How will quantum computing affect the mainframe environment and its applications?

Bachelor's thesis proposition 2019-2020

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Samenvatting
Quantum computing has been a significant field of interest over the last 30 years in computer science. But finally with the recent *Quantum arms race* between IBM and Google, there have been significant breakthroughs in the physics department that make the whole subject more realistic and approachable. This paper won't be going into the physics details, it will however try and look at the most prevalent upsides and downsides of quantum computation becoming a real thing. Furthermore the paper will tie in how the current high-transactional environment of a mainframe will be affected with this new system of computation. So for the largest part the focus will remain on the theoretical research of quantum applications, but it will also include a demonstration of quantum computation inside a simulation with Qiskit (Amico, Saleem & Kumph, 2019, 1).

Keywords
Mainframe. Quantum computing — Encryption — Qiskit

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Inhoudsopgave

1. Introduction

With the approaching realisations of quantum technology, the interest in the subject has risen exponentially. There has been a strong believe in the last 30 years that quantum computing can and will influence our environment more than we think. The mainframe environment is one of the sectors that can become the most influential in *computer science*, because of its immense creation of data. Data will become the driving factor inside our societies, think of how much our daily lives are controlled by data (e.g. online shopping, social media etc.). With the usage of mainframes we are able to create a sense of logic in this almost infinite pile of data. But through the utilisation of quantum computing, data exploration and mining can become much more thorough and meaningful for business applications. The main driving factors for technological breakthroughs have always been wars and economics (e.g. Atomic energy, commercial aircraft, radio etc.). The more applications of quantum computing that we are able to find for existing economical applications, the more general investment in research will be made. Which would obviously boost both fields at once. In this paper we will try and find these general applications in reality of quantum computing.

1.1 Topics

- Security implications with the rise of quantum computing
- Efficiently exploring mainframe data using quantum computing
- Advantages and disadvantages of combining classical computing with quantum computing
- Building quantum software before the creation of the hardware

2. State-of-the-art

2.1 Prior knowledge

Inside the paper a couple of physics associated terms will be utilised. If you are not familiar with basic quantum physics notations, it would be highly recommended to read one or both of the following papers, Rieffel en Polak (1998) or Shor (2000). It is also possible to read this paper as an informational piece without the implications of the mathematics and physics surrounding the subject. As previously stated the paper will not be going in depth technologically, because the paper wants to expose the practical usages of quantum computing compared to classical computing and

because that would reach far out of the scope of this paper.

2.2 Literature review

As of now Google has claimed to have won the *Quantum Supremacy race* (Arute e.a., 2019)

Je mag gerust gebruik maken van subsecties in dit onderdeel.

3. Methodology

Hier beschrijf je hoe je van plan bent het onderzoek te voeren. Welke onderzoekstechniek ga je toepassen om elk van je onderzoeksvragen te beantwoorden? Gebruik je hiervoor experimenten, vragenlijsten, simulaties? Je beschrijft ook al welke tools je denkt hiervoor te gebruiken of te ontwikkelen.

4. Expected results

Hier beschrijf je welke resultaten je verwacht. Als je metingen en simulaties uitvoert, kan je hier al mock-ups maken van de grafieken samen met de verwachte conclusies. Benoem zeker al je assen en de stukken van de grafiek die je gaat gebruiken. Dit zorgt ervoor dat je concreet weet hoe je je data gaat moeten structureren.

5. Expected conclusions

Hier beschrijf je wat je verwacht uit je onderzoek, met de motivatie waarom. Het is **niet** erg indien uit je onderzoek andere resultaten en conclusies vloeien dan dat je hier beschrijft: het is dan juist interessant om te onderzoeken waarom jouw hypothesen niet overeenkomen met de resultaten.

Referenties

Amico, M., Saleem, Z. H. & Kumph, M. (2019). Experimental study of Shor's factoring algorithm using the IBM Q Experience. *Phys. Rev. A*, *100*, 012305. doi:10.1103/PhysRevA.100.012305

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