QUANTUM COMPUTING

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 observations 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

"Quantum computing is an application of Quantum Mechanics"

[QU]BIT OF QUANT HIST

1981 — Feynman proposes framework
1994
Peter Shor shows factorise
1998 — 1st experimental demostration qAlg
Few-quibit processors and error
2012
2017 — Cloud-based quantum computing
Quantum Supremacy
2019

WHY GO QUANTUM?

Some problems are just too hard for a classical computer to solve

MOORE'S LAW

"Computational power gets doubled every 18 months"

1900   1960   2020

U.S PENNY
BACTERIA
ATOM.
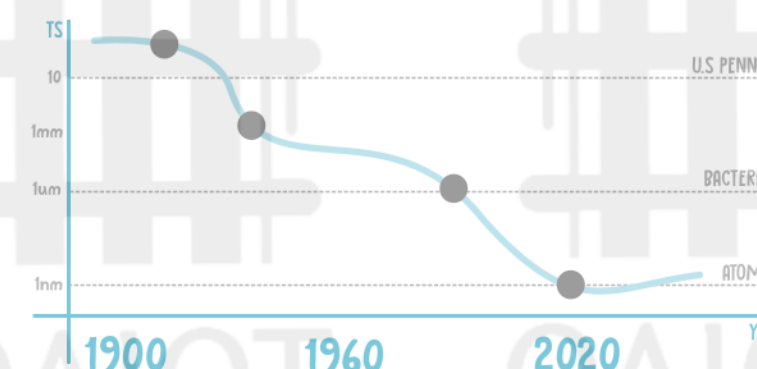
QUAN HARDWARE PLAT

★ Nuclear magnetic resonance
★ Trapped Ions
★ Majorana/Topological
★ Neutral Atoms
★ Diamond NV Cent
★ Superconducting
★ Photonics

CURRENT STATE QCM
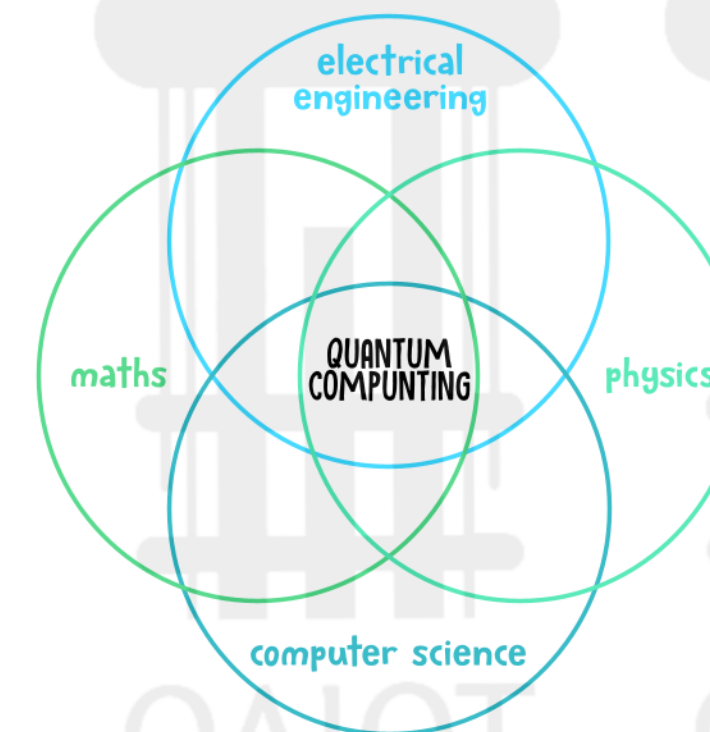
"fifty-four quibit superconducting quantum computers"

- IBM, Google, Intel, Rigetti...

APPLICATIONS

★ Chemistry
★ ML
★ Finance
★ Cryptography
★ Agriculture
★ Biology
★ Physics
★ Medicine...

WHAT IS IT?

It's interdisciplinary

electrical engineering
maths
QUANTUM COMPUNTING
physics
computer science

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)
0
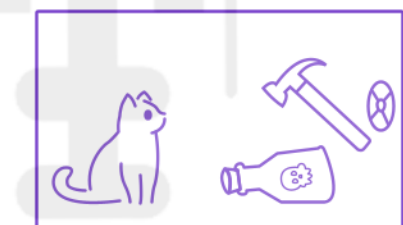1
Basic unit of information processes

QUBIT (Quantum computing)
0
1
It can be a combination of 0 and 1 simultaneously

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 quibit collapses to be either zero or one
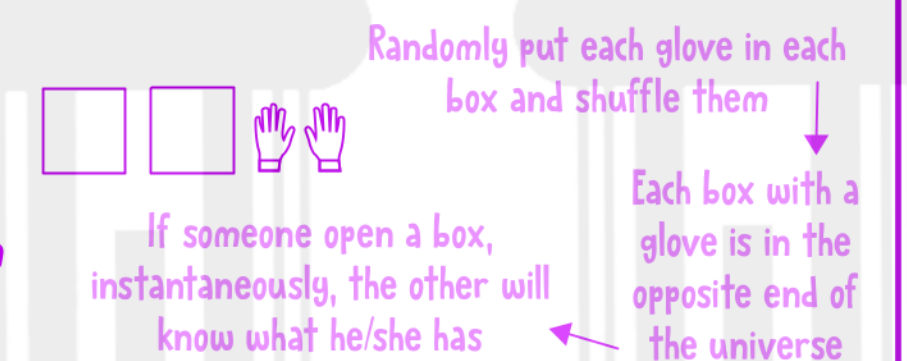
SCHRÖDINGER'S CAT
The cat is dead but alive, and alive but dead

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

Randomly put each glove in each box and shuffle them

If someone open a box, instantaneously, the other will know what he/she has

Each box with a glove is in the opposite end of the universe

INTERFERENCE quantum objects can interact like waves

Essentially: the probability amplitudes of particles in quantum states can constructively interfere to create peaks and crests that we call quantum interference
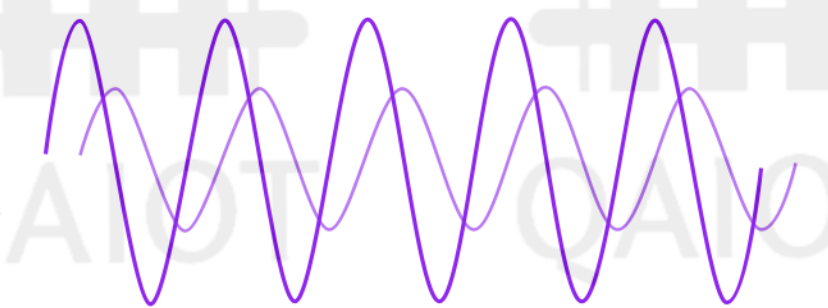
These three weird properties enable the design of quantum algorithms which can compute in ways classical computers cannot.