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Applications of Quantum Computing for Business Analytics in Healthcare Management

Krish Kawle[1] and Sheetal Dhavale[#]

[1]Union County Academy for Allied Health Sciences
[#]Advisor

ABSTRACT

The advent of Quantum Computing is a revolutionary step of mankind. This computer has the potential to grow in many areas, especially with healthcare. This paper views the role of quantum computing in healthcare, more specifically how quantum computing can reduce costs for healthcare providers and their insured customers.

Introduction

Recently, quantum computing has garnered a lot of attention and there have been several streams of discussions about the role of quantum computing in society. More specifically there has been a lot of debate around the ability of quantum computing to break current cryptography algorithms implemented in the industry. However, this article aims to examine the role of quantum computers in useful applications, aside from the threat of breaking encryption algorithms. The article will focus on how quantum computers could use their superior computing power to conduct analysis of voluminous data to make strategic business analytical decisions, revolutionizing healthcare management and administration.

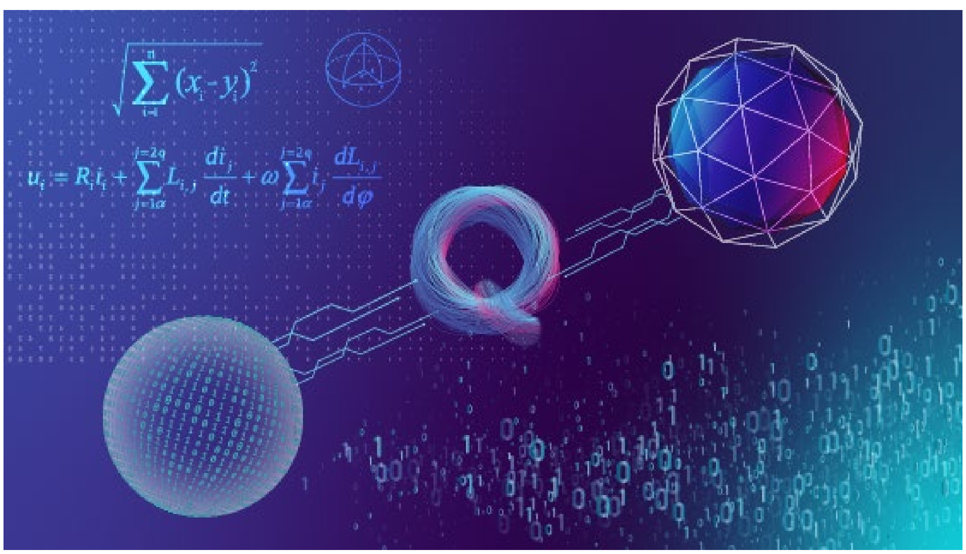

Figure 1. An image of the field of quantum physics shown a qubit in the top left corner with some math Brown, R. (2021, December 10). The Many Faces of a Qubit | Quantum Computing Inc. *Quantum Computing Inc.* https://www.quantumcomputinginc.com/blog/the-many-faces-of-a-qubit/

The Way a Quantum Computer Works

Understanding a Quantum Computer requires understanding the basics of quantum physics. Quantum computers rely on the principle of quantum superposition. Particles in the quantum realm exhibit much different behaviors than in the real world. The peculiarity of quantum physics is that the state of an object is affected by physical interactions. A good representation of this behavior is the thought experiment of Schrodinger's cat. Schrodinger's cat is an experiment about a cat in a closed box. Inside this box is a vial of poison gas that is either open or closed. When opened, the poison gas spews out and kills the cat. The idea is that it is unknown what the cat's state is until the box is opened, and an observation can be noted. When the box is open, the cat is either alive or dead. However, when the box is closed, before it is opened, the cat is both alive and dead at the same time. This is called superposition. It is only when the box is opened that this superposition collapses into a single, observable state that could be deduced. This odd experiment encapsulates the physics of particles in the quantum realm.

In a state of superposition, a particle is simultaneously in multiple possible states at the same time. However, the probability of each state occurring is different. For example, in Schrodinger's cat experiment, while the cat is in superposition, the cat is 50% likely to be alive and 50% likely to be dead. Similarly, the probability of a particle in superposition being in a certain state is different from the probability of this particle being in another state. This probability can be described as a wave of probabilities through a wave function. Which explains the wave-particle duality of subatomic particles. The state of a particle is unknown, in superposition, which can be represented by a wave function that represents the different probabilities for the different states a particle could be in. It is only when the state of this particle is finally measured that superposition collapses, and there is a definitive state observed.

Quantum computing embraces the idea of superposition for higher computing power. Classical computers use classical bits. These bits are either 0 or 1 in one possible state at all times. However, quantum computers use Quantum bits, or Qubits. They act the same as a classical bit except when the qubit is in superposition, it is both a 0 and 1 at the same time. This means one qubit can represent two possible states at the same time. With 2 classical bits there are four possible combinations, [0,1], [0,0], [1,0], [1,1]. However, the 2 classical bits must be in one single combination. Meanwhile, two qubits, due to superposition, can represent these 4 states at the same time. The amount states that a qubit could represent in parallel is 2^n, where n is the number of qubits. This is extremely powerful. At 10 qubits, a thousand states can be represented in parallel. At only 20 qubits, a million states could be represented in parallel. A key distinction to highlight is that a quantum computer is not inherently faster than a regular computer. The speed at which it can conduct a certain computation is not faster than a regular computer. However, these computers are much faster at analyzing huge amounts of data compared to regular computers because quantum computers can conduct multiple computations at the same time due to the principle of superposition.

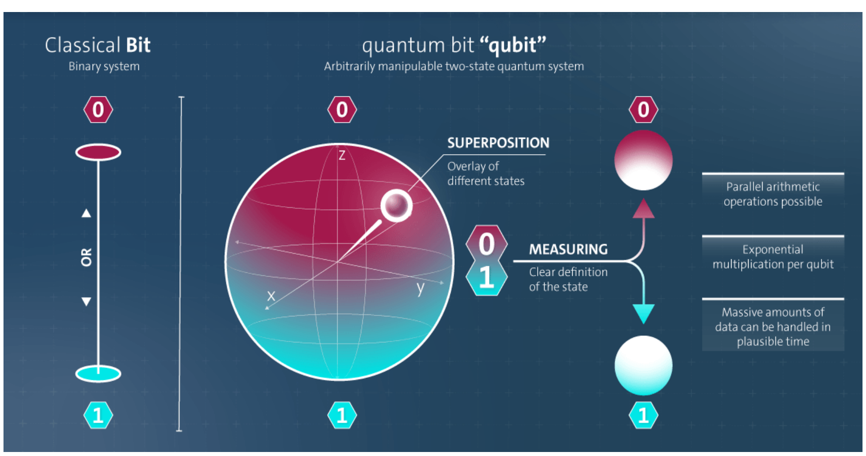

Figure 2. An image showing a comparison of a classical bit and a qubit. Arvindpdmn, P. P. (2022). Qubit. *Devopedia*. https://devopedia.org/qubit

Applications of Quantum Computing

Quantum computing has a potential role in aiding health insurance companies to administer healthcare to help reduce costs for both providers and customers. They are already playing a role in insurance prices, improving diagnostic procedures, and administering more precise treatment options for patients. Setting a price that is affordable for patients relies on multiple factors such as patient age, gender, genetic disposition, demographics, and much more. Since a quantum computer can handle more calculations in parallel, it can efficiently analyze staggering amounts of data regarding these factors mentioned above and can therefore set prices that are more affordable for any insurance users, and cost-efficient for insurance providers.

Diagnosing patients is also getting increasingly complex as it requires taking into account a lot of factors regarding a patient's health. At the same time, the use of revolutionary imaging techniques such as X-rays, CT scans, and MRIs are particularly helpful; however, sometimes these images have noise or have poor resolution of human anatomy. Quantum computers are already showing superior performance with image detection, allowing these computers to analyze such medical images effectively without the need for patients to undergo repeated medical imaging, reducing costs for healthcare providers and their insuree.

Quantum computers pave the way for more niche treatments for patients. The most effective treatment in healthcare is one that is preventive and proactive about the situation rather than reactive. Quantum computers could create better risk-forecasting models for their patients. This also better predictions for specific risks a patient might have that requires proactive treatment. At the same time, the treatments given to the patient can be tailored more effectively due to the use of quantum learning models. These models can identify interdependencies and other patterns based on the variety of factors that make up a patient's health. By effectively analyzing and identifying these interdependencies, quantum computers can help in aiding scientists to create treatments that are best effective against the patient.

Conclusion

Because of the stochastic nature underlying quantum physics and the complex data involved in quantum experiments, there is a great need to develop better data science approaches for quantum computation and quantum information. Quantum data science enables data scientists and business analysts to work with quantum scientists and engineers on this exciting frontier of scientific endeavor by integrating quantum science and data science.

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