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Quantum Computing

Reading 7

The Physical Implementation of Quantum Computation

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October 1, 2019

Abstract

In this text, that is based on the paper: "The Physical Implementation of Quantum Computation" by David P. DiVincenzo, two ideas are extracted arbitrarily and discussed, according to the interest of the author.

1 Idea 1

What can compute: part II

In other reading reports, I have already mentioned that we can imagine, for example, stones as computers. Stones are computing trivial problems, from our point of view. But these computations are necesary, a stone needs to remain a stone, doing nothing is the essence of the stone, and although we could see the problem of being a stone as trivial, it is actually very important. In this same fashion, we can imagine the approaches for computing that are presented in the paper, such as the ion trap, the many neutral atoms, the quantum dots, or the quantised states of superconducting devices. In their natural form, we find these elements to be computationally useless, but at least in the second set of elements, that do not contain the stone, we have found (or at least) a way to arrange them in such a way that they are computationally useful. Following this line of thought, I can imagine that stones can be useful for computing, can arrange some rocks to for an abacus, and this is useful for us, because it could keep a representation of a certain quantity for a long time. Furthermore, we can observe that these composite system of rocks can stay static for a long period of time, which would make it useful to store valuable information, this same task is pretty difficult for quantum systems due to their small coherence times.

Once again I find it mesmerising how our creativity allows us to use things in ways that help us solve complex problems.

2 Idea 2

The standard approach is a digital quantum computer...

The paper describes that a quantum algorithm as a set of gates that are turned on and off in a predefined fashion. But if we switch them on and off arbitrarily fast, we can find non desirable outputs that are due to the reaction of the quantum system we are working with. This phenomenon occurs because all physical systems behave in a different way when interacting with outside elements at different time frames, for instance, we can imagine an inductor, when we power the inductor with an electric potential that does not change, the effects of the inductor will be negligible, but when we alternate this electric potential, the effects of the inductor are important, in fact, the inductor's effects are dependent on how fast we are alternating the potential. In this way, also quantum systems' behaviour differ when we apply the same "gates" at different speed. The effects that have been studied and are useful for quantum computation, are modelled with what is called an "adiabatic approximation".

The *standard* model provides us with a platform we can build knowledge upon. In the other hand, there are other fronts we are attacking this same problem from, being the adiabatic model and the quantum walks the most promising ones.

There is so much work to be done! I can hardly think of a most exciting time to be a computer scientist.