***~~QUANTUM COMPUTING~~***

# Definition : -

Quantum computing uses specialized technology including computer hardware and algorithms that take advantage of quantum mechanics to solve complex problems that classical computers can’t solve, or can’t solve quickly enough.

# Need : -

**When scientists and engineers encounter difficult problems, they turn to supercomputers. These are very large classical computers, often with thousands of classical CPU and GPU cores capable of running very large calculations and advanced artificial intelligence. However, even supercomputers are binary code-based machines reliant on 20th century transistor technology. They struggle to solve certain kind of problems.**

**If a supercomputer gets stumped, that’s probably because the big classical machine was asked to solve a problem with a high degree of complexity. When classical computers fail, it’s often due to complexity.**

**Complex problems are problems with lots of variables interacting in complicated ways. Modelling the behaviour of individual atoms in a molecule is a complex problem, because of all different electrons interacting with each other. Identifying subtle patterns of fraud in financial transactions or new physics in a supercollider are also complex problems. There are some complex problems that we do not know how to solve with classical computers at any scale.**

**The real world runs on quantum physics. Computers that make calculations by using the quantum states of quantum bits should in many situations be our best tools for understanding it.**

# Why Are They Faster?

Let’s look at an example that shows how quantum computers can succeed where classical computers fail:

A classical computer might be great at difficult tasks like sorting through a big database of molecules. But it struggles to solve more complex problems, like simulating how those molecules behave.

Today, if scientists want to know how a molecule will behave they must synthesize it and experiment with it in the real world. If they want to know how a slight tweak would impact its behaviour, they usually need to synthesize the new version and run their experiment all over again. This is an expensive, time-consuming process that impedes progress in fields as diverse as medicine and semiconductor design.

A classical supercomputer might try to simulate molecular behaviour with brute force, by using its many processors to explore every possible way every part of the molecule might behave. But as it moves past the simplest, most straightforward molecules available, the supercomputer stalls. No computer has the working memory to handle all the possible permutations of molecular behaviour by using any known methods.

Quantum algorithms take a new approach to these sorts of complex problems creating multidimensional computational spaces. This turns out to be a more efficient way of solving complex problems like chemical simulations.

We do not have a good way to create these computational spaces with classical computers, which limits their usefulness without computation. Industrial chemists are already exploring ways to integrate quantum methods into their work. This is just one example. Used at:

* Engineering firms
* Financial Institutions
* Global Shipping companies

An explosion of benefits from quantum research and development is taking shape on the horizon. As quantum hardware scales and quantum algorithms advance, many big, important problems like molecular simulations should find solutions.