Quantum Computing Final Project Task 1

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Question 1. According to the article, how do ambitions for quantum networks differ across nation-states around the world, and why? Include your own convictions about what role quantum networks should play.

Nowadays many countries are working towards quantum networks and quantum internet. Some of them include Australia, South Korea, Britain and China. However, while South Korea is funding a huge network link to join the existing networks. Britain will make a similar sized link to connect two cities. Australia is building a closed government network inside just one city. China is connecting several big cities using quantum networks. The most ambitious quantum network is the one in China linking Beijing and Shanghai which most notably works with banks and news agencies. It has 50+46 “nodes”. To have a quantum internet it’ll need to have parts that are as big as the one in China and connect them with very long links like the one in Britain. It’ll also need to have the capability to link some other networks to it. Thus, every one of these different projects in the end will have to be connected to be one project in face of the quantum internet. Plus it’ll need to have working cryptography without any breaches. So far most of the quantum cryptography real life tests resulted negative as the devices used for it had many security breaches. However the project in Australia will surely spend a lot of resources on security. This way, however all these projects are different, we need them all to work, to be able to have quantum internet.

In my opinion, quantum networks are very important for highly secured transmissions, like banks, however, I don’t think they’ll be used by the average customer in near future. Nevertheless, a day will come that we use quantum technologies in every field, sharing our data instantaneously using quantum internet, connecting many supercomputers with the help of quantum networks and creating new QGPUs and supercomputers using quantum network technologies in small scales.

Question 2. Give four reasons why corporations and governments believe "the time for investment, all agree, is now" for quantum computation, according to the article. Comment on which of the reasons you believe are most convincing.

First of all, as the field is very new, any new and small invention will get revenue. The first quantum devices to be engineered will most probably be physics simulations. These might help to construct room temperature superconductors that will allow electricity to travel without losses. Secondly, it is believed that quantum technologies will increase the computing speed tremendously and will be able to solve problems that the classical computers didn’t have the computing power to do (Prime Factorization f.e.). Though this isn’t true for all the cases, in many cases quantum technologies do speed up computations, even exponentially. Third, quantum simulations will help to design, manufacture and test new materials for batteries or alloys for aircraft and spacecraft. This will greatly increase the speed and ease the manufacturing process. And lastly, again the field is very new and many young scientists are choosing this field for their career which makes a very good environment to make investments.

The most convincing reason here from an investment standpoint is the one that even the small inventions get revenue in new fields like this. There hasn’t been enough time to solve even some of the easiest problems using quantum computing. There are many paths to investigate, many new “leaves” to explore. The “tree” of investigation of quantum computing is just starting from its nodes. Anything that the scientist wants to investigate will most probably result in a new invention that will get its revenue. This is a goldmine for investors, as they will be able to have their investments pay off with very high chances in the long term.

In my opinion, the most important reason is that investing now in quantum computing will help this new and small field to grow into something much bigger and take our technologies to a new, quantum level.

Question 3. The article quotes IBM vice president Dario Gil saying, "The power of quantum computing is rediscovering all the problems that computers cannot solve, and having a path to solving them." Discuss three ways "quantum software" addresses this idea, and argue whether one should believe Dr. Gil's statement (or not).

Some of the essential rediscoverings of a classical computation unsolved problem are in the cryptography field. The classical encoding falls flat when it is brought against quantum computing. This makes people work simultaneously on quantum encryption and quantum decryption. This leads to another rediscovering of an unsolved problem, the encryption. There’s no classical encryption method that is safe from eavesdropping, however quantum encryption protocols are challenging this aspect of cryptography too. However, the eavesdropping isn’t the only problem existing in classical encryption. So-called post-quantum ciphers that will ensure unbreachable security that even the quantum algorithms won’t be able to “hack”.

All three show that quantum computing is about getting to problems classical computing couldn’t solve. Nevertheless, I don’t think it is completely correct. Quantum computing is also about speeding up existing computing problems. Some scientists think that simulations like “4x4 Rubik’s cube minimum amount of steps to solve” could be sped up using quantum computing. This isn’t a rediscovering of non solved problems. 3x3 version of the problem is solved using classical computing and 4x4 isn’t much different. Quantum computing and quantum networks can speed up the process. Yes, quantum computing solves problems unsolvable for classical computing. One of the best examples is the simulation of physical problems. Classical computing can’t simulate such things and they can’t be solved analytically using math. The reason for that is the amount of objects in any phenomenon is very high and even if you get differential equations to describe their states it isn’t possible to get the initial states for every object in the phenomenon. Using quantum simulations can solve this problem while classical computing cannot. This doesn’t mean that “The power of quantum computing” is this specifical thing. The power of quantum computing is also its ability to speed up the technology we use.

Question 4. The article states "subjects that used to be mere footnotes to physics will rule, and engineers (and perhaps even consumers) will have to learn to speak quantum." How is this point presented in the article (cite corporate and government examples), and can you give examples from your own experience?

First of all quantum computing creates many breaches in nowadays security. Considering this many governments and corporations, like banks in Switzerland and China are already starting to test quantum security protocols and set-up quantum networks. If governments fail to find a way of security before the quantum decoders become reality lifelong secrets will be in danger. Moreover, quantum simulations will bring a new era for testing and manufacturing of new materials. As quantum computing develops, more and more technologies will turn into quantum. Quantum internet is also something expected to be a thing. Thus, any competent engineer will have to learn and speak quantum to be able to keep up with the needs of the technologies. Now already many engineers work on post-quantum encryption. Being able to simulate the material they want to use in aerocraft, spacecraft, circuits, etc will help many engineers increase the speed of the search of solutions to many existing problems.

As the quote states, even the customers might have to learn speaking quantum. When quantum internet becomes a thing and we have quantum wi-fi and quantum broadcast, many customers will have to learn quantum to be able to fully understand the tech they use and to be able to use it to its full capacity.

From my experience the same thing happened with neural networks. When our computing powers became good enough to program and use neural networks it was something new that made everything better. Every data scientist nowadays has to learn deep learning. The same thing will be the result of quantum computing development.