Quantum computing is a topic that is not being discussed enough amongst the general public even though it can revolutionise the entire prospect of the world. It can solve the current energy crisis, then further solving climate change. It can also transform the development of drugs and materials. It can affect several aspects of our daily lives (TEDx Talks, 2020) but what is quantum computing?

The idea of quantum mechanics, the basis of quantum computing, has been around since 400BC. It was introduced by an Ancient Greek philosopher, Democritus. He believed that the entire universe is made up of atoms in a void that are always moving around because of some predetermined and understandable laws. Furthermore, he thought these atoms can bounce and hit off each other or eve stick together to make bigger things which can be known as molecules now (Aaronson, 2013). It is obvious to see that this Ancient Greek philosopher has a pretty modern view of science and he is often accredited for his formulation of the theory of atoms in the universe. Fast forward a couple thousand years, the conception of quantum computers was brought forward around the late 1970s and early 1980s. The name Richard Feynman is often brought up. He observed that particular quantum mechanical operations cannot be operated on classical computers (Polak & Rieffel, 2000).

To completely comprehend what quantum computing is, the basics are to be understood. First, it is to know what classical computing is. The computers everyone is very familiar with are models of classical computing, but there are supercomputers that are of a higher-level performance that still follow classical computing. The rudimentary building block of a computer, the bit, can store information and be represented logically by a zero, meaning off, or a one, meaning on (Bone & Castro, 1997). Then understand that quantum computing is a simulation of quantum mechanics. This deals with the behaviour of atoms and fundamental particles like electrons and photons. The sight can further be extended to the likes of molecules which are a group of atoms bonded together.

Thinking about the molecule for caffeine allows further inspection in this aspect. With the existence of supercomputers, it is understandable to think that this molecule can be taken and represented exactly in a computer. However, it is near impossible to do so on a classical computer. This is because the amount of bits that store the information of a caffeine molecule sums to roughly one to ten percent of the number of atoms in the entire world (Sutor, 2020). With a quantum computer, you can represent this molecule with quantum bits or qubits for short. These can exist in the classical position of either zero or one, however, it can be in a state where it is both zero and one. This is called superposition. This state can be taken advantage of. Operating on a singular qubit, essentially performs the operation on both values simultaneously. Increasing the number of qubits can exponentially increase this ‘quantum parallelism’ obtained from the system (Bone & Castro, 1997). Trying to determine whether the qubit is zero or one, will collapse the superposition, forcing the qubit to be either zero or one but the outcome is seemingly random. This is called decoherence. Scientists don’t completely understand what happens but there are a lot of theories trying to explain this. In the eyes of Shai Machnes on TEDx Talks (2020) or Bone and Castro (1997), the universe is split into two parallel universes where the qubit exists as zero in one universe and one in another. Unfortunately, the very reliance of the bizarre subatomic rules of quantum mechanics makes quantum computing difficult to control and fragile.

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