

**Possible Questions Regarding Technologies:
Technology Assessment Form**

Technology Name: QUANTUM COMPUTING

Good paper, although make sure you are answering the question asked.

Category: COMPUTER SCIENCE

Keywords: quantum physics, qubit, NMR, quantum dots, **algorithms, gates**

Technology Background: The story begins at the turn of the twentieth century when an unheralded revolution was underway in science. A series of crisis had arisen in physics. The problem was that the theories of physics at that time (now dubbed classical physics) were predicting absurdities such as the existence of an “ultraviolet catastrophe” involving infinite energies, or electrons spiraling inexorably into the atomic nucleus. At first such problems were resolved with the addition of *ad hoc* hypotheses to classical physics, but as a better understanding of atoms and radiation was gained these attempted explanations became more and more convoluted. The crisis came to a head in the early 1920s after a quarter century of turmoil, and resulted in the creation of the modern theory of *quantum mechanics*. Quantum mechanics has been an indispensable part of science ever since. Quantum computation and quantum information fit naturally into this program. They provide a useful series of challenges at varied levels of difficulty for people devising methods to better manipulate single quantum systems, and stimulate the development of new experimental techniques and provide guidance as to the most interesting directions in which to take experiment. Conversely the ability to control single quantum systems is essential if we are to harness the power of quantum mechanics for applications to quantum computation and quantum information. Richard Feynman observed that quantum systems could not be modeled using conventional computers and in 1982 proposed a model for quantum computation. In 1985, David Deutsch showed that, in principle, any physical process could be modeled by a quantum computer.

Technology Description: Quantum Computation and quantum information is the study of the information processing tasks that can be accomplished using quantum mechanical systems. Changes occurring to a quantum state can be described using the language of quantum computation. Analogous to the way a classical computer is built from an electrical circuit containing wires and logic gates, a quantum computer is built from a *quantum circuit* containing wires and elementary *quantum gates* to carry around and manipulate the quantum information. For researchers working to build a quantum computer, speed is of the essence. That's because quantum data bits last just billionths of a second, too short for doing meaningful computations. *Qubit*, as quantum bits are called perform the binary switching functions of transistors used in conventional electronic components. Quantum computers use atoms or electrons in place of a conventional computer's processor and memory. They rely on the unusual principles of quantum mechanics, which let atomic matter exist in multiple states simultaneously. In a binary computing model, for example, a value could be both zero and one. This physical property lets atoms or nuclei work together as qubits. The "gotcha" of quantum computing is that qubits must interact with one another but be isolated from their external environment to prevent corrupted data from being passed along. Scientists use electron-beam lithography on a gallium arsenide semiconductor compound coated with plastic to create quantum dots. The dots are comprised of atoms that are clustered to form 3-D atomic islands comprised of 20 to 40 electrons. The lines created by the electron beam are then filled with metal and the plastic coating dissolved, leaving behind metal lines 50 nanometers wide that function as connections between the dots. The researchers are able to link the dots and control how many electrons are in each dot, then detect the "state" of the dot, letting values be retrieved.

1. Social Impact

a. Who are the stakeholders?

Computers are everywhere. There's one in the gas station down the street, one in the library, two hundred in the school two blocks away, a dozen in as many friends' homes. The computer promises to make as many changes in our lives as the family car did years ago. So any development in computer technology will affect all the individuals.

b. Who will benefit?

Those who sell the technology, manufacturers and people who can afford to have that new technology in their homes or companies since the price of a new technology has always been expensive and difficult to be afforded by all the individuals.

c. What cultures could be impacted?

No specific culture will be much more impacted than the other.

d. What ethnic groups could be impacted?

No specific ethnic group will be much more impacted than the other.

e. How are different groups of people affected (e.g. poor, minorities, disabled...)?

The poor will not be able to have an access since it would be expensive when it first comes out like every new technology we've been introduced have become.

f. What portions of society does it bring together, and what does it divide?

Employer-employee, client-professional relationships will be different. And besides this, which is much more important, maybe we'll again experience a discrimination between ones who have and ones who cannot like the discrimination we used to see when cell phones came into our lives.

g. What effects will it have on employment?

Maybe manpower will leave its place to this new technology in certain areas but this negative effect will probably be offset by the new job openings necessitating the use of this technology. Computer needs to be controlled by individuals. It is not a substitute person.

2. Ethical Questions

a. What individual rights might be violated?

Computers in communication if not poses a potential threat to the privacy of the individual do not give harms to the community in any way. Vast databases that can be accessed at very high speeds will enable governments, businesses and so on to collect, store and access much more information about individuals than is possible today. In addition, the capacity for data mining, the exploration and analysis of very large amounts of data for the purpose of discovering meaningful and useful rules and patterns, will increase dramatically. And the monitoring and surveillance of workers, prisoners, and others will be greatly enhanced with the use of small, powerful computers and new sensing devices for input.

b. What is the proportional distribution of burdens and benefits?

It has much more benefits than burdens.

c. How does it produce the maximum good?

Nanotechnology and quantum computing have the potential to radically change the information technology. If these technologies are successful, and

there are signs that they will be, computers will become very very fast, small and have enormous amount of memory relative to computers of today.

d. How does it promote the common good?

It depends on for what purpose you're using it.

e. Would some people have ethical issues with pursuing this?

The user associations, however, do not require members to observe specific behavior standards, nor do they seem to be particularly interested in discussing ethics.

3. Legal Implications

a. Is it legal?

Yes, it's legal.

b. How does it promote Law (or assist law breaking)?

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Ethics represents the expected behavior that supports laws. Computer Software Copyright Act was not signed into legislation until 1980. Copyright is not considered an adequate form of protection for several fairly obvious reasons. As "literary works" programs are protected as formal expressions of ideas, this means the source program is protected but not the algorithm.

c. How does it assist (or hinder) law keeping?

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Trade Secrecy Laws give a company the right to keep certain kinds of information secret. And also patents are very attractive form of protection for software.

4. Economics

a. Is it desirable or undesirable on any of these scales: global, country, region, company, immediate neighbors, people in general?

Taking all of its benefits into account, it's desirable globally.

b. What is the impact on economic stability?

A new industry will be introduced. New products, new demands will bring movement to the economy of the country.

c. How would it affect the cultural, ethnic, and/or economic divides?

It will create discrimination between people being able to afford that and the others that are not.

d. What is its economic feasibility?

United States have the power and money to develop a new industry.

5. Environmental Issues

a. How does it affect our environment (short term and long term)?

1. Air? N/A
2. Water? N/A
3. Land? N/A
4. Other? N/A

6. Unanticipated Consequences

a. How might it be used?

It increases people's creativity. Since quantum computing will be faster, it will allow individuals to put into its records thoughts and decisions as quickly as their fingers can move. What makes an action right or wrong is not the action itself but rather something outside the action, its consequences. So if its consequences do not violate people's rights, the more technology gets further the more we are happy.

b. What alternate paths might it take?

In industry today robots controlled by computers do dangerous and boring jobs as welding, removing toxic or dangerous wastes. A similar path can be taken to use quantum computers in jobs that we don't want humans to do.

c. Can you think of any uses of this technology other than the one proposed here?

We could have saved ourselves a lot of time and effort if we develop this technology in everyday jobs like heating or cooling.

d. Are there any historical examples of developments analogous to this one that might serve as a guide to ways in which this technology might evolve?

Computer technology has experienced a lot of new steps that at first made people think like nothing more could be done at that time.

e. Are there any other consequences that have not been mentioned?

Artificial Intelligences. If machines were developed that behave in much the same way as humans do, in a wide variety of contexts, the issue will arise of whether or not they are things with moral rights and responsibilities.

Secondly, Prosthetic Devices. Chip Implants in humans that enhance various of the senses, memory and perhaps even other feelings.

MY SUGGESTIONS FOR POSSIBLE QUESTIONS:

1) Discuss whether technology should be limited to inventions which would in no way interfere with personal privacy

- 2) What types of education should a child receive in order to function in an increasingly technological society?

- 3) What if a computer could exhibit all human activities and be made to look exactly like human? Should this computer have rights?