an object can be represented by different equations on computers. All those equations together create a model of that one object. Many models put together create a system, in which each model directly affects the others. Let us take a computer system of a piano, for example. Different equations are used to virtually structure the keys, strings, nails, hammers, felt, and wood.

All these models put together create a system on the computer, which is a virtually fully functioning piano. The computer calculates each equation to see how it affects the others. If screws replaced the nails, new equations, representing screws, would replace the equations for nails. Those new equations would have an effect on the entire system. The computer calculates how the screws' equations affect the entire system's equations, thus predicting how screws would affect a physical piano. With quantum computers more complicated models and complex analysis will be possible

without physically building models or working on an actual object or, in some cases, a person.

More complicated systems made on a quantum computer could make great advancements in medicine. Currently, doctors usually make systems of body parts on supercomputers such as a lung. However, because there are so many variables that affect the entire body, a supercomputer is unable to create a system that incorporates all aspects of the human body. A quantum computer, on the other hand, is capable of computing many large equations quickly and may be able to create a system of the entire human body. Doctors could use such a system to calculate the effects of different drugs on people, which would lead to safer, more effective treatment.

Scientists would also benefit greatly from quantum computers. I read an article about a certain crystal called ammonium dihydrogen phosphate (ADP) that behaves in an unexpected way and has baffled scientists for years. It is capable of being ferroelectric or antiferroelectric at different points in time, and scientists could never figure out why. Dr. Naresh Dalal found out why by using a supercomputer to virtually adjust the ions of the crystal as an experiment, something scientists cannot do in a lab.

This experiment explained ADP's unique characteristic. Although Dalal used a supercomputer for his experiments, by using a quantum computer, the experiments scientists perform and the substances on which they perform them can become much more complex and can produce answers much more quickly. The first quantum computer, D-Wave One, was made and sold by D-Wave Systems, Inc. to a global security company, Lockheed Martin

Corporation. D-Wave One was created to solve problems experienced by Fortune 500 companies, governments and other organizations. D-Wave One uses a 128-qubit processing chip stored in a ten square meter case to ensure it stays cool when operating.

At present, quantum computers may be too powerful and too big for the public to own, but these powerful computers can still affect our lives. Doctors using quantum computers will be capable of prescribing drugs that have been tested without putting people at risk. Scientists can learn more about our world, how to live in it, and possibly how to conserve it. Biomedical engineers also have the benefit of testing their inventions without physical models and actual people. If we think computers have brought us far in the past thirty years we can scarcely imagine where quantum computers will lead. They can bring us closer to a world where sickness is eliminated or easily cured and almost any idea can be tested and possibly become reality.

Although such advancements may seem fantastical, as Bill Gates can testify, we should never set boundaries for ourselves in technology because we are destined to tear down those boundaries and make the fantastical, reality. Works Cited Barry, Ray. " NRI Florida State University Scientist Solved 70 Years-old Crystal Mystery." NIR Internet. com.

N. p., 22 Oct. 2007. Web. 30 Nov.

2011. .

Bodet, Paul Walter. Personal interview. 8 Jan. 2012. Dickson, Michael W. " Physics, Quantum.

" Encyclopedia of Science and Religion. 2003. Encyclopedia. com. Web.

28 Nov. 2011. .

D-Wave: The Quantum Computing Company. D-Wave Systems Inc., 2011.

Web. 26 Dec.

2011. . " Electromagnetic Spectrum.

" Science of Everyday Things. 2002. Encyclopedia. com. Web.

28 Nov. 2011. .

Encyclop? dia Britannica. Encyclop? dia Britannica Online Academic Edition.

Encyclop? dia Britannica Inc., 2011. Web.

30 Nov. 2011. .

Garnett, P. J., et al. Foundations of Chemistry. Illus.

Wendy Gorton and Bruce Rankin. Ed. P. J. Garnett. 2nd ed.

1985. Melbourne: Addison Wesley Longman Australia, 1996. 73. Print.

Hames, Roderick.

" Computers and How They Work." Alton C. Crews Middle School: CS Dept –

Article. N. p.

, Spring 2011. Web. 26 Nov. 2011.

crews. org/////. htm>. Henderson, Harry. " Quantum Computing.

” Encyclopedia of Computer Science and Technology. Rivised ed. Science Online. Web. 26 Nov. 2011.

. “ High-stakes Predictions: From Forecasting Shuttle Re-entry to Medical Procedure Outcomes, Engineers Are Working Fast to Create Computer Models We Can Trust.

” University of Texas at Austin. N. p., 5 Dec. 2011.

Web. 22 Dec. 2011. .

“ Is Quantum Computing Real? The Answer Is Yes and No. and Yes and Yes. and No and No.” Academic OneFile. Gale Cenage Learning, 26 Sept. 2011.

Web. 14 Dec. 2011.

do? sgHitCountType= None= DA-SORT= true= GPS= mlin_b_winsor= T003= R1= RESULT_LIST== BasicSearchForm¤tPosition= 3= GALE| A267972185&&docId= GALE| A267972185= GALE= AONE>. Knapp, Alex. “ Lockheed Martin Installs Quantum Computer.” Forbes. N. p.

, 31 Oct. 2011. Web. 23 Jan. 2012.

. “ Medical Modeling.” Huntsman: Enriching Lives through Innovation. Huntsman International LLC, 2011.

Web. 29 Dec. 2011.

cfm? PageID= 5843>. Page, Lewis. “ Future Quantum Computers Could Be Made Of...

Silicon?" The Register. N. p., 24 June 2010. Web. 1 Dec.

2011. . " Physical Sciences: Year in Review 2004.

" Encyclop? dia Britannica Online Academic Edition. Encyclop? dia Britannica Inc., 2011. Web. 30 Nov.

2011. . " Quantum Computer Material Developed.

" United Press International 9 Oct. 2007: n. pag. Scienc Online. Web. 26 Nov.

2011. .

"' Quantum' Computers Said a Step Closer." United Press Internation, Inc. 22 Mar. 2011: n. pag.

United Press International, Inc. Web. 28 Nov. 2011. . " Quantum Computing in Semiconductors Doable." University Press International, Inc. 30 June 2008: n. pag. Science Online.

Web. 28 Nov. 2011. . " Quantum Computing Moves Closer to Reality." United Press International, Inc. 23 June 2010: n. pag.

Science Online. Web. 30 Nov. 2011. . Schwartz, Peter, Chris Taylor, and Rita Koselka. " Quantum Leap: Brain Prosthetics. Telepathy. Punctual Flights.

A Futurist's Vision of Where Quantum Computers Will Take Us." CNN. Cable News Network, 2 Aug. 2006. Web.

29 Dec. 2011.

htm>. Silverman, Jacob. " What Will Quantum Computers Be Used for in the Future?" Curiosity. com. Discovery Communications, LLC, 2011.

Web. 17 Dec. 2011. . " Supercomputer Predicts Revolution." BBC News. N. p.

, 9 Sept. 2011. Web. 23 Dec. 2011.

. Thomas, Keir.

" Lockheed Martin Bets Big on Quantum Computing." PCWorld. PCWorld Communications, Inc., 2011. Web.

26 Dec. 2011.

html>. Tucci, Robert R. " Quantum Computers and the Coming Era of Personalized Medicine." Quantum Bayesian Networks. WordPress. com, 15 June 2011. Web. 17 Dec. 2011.

wordpress. com////computers-and-the-coming-era-of-personalized-medicine/>. " Vesuvius: A Closer Look – 512 Processer Gallery." Hack the Multiverse: Programming Quantum Computers for Fun and for Profit. WordPress. com, n. d. Web. 26 Dec. 2011. .