quantum computing

by María Delgado

WHat DOes "quantum" mean?

- QUANTUM MECHANICS: describes how objects behave at small scale
  - *Describes physics at the microscopic level
  - * Seemingly incompatible with the types of obs. in everyday
  - * Leads to counter-intuitive effects
  - * Used for describing the behavior of an atom

➡ QUANTUM COMPUTING: uses quantum phenomena to perform computation

- *Quantum mechanics is an additional tool used by quantum computers
- * Solve certain computational problems that normal computers cannot

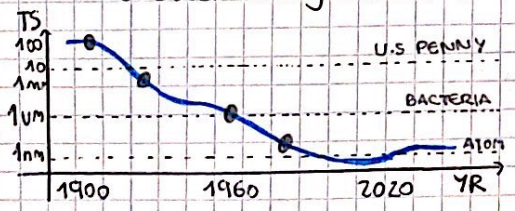
~ QC is an application of QM

WHy go quantum?

- Some problems are just too hard for a classical com to solve

*MOORE'S LAW

"Computational power gets doubled every 18 months"



Current state QCOM

" 54-qubit superconducting quantum computers"

⇒ IBM, Google, Intel, Rigetti...

[QU]BIT of quantum Hist

Quantum Hardware PLat

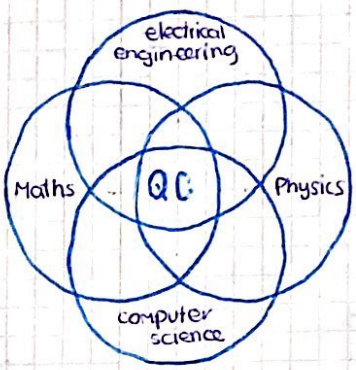
- Nuclear magnetic resonance
- Trapped Ions
- Majorana | Topological
- Neutral atoms
- Diamond NV cent
- Superconducting
- Photonics

applications

- * chemistry
- * Machine learning
- * Finance
- * Cryptography
- * Agriculture
- * Biology
- * Physics
- * Medicine ...

WHat is it?

- It's interdisciplinary



*AMIR'S COCKTAIL PARTY DEFINITION

"In quantum computing we use the weirdness of quantum mechanics to solve problems that normal computers cannot"

BIT (Classical computing)

Basic unit of information processes.

QUBIT (Quantum computing)

It can be a combination of 0 and 1 simultaneously.

Superposition | Entanglement | Quantum Interference

These three weird properties enable the design of quantum algorithms which can compute in ways classical computers cannot. Quant Com are more powerful.

Superposition: quantum systems can exist in two states at once

our qubit can be in 0 and 1 at the same time. But then, when we as humans observe it or perform a measurement, this qubit collapses to be either zero or one.

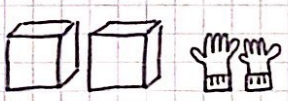
EX: SCHRÖDINGER'S CAT
- If deccays → Hammer hits poisson
- If not deccays → Hammer won't hit it

It is dead but alive

Entaglement: spoky action at a distance

the idea that if you have an entangled pair of particles or more, one of the states of one of the cubic bits or quantum particles cannot be described without the other's state.

EX:



randomly put each glove in each box and shuffle them.

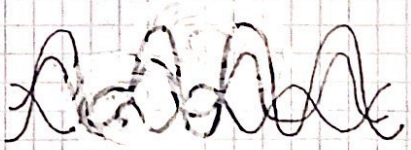
↓

Each box with a glove is in the opposite ends of the galaxy ← If someone open a box, instantaneously, the other will know what he/she has

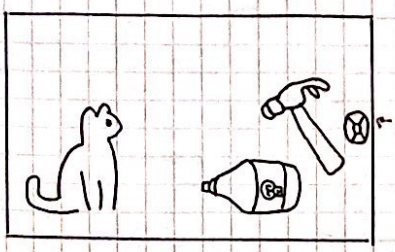
Interference: quantum objects can interact like waves

This is the notion of wave particle duality

Essentially: the probability amplitudes of particles in quantum states can constructively and destructively interfere to create peaks and crests that we call quantum interference



SCHRÖDINGER'S CAT



← Apparatus with radioactive isotope in → It has a certain probability of decaying within the next hour

- If not decays → Hammer won't hit pois. → Cat is Alive
- If it decays → Hammer will hit pois → Cat is Dead