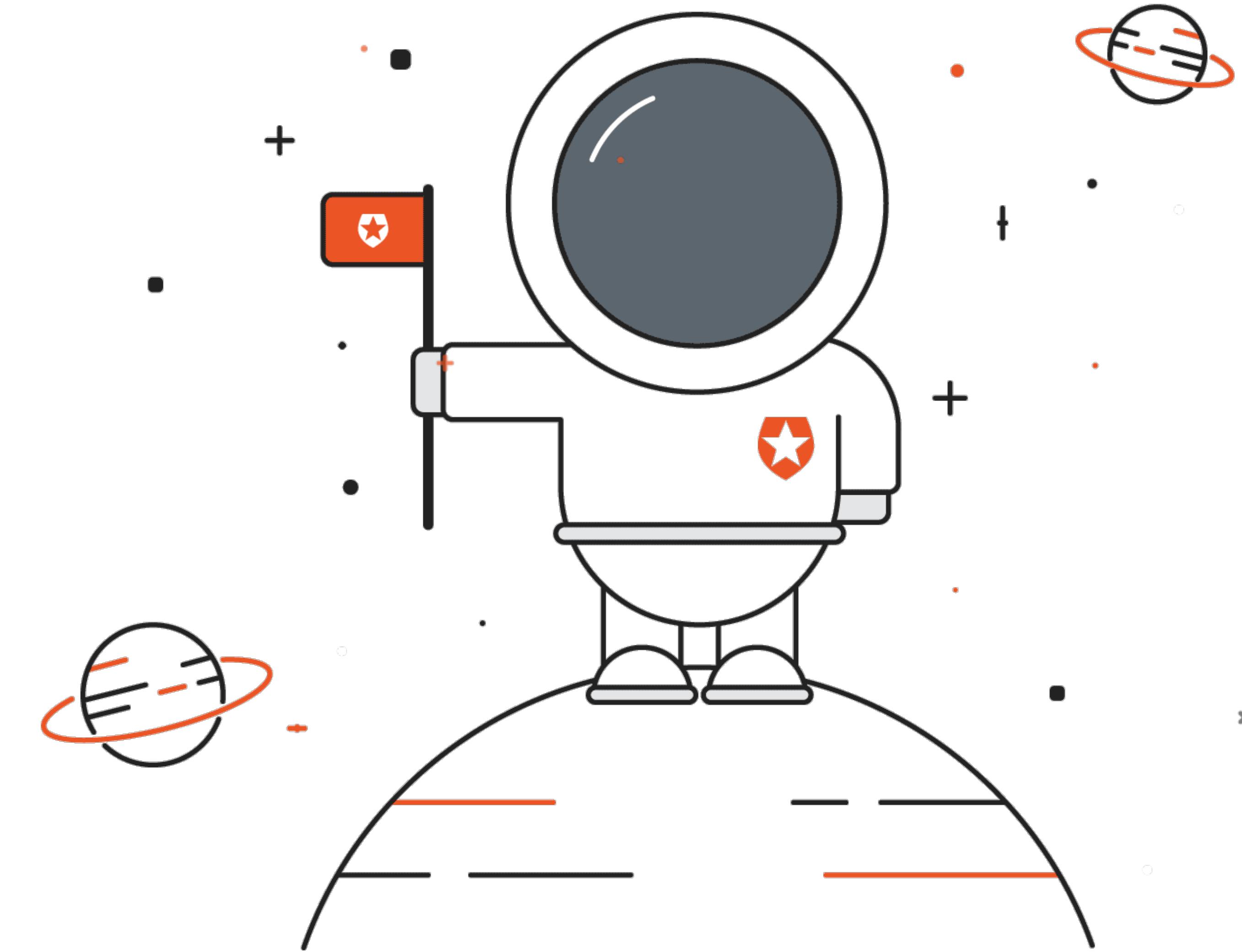
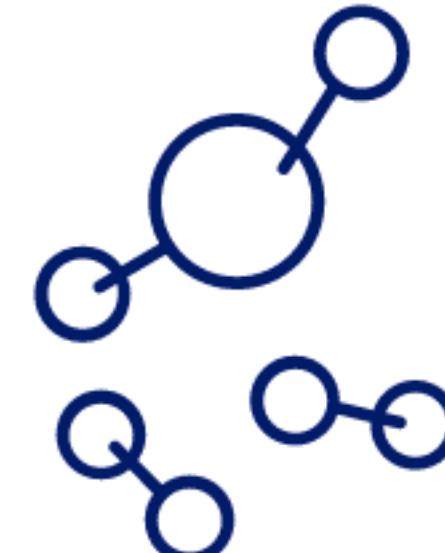


Introduction to Quantum Computing



“Quantum Computing is a beautiful combination of quantum physics, computer science, and information theory”

QUANTUM COMPUTING, A Gentle Introduction
Eleanor Rieffel and Wolfgang Polak

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“Quantum Computing is based on quantum physics, there is often some mystery associated with it. Quantum physics is not the simples part of physics, and some aspects of quantum physics are extremely difficult to understand”

Quantum Computing for Java Developers
Johan Vos

@itrjwyss



Mercedes Wyss

@itrjwyss



Community Leader
+
Devs+502 & JDuchess Guatemala

Co-Leader
PyLadies & Women in Data
(Ciudad de Guatemala)

Mozilla (Hispano & Guatemala)

Chief Technology Officer (CTO) at Productivity
Full Stack Developer (Mobile, Backend)

Auth0 Ambassador & Oracle Groundbreaker



Oracle
Groundbreaker
Ambassador

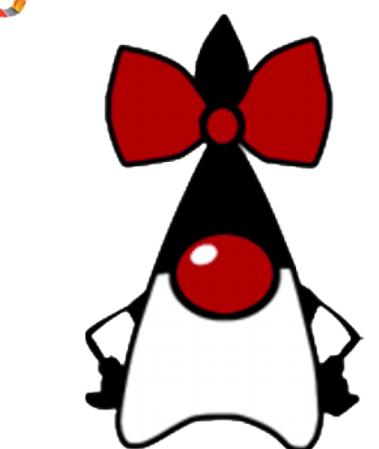


Devs
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Comunidad Desarrolladores en Tecnologías
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Quantum Computing

What is?

- Quantum Physics and Quantum Mechanics.
They study the fundamental particles of nature.
- Replicar el comportamiento e interacciones de las partículas más pequeñas.



Principles of Quantum Physics / Mechanics

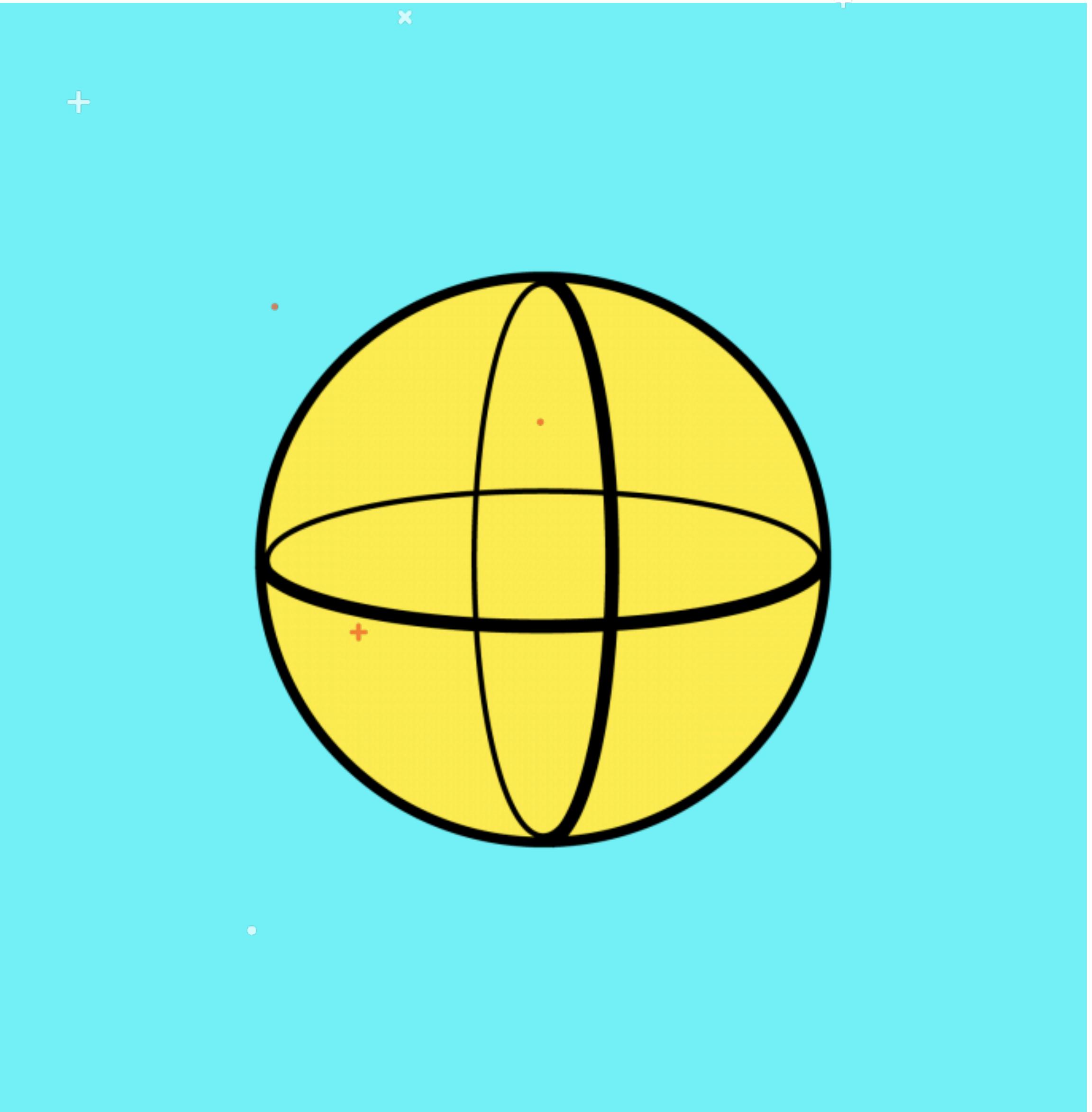
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SPIN

Quantum Principle

- Can take two values: up and down.
- In computing it is taking the values: 0 o 1.
- Complemented by another property called **superposition**.

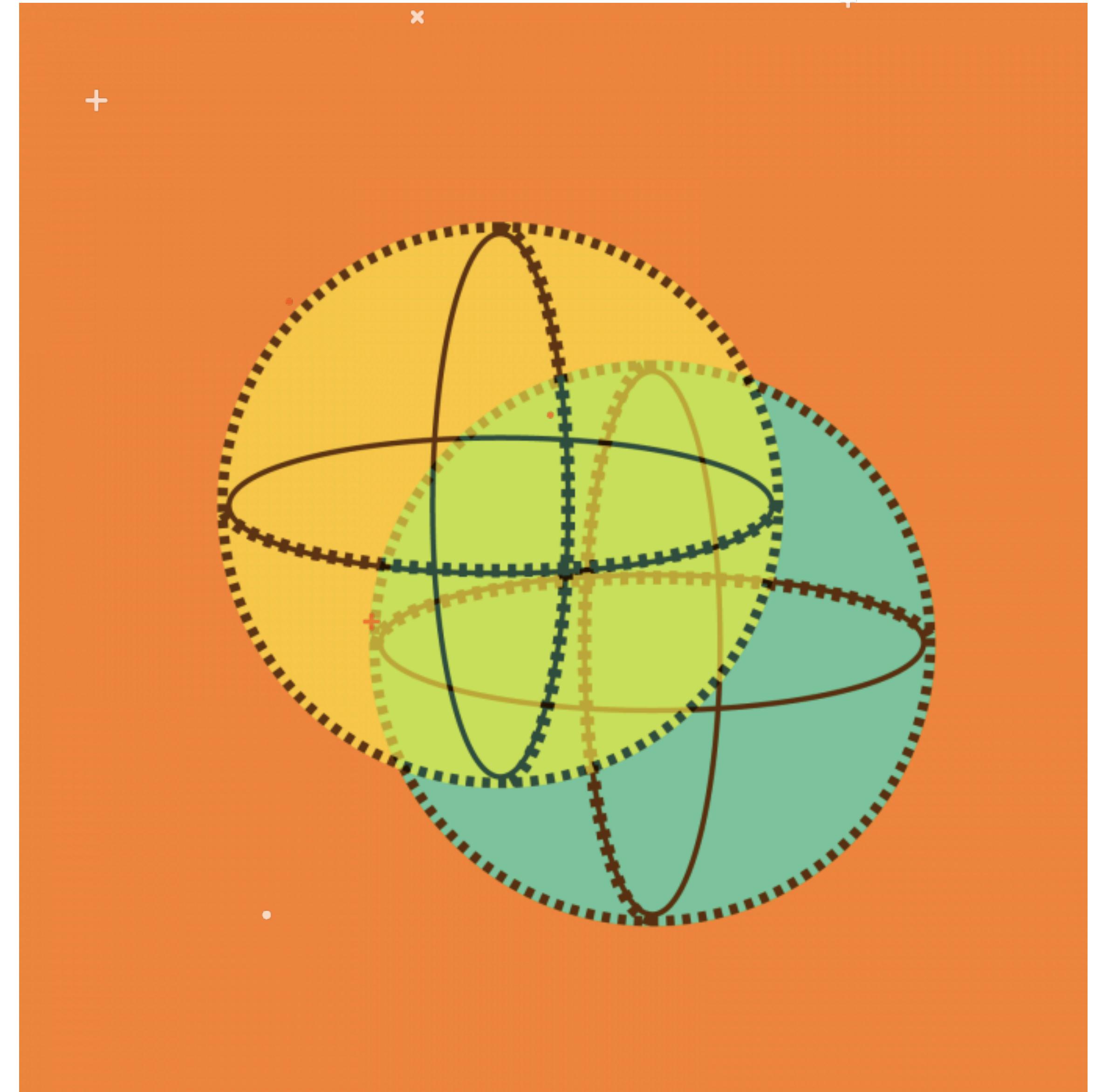
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Superposition

Quantum Principle

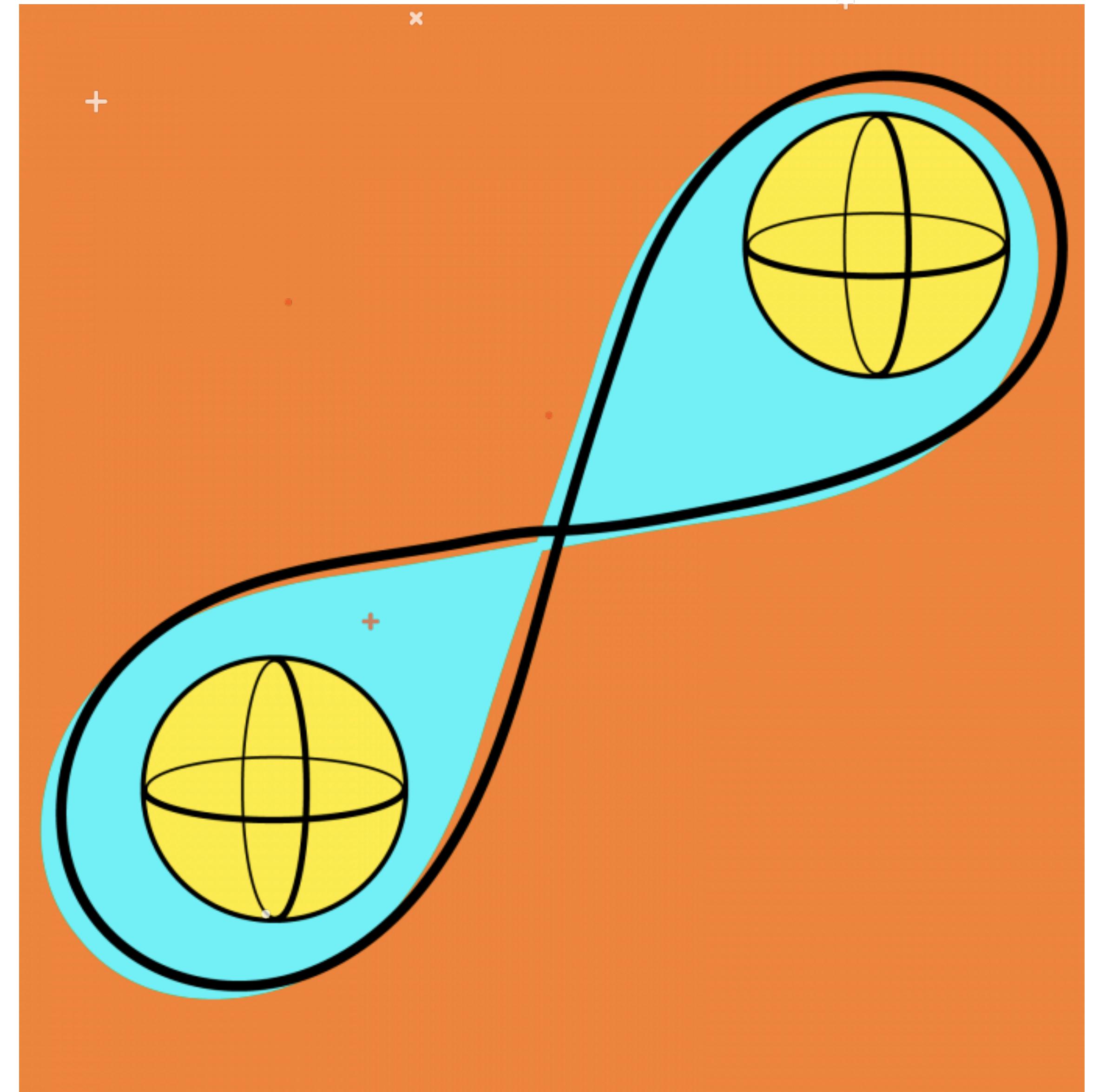
- A particle can represent both values, up and down, at the same time.
- In computation is take the values, 0 y 1, at the same time.



Entanglement

Quantum Principle

- Tangle particles behave together.
- They replicate their state as a mirror.



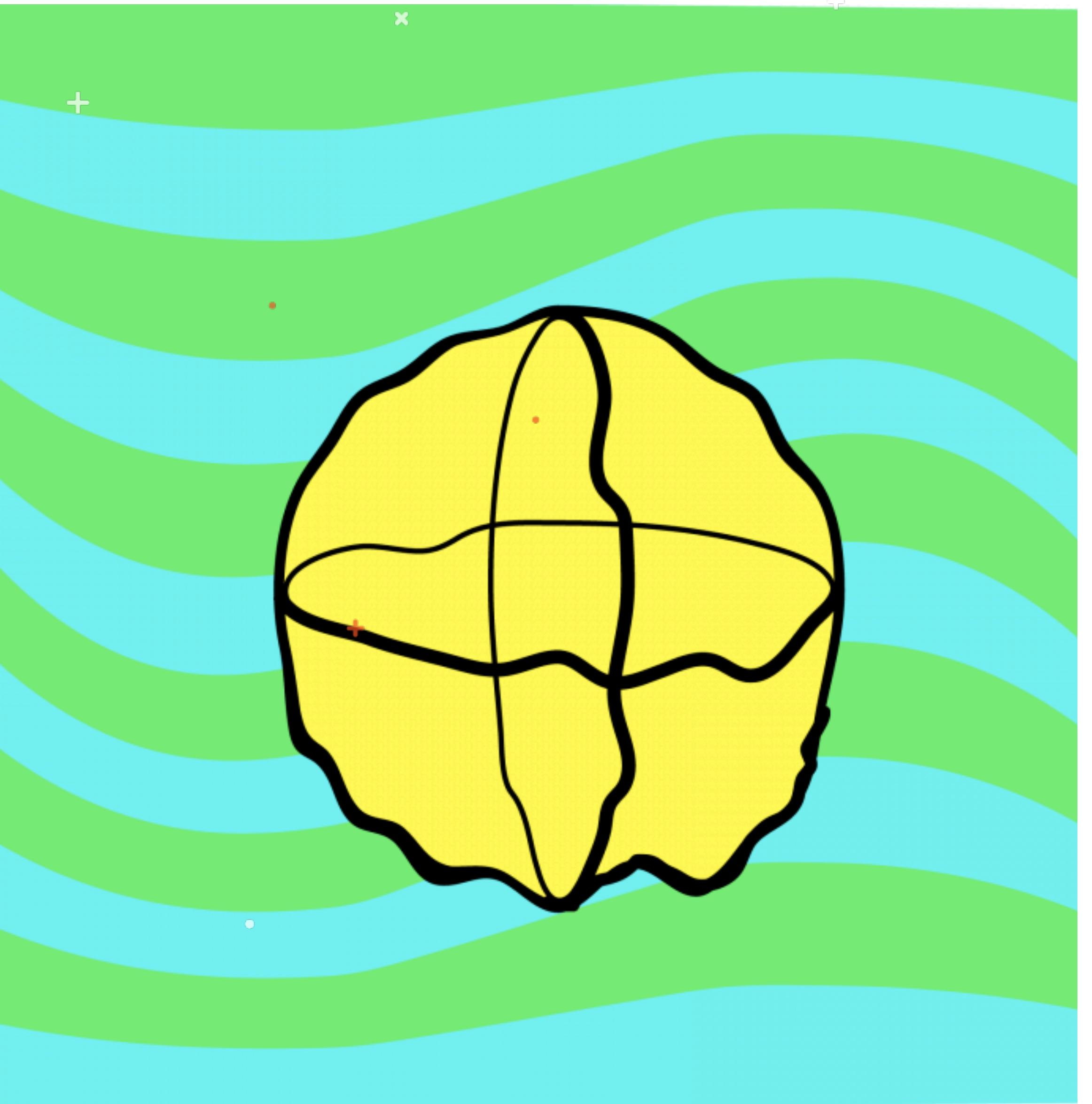
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Decoherence

Quantum Term

- Go from a quantum state to a classical physical state.

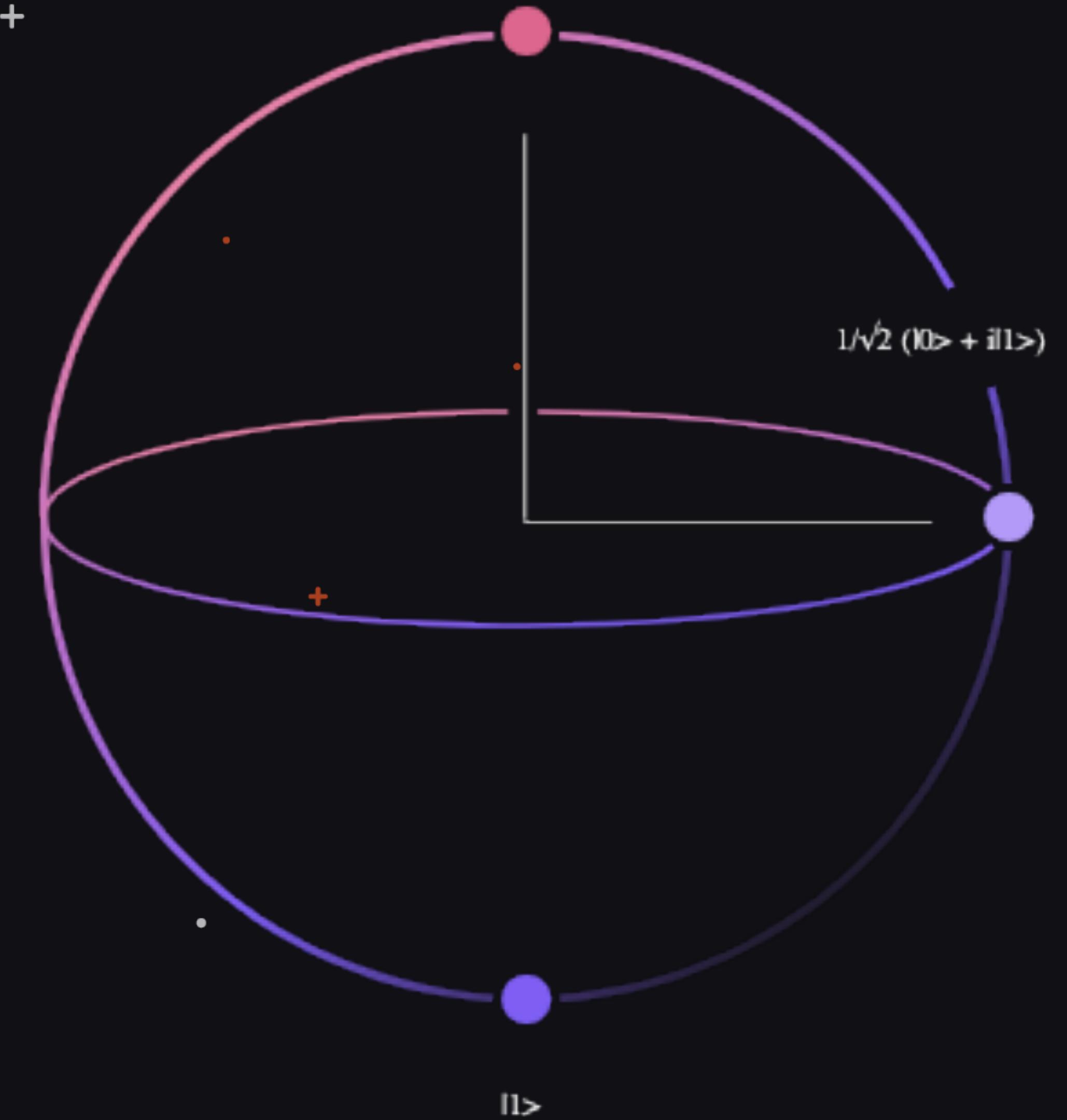
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QUBIT

Processing Unit

- Emulate the **spin** property.
- Can has both states at the same time (0 y 1), **superposition**.

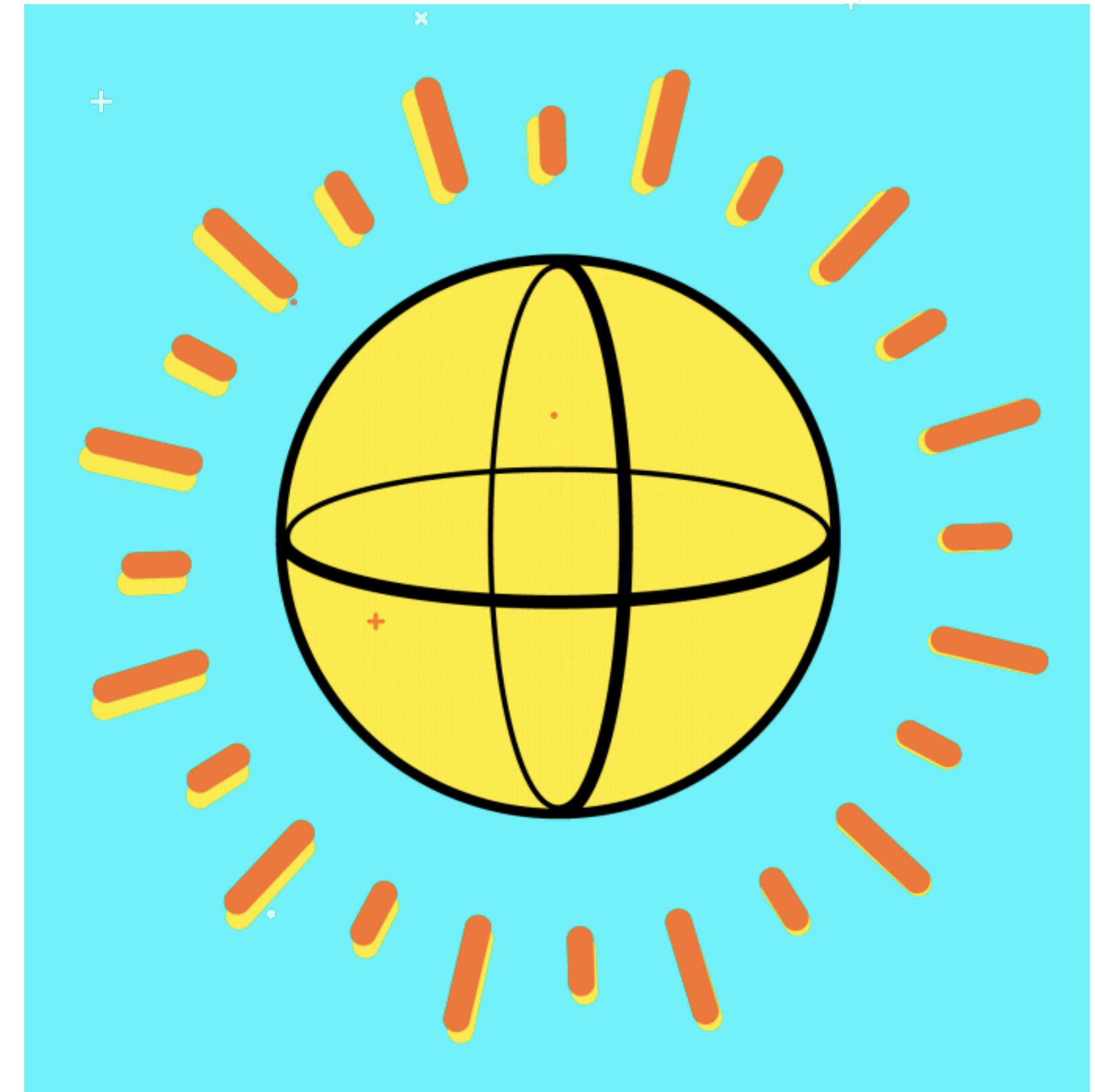


Quantum Supremacy

Quantum Computing Term

- Complete a mathematical calculation that is demonstrably out of reach (even) of the most powerful supercomputer.
- It is estimated that it will take 5 or more years to reach it..

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Quantum Processing

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Quantum Processing

- Integer Factoring

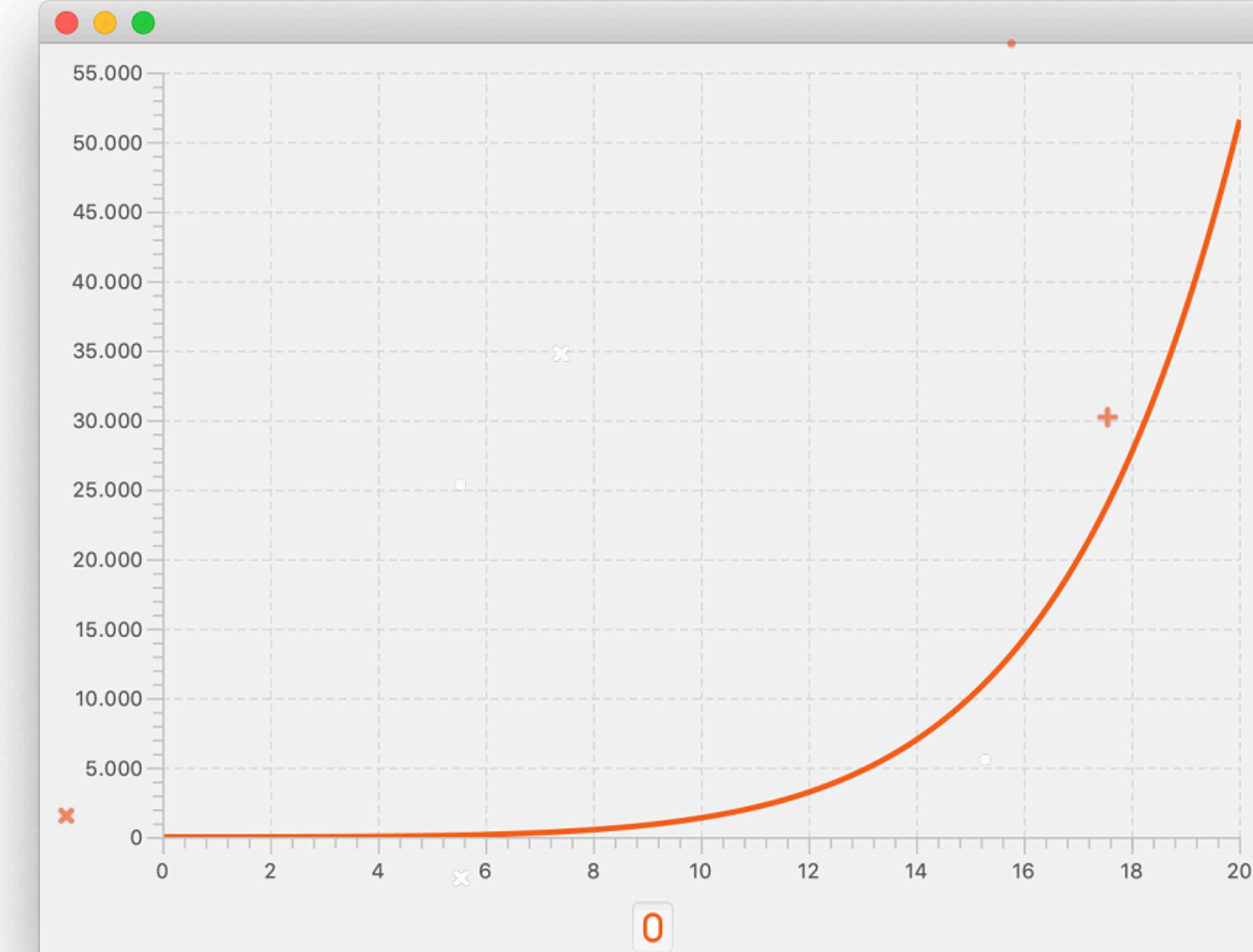
$$15 = 3 \times 5$$

$$146963 = 281 \times 523.$$

$$e^{\sqrt{(64/9)b(\log b)^2}}$$

Quantum Processing

Time grows exponentially with the number of bits.

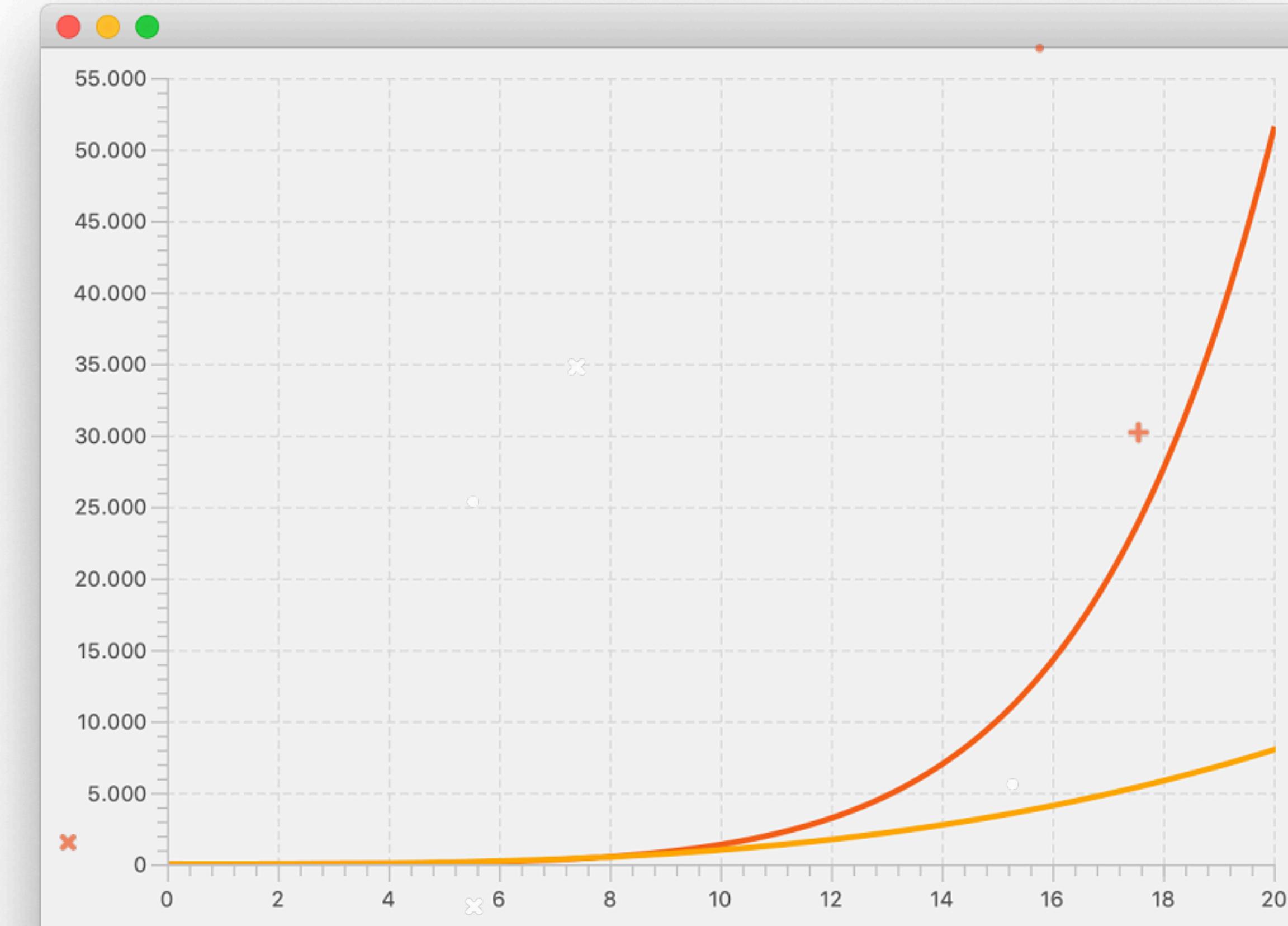


The Times

- **Exponential Time:** Use time exponentially based on the number of variables.
- **Polynomial Time:** Use less time than the number of variables involved.

Quantum Processing

Polynomial Time vrs Exponential Time



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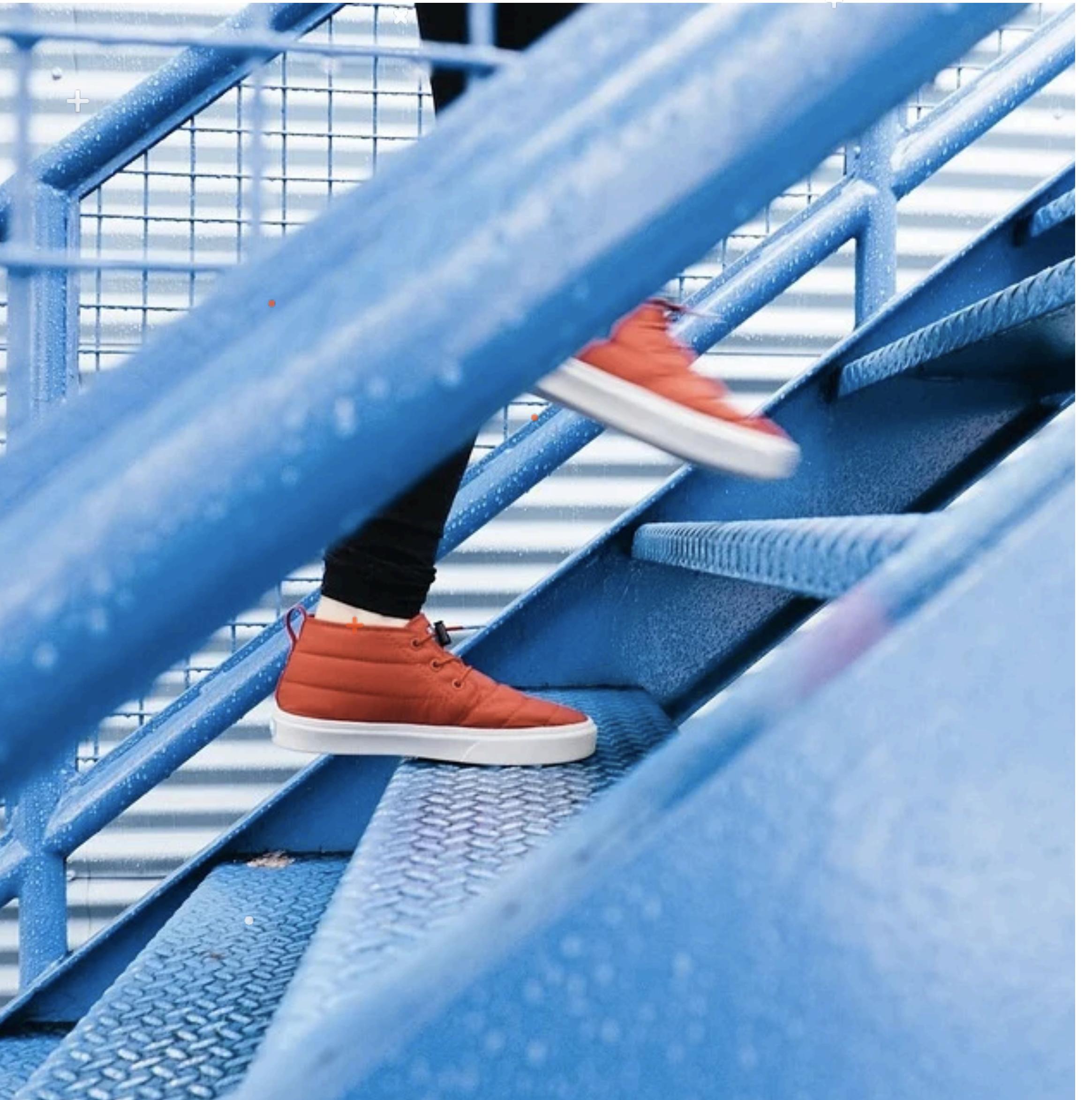
Quantum Computing Landscape

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Landscape Quantum Computing

- Hardware
- Software

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Quantum Computer

Is a device that takes data as input and does some sort of operations on that data, which requires the use of quantum physics to describe this process.

Quantum Hardware

Quantum Computers or Quantum Co-Processors

- Practical restrictions (permanent nitrogen cooling and over-cooled vacuum chambers).
- Decoherence, intelligent quantum algorithms.
- Standard QUBITS and Logic QUBITS.
- Maximum generated Standard Qubits are 128.

Quantum Algorithms

- First Algorithms
 - ◆ Deutsch Problem
 - ◆ Deutsch-Jozsa Problem
 - ◆ Simon Problem
- Grover Algorithm
- Quantum Fourier Transform
- Shor Algorithm

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5) $f(x) = x^2$
Find the derivative

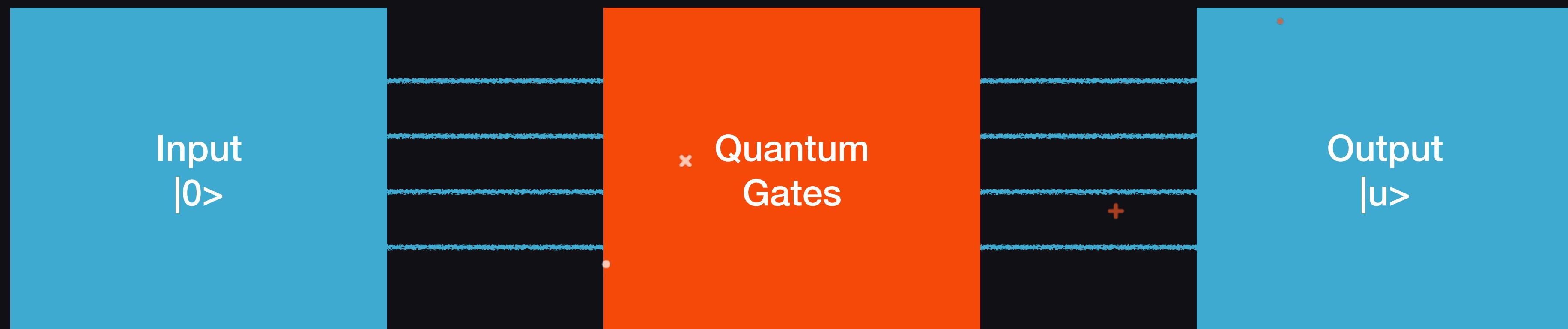
$$\frac{y_0}{x_0} = \frac{g(x+h) - g(x)}{(x+h) - x} = \frac{g(x+h) - g(x)}{h}$$

$y = g(x)$
Secant Lines
Tangent Line

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$
$$f'(x) = \lim_{h \rightarrow 0} \frac{(x+h)^2 - x^2}{h}$$
$$= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 - x^2}{h}$$
$$= \lim_{h \rightarrow 0} \frac{2xh + h^2}{h}$$
$$= \lim_{h \rightarrow 0} h(2x + h)$$
$$= \lim_{h \rightarrow 0} (2x + h)$$

$f(x) =$
 $f(a) = \frac{1}{h}$
 $f'(a) = \lim_{h \rightarrow 0}$

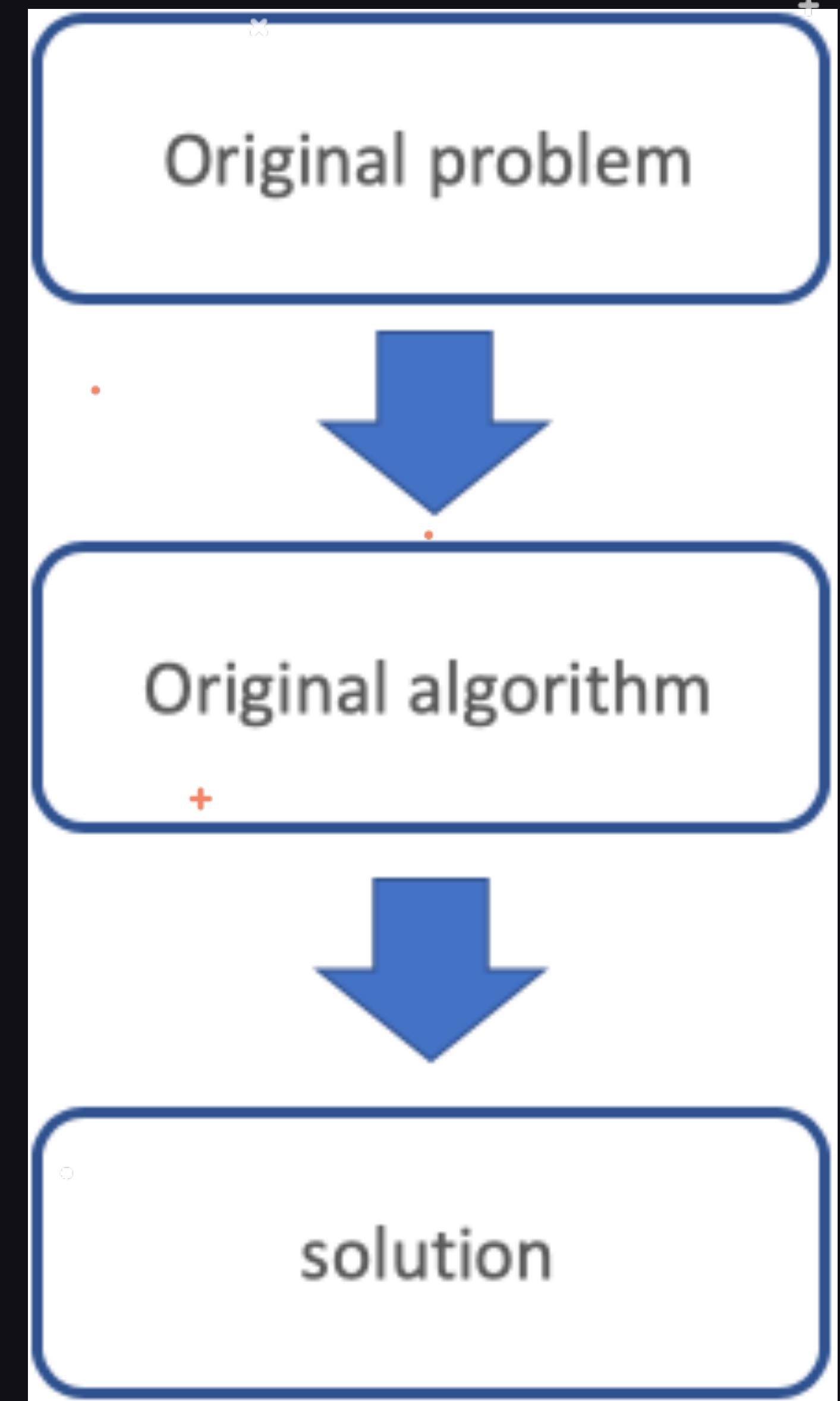
Quantum Algorithms



Classic Algorithm

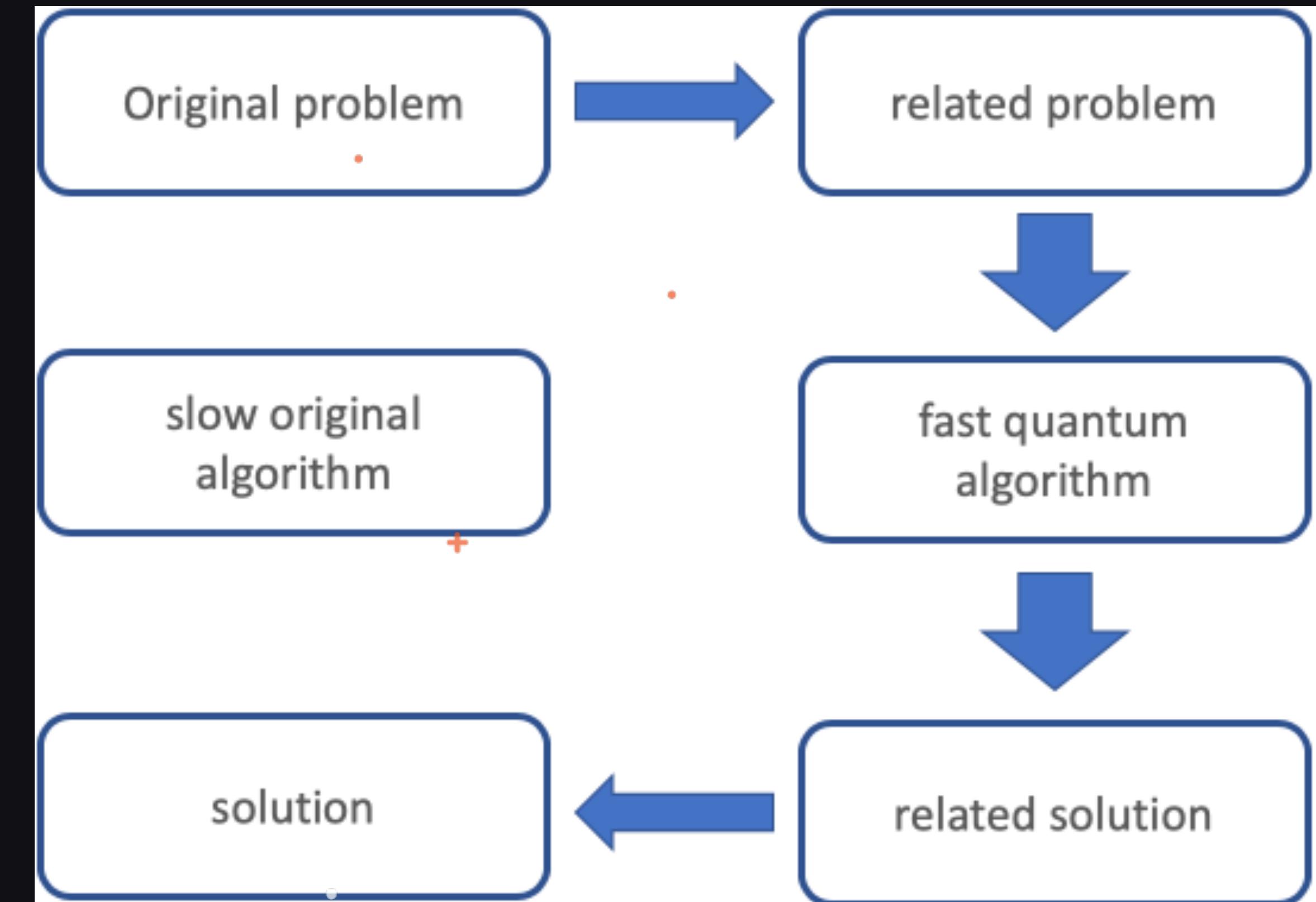
- Problem solving with classical computing.

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Quantum Algorithm

- Solve a problem using quantum computers.

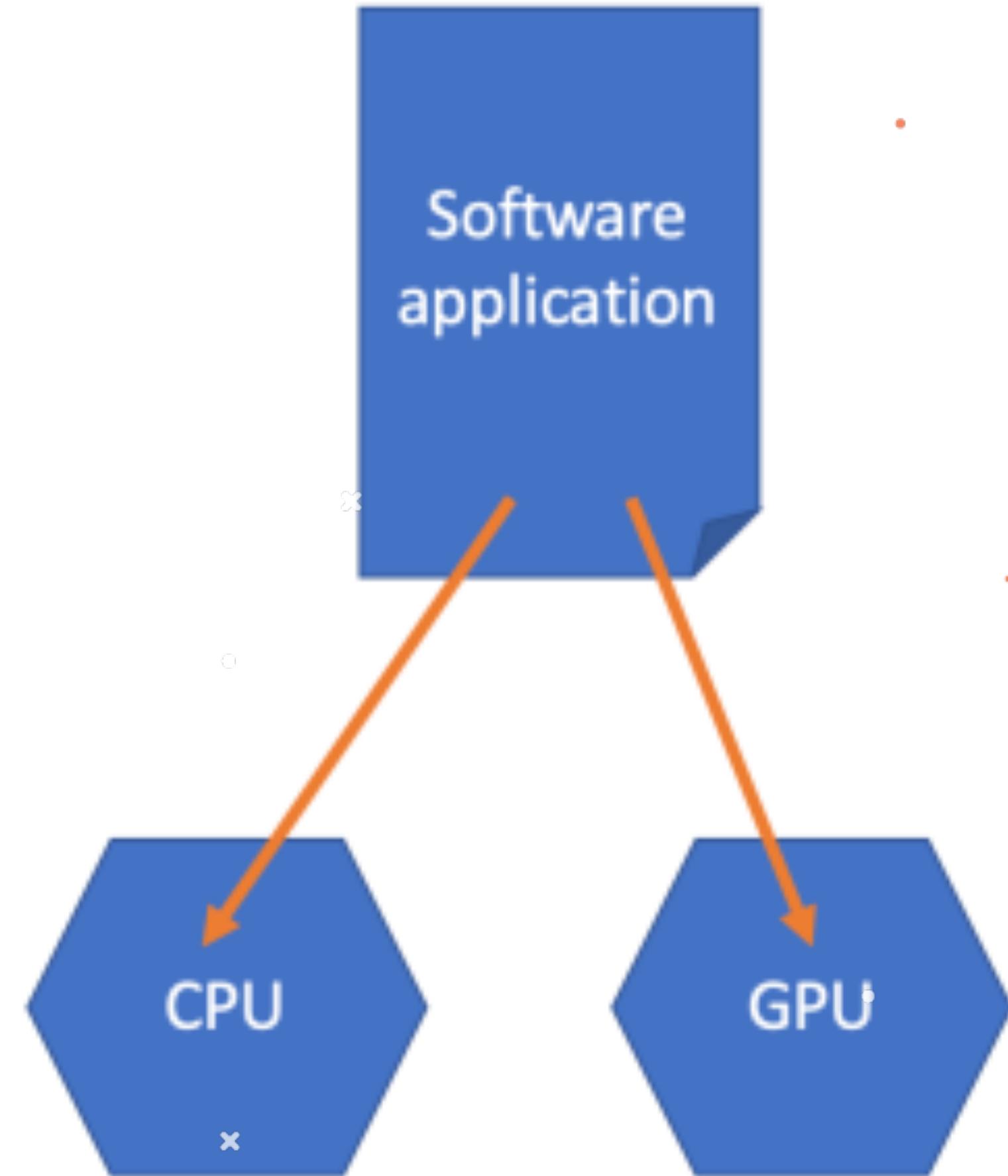


Hybrid Computing

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Hybrid Computing

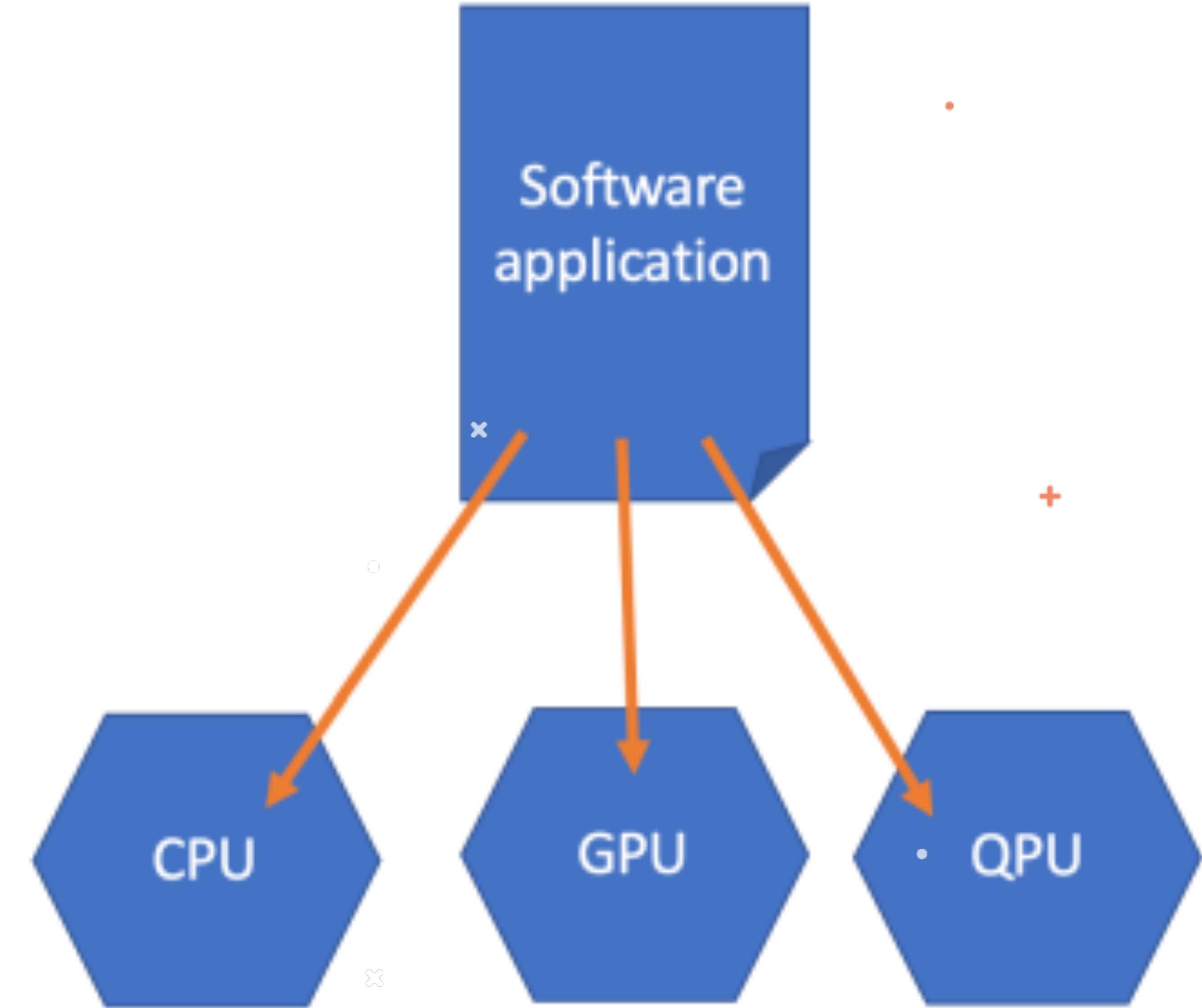
Example



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Hybrid Computing

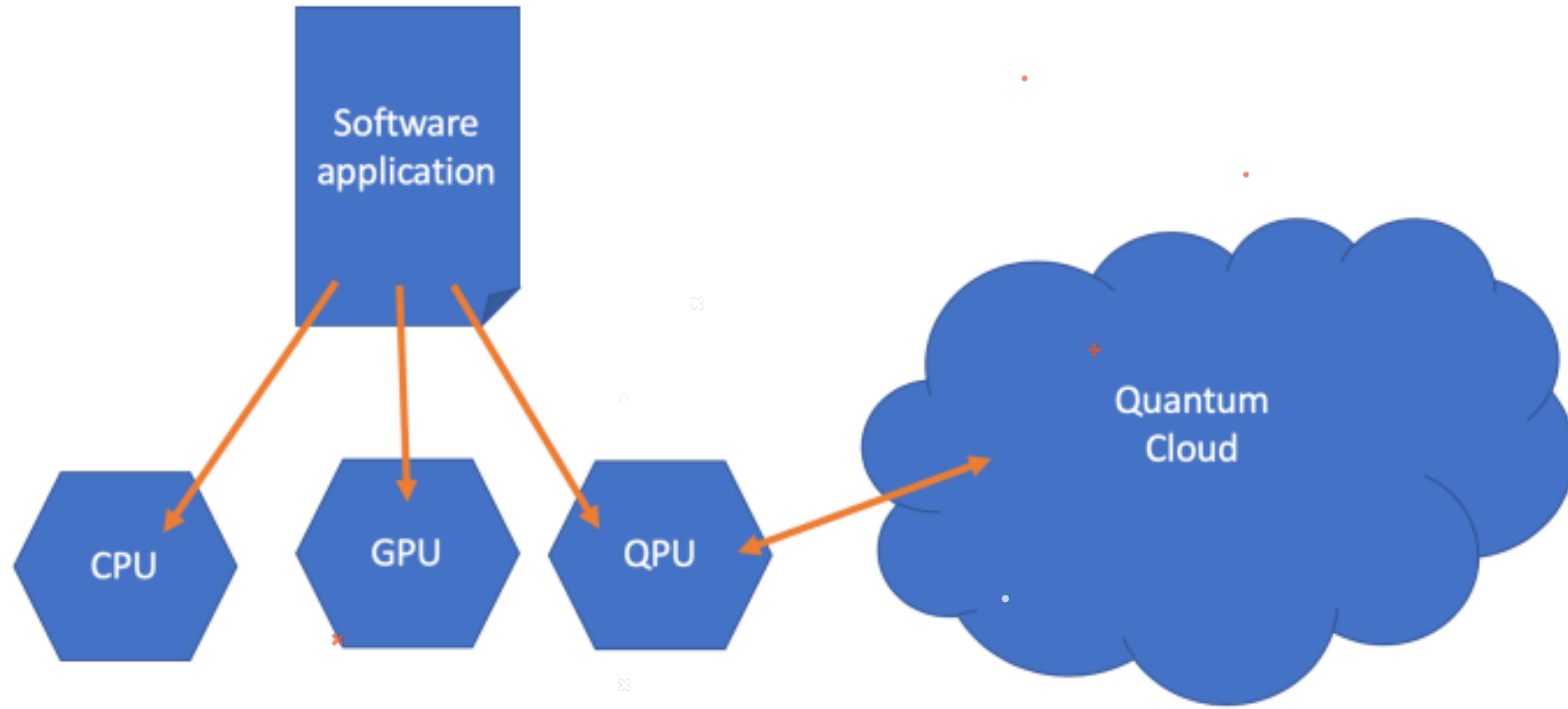
Example



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Hybrid Computing

Example



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Use Cases or Applications

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Applications Landscape

- Quantum Security
- Molecular simulation
- Healthcare



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Increasing Security

- Blockchain
- Better encryption algorithms



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Supersonic drug design

- Artificial intelligence, human organs on chips, silico testing.
- Power this with quantum computing.



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In silico clinical trials

- Better computer simulations.
- Virtual humans.



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DNA sequencing and analysis

- Genetic testing.
- Disease diagnosis.



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Focus on Patients

- Make sense of huge amounts of data.
- Health sensors, portable and / or medical devices.
- Lifestyle predictions.



Decision Support System

- Text mining.
- Offer a decision support system for physicians.
- Show related studies.



<https://github.com/itrjwyss/>

<https://www.facebook.com/itrjwyss>

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