Quantum Computing

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You might have probably heard the term Quantum computing *(often referred to as new era of computers)*, if not, you'll get to know about it by the end of this article!

Overview

Now what exactly is Quantum computing?

Quantum computing is a special kind of computing that uses the principle of quantum mechanics *(a branch of physics that deals with really tiny particles like atoms)*, to perform complex computations.

But what makes it different from normal computing?

Unlike traditional computers which use 0's and 1's for performing computations, Quantum computing uses Qubits for computations which is millionth times faster than normal computers and super computers.

Now what's a Qubit?

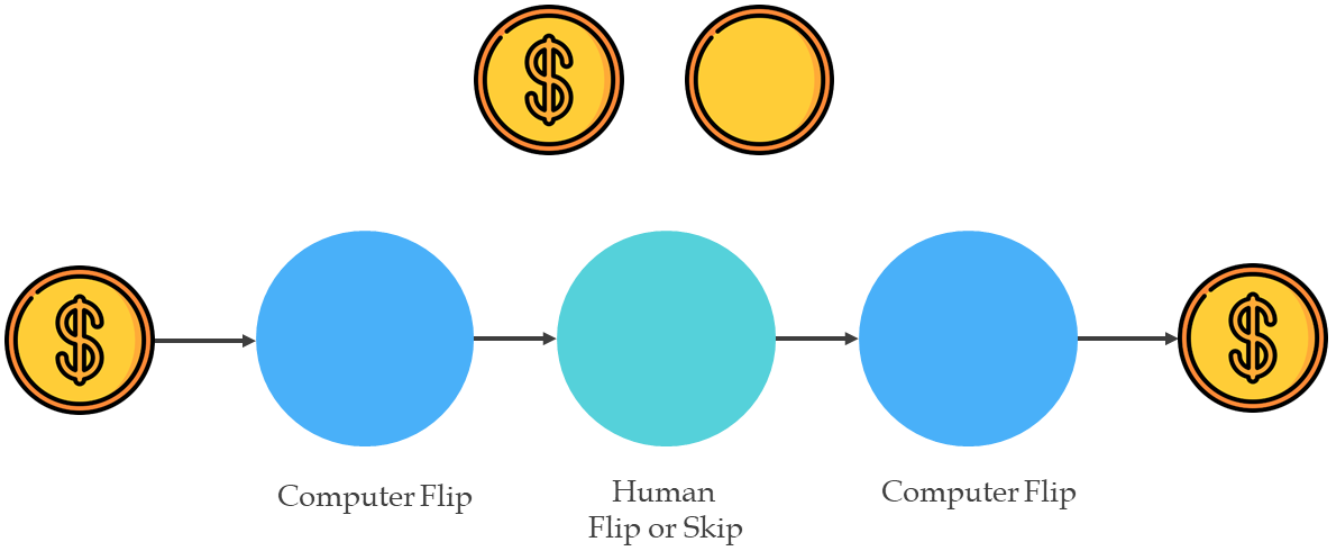
Qubits are basic units of quantum information *(just as 0's and 1's but not exactly either 0 or 1)*, that can be in superpositions.

Now what's a super position?

Super positions allow Qubits to represent both 0 and 1 at the same time which enables quantum computers to perform multiple tasks in parallel.

Example

Let's use the analogy of flipping a coin.



Here in this case, coin with **$** represents heads and the **plain** represents tails. Now there are 3 turns, the first and last turn is of computers and the middle turn is human's, here conditions are there,

1. computer must flip and humans may or may not flip.
2. Initially the coin will be in heads state.

Winning cases,

1. Computer wins, if the final output after 3 turns is heads.
2. Human wins, if the final outcome is tails.

In case of Classical computer:

First the computer will flip, now it will be tails, now assume human will flip, now it will be heads and finally the computer will flip, and the final outcome is tails, now the human wins. Even if in the second step if the human decides not to flip, the final outcome will be heads, in this case computer wins.

So, in classical computers case, there is a clear 50-50% chance of winning, for both computer and human.

In case of Quantum computer:

First the computer will flip, applying Hadamard gate *(don't worry of what it is, we don't need to understand it, for now)*, now in this case the coin's state will be neither 0 nor 1, it will be in a superposition, see below

now whatever the human does, either flip or not, it will be in the same state, as it is *(just assume flipping that coin at superposition it will be same regardless).* So now, in the final flip, the Quantum computer will again apply Hadamard gate to flip the coin, the result will be heads *(that's how Hadamard gate works, you can look online to learn more about it).*

So, there is a clear **100% chance** of Quantum computers winning & 0% of humans.

Now you might argue that, isn't it unfair to flipping like that by computer, might be the right question, but you might not understand the term Flip correctly.

Flip, need not be necessarily either heads or tails. Toss, is the one, which will be in either heads or tails.

So that's how Quantum computing works, Quantum computers can preserve that superposition by working at atomic level or sub atomic level. To do that there needs to be too cold temperature to work at atomic level, because of which huge refrigeration is needed, this is one of the conditions, there are many and you can learn more about it online.

Use cases of Quantum computing

1. Cryptography and Security:

Quantum computing threatens traditional encryption by efficiently solving complex mathematical problems, prompting the development of quantum-resistant algorithms and secure communication methods.

2. Drug Discovery:

Quantum computers accelerate drug discovery by simulating molecular interactions, predicting potential drug candidates, and optimizing molecular structures for enhanced pharmaceutical efficacy.

3. AI and Machine Learning:

Quantum computing enhances machine learning algorithms, enabling quicker and more accurate pattern recognition in areas like image and speech recognition.

4. Supply Chain Optimization:

Quantum computers optimize supply chain management by determining efficient transportation routes, minimizing costs, and optimizing inventory levels.

5. Climate Modelling:

Quantum computers simulate complex climate models, aiding researchers in predicting weather patterns, studying climate change impacts, and optimizing sustainable resource management strategies.

Wrap up

So now that you've got to know a bit about Quantum computing, now let's see who are all working towards this.

There are many industry leaders & nations who are working too hard and investing Billions of dollars to make one computer like this, because it is so much powerful and useful than normal computers.

Naming some of them,

IBM, Google, Amazon, Microsoft, Intel, D-Wave, Quantinuum and many more…

So, what you are waiting for learn more at **ibm.com/quantum**