

Introdução a Quantum Computing

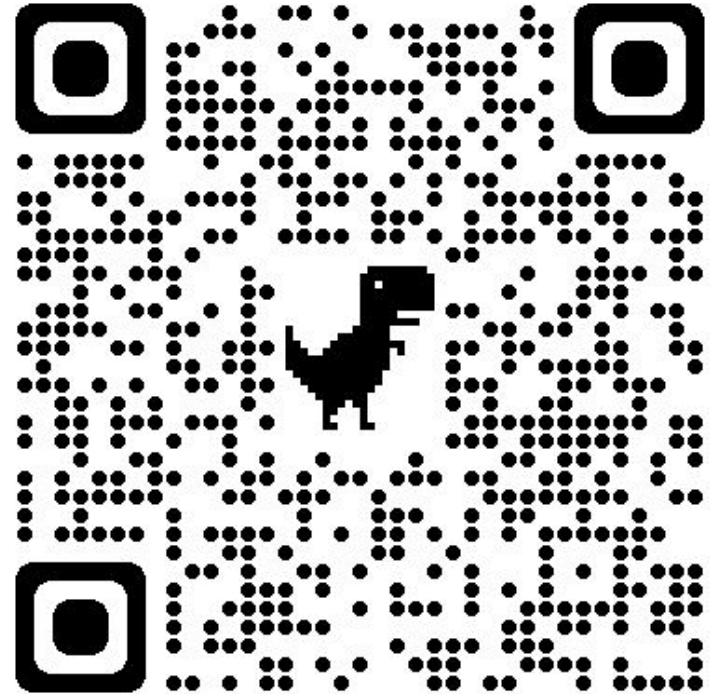
Alexandre Silva - BCC

Objetivos

- Mostrar um pouco o mundo da computação quântica;
- Dar o pontapé inicial;
- Instigar o estudo dessa área.

MATERIAIS

github.com/Dpbm/introduction-to-quantum-computing/



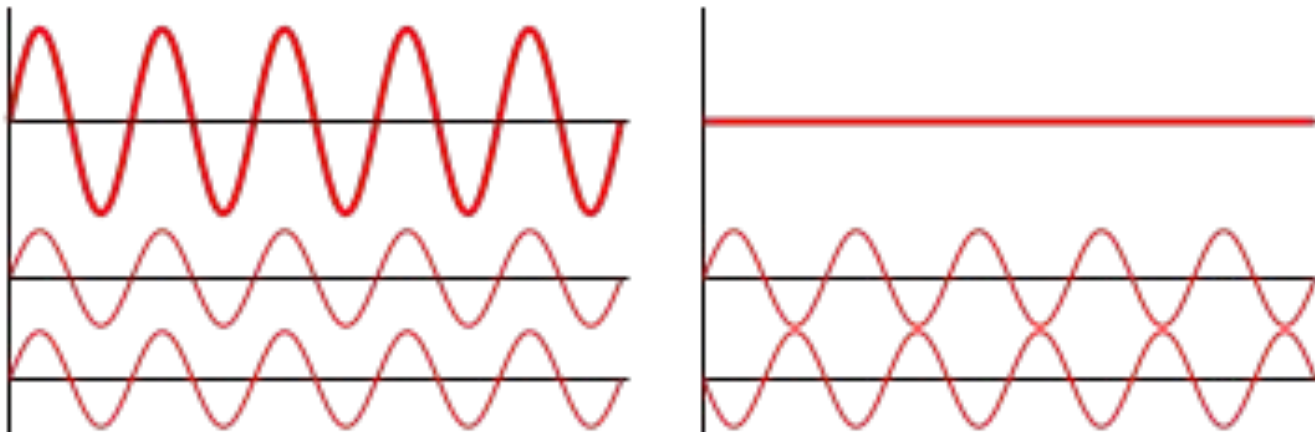
O que é computação
quântica?

“Computação quântica é uma tecnologia, emergente, que se aproveita da mecânica quântica para resolver problemas”.

Fonte: [IBM](#)

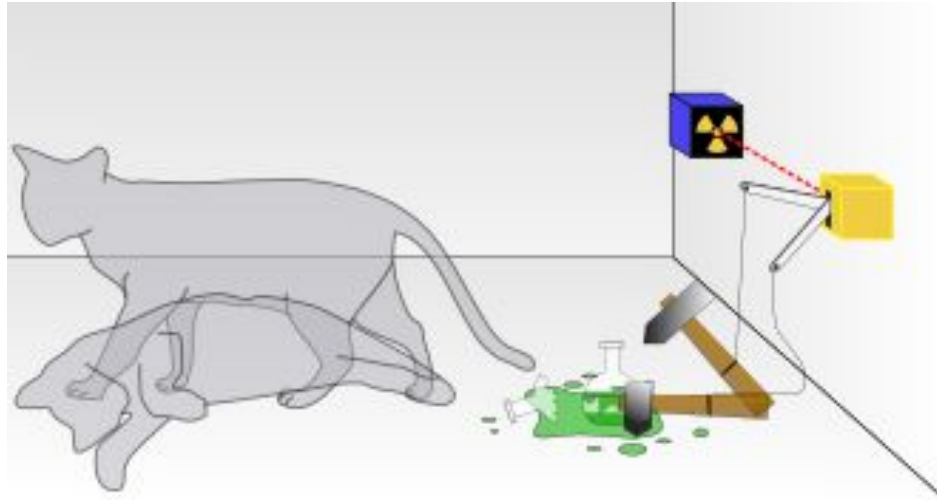
Quais efeitos ela se
aproveita?

Interferência



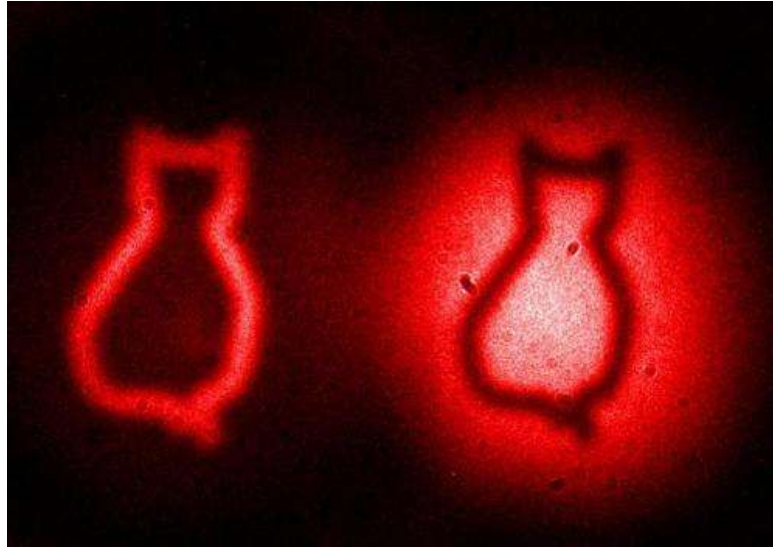
Fonte: [Wikipedia](#)

Superposição



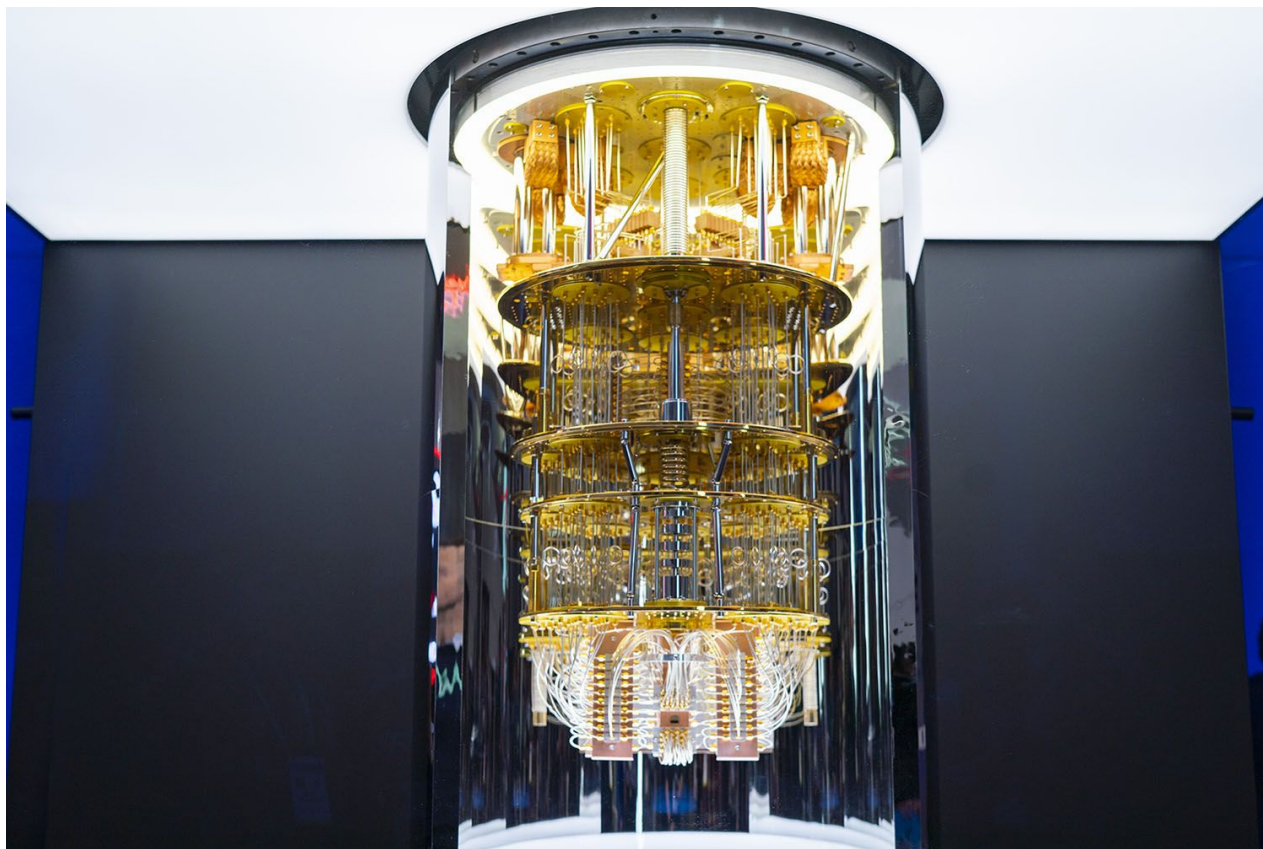
Fonte: [Wikipedia](https://pt.wikipedia.org/wiki/Schrodinger's_Cat)

Entanglement



Fonte: [PhysOrg](#)

Como está hoje?



Fonte: [IBM](https://www.ibm.com/quantum)

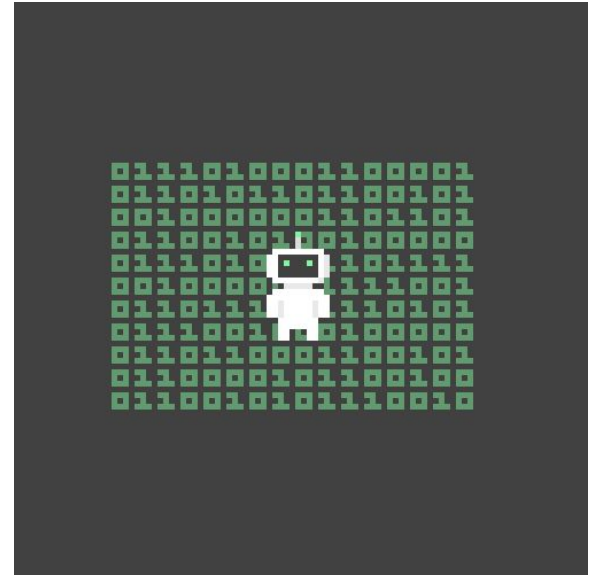
Plataformas

- [AWS \(Braket\)](#);
- [Azure](#);
- [IBM](#);
- [IONQ](#);
- [Pasqal](#);

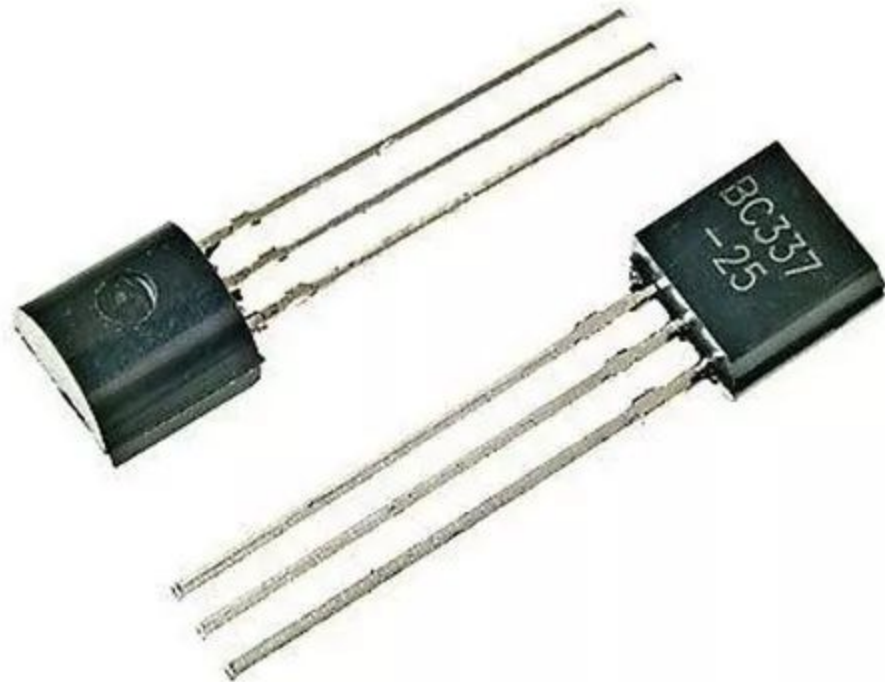
Como funciona?

Computação Clássica

- Binário (0, 1);
- Cada unidade é denominada Bit;
- Informações podem ser manipuladas usando operações Booleanas;
- Representação de inúmeros tipos de informação (imagens, áudios, texto, números, etc.).



Fonte: [Giphy](#)

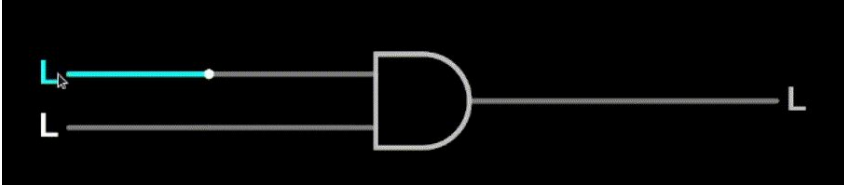


Fonte: [MercadoLivre](#)

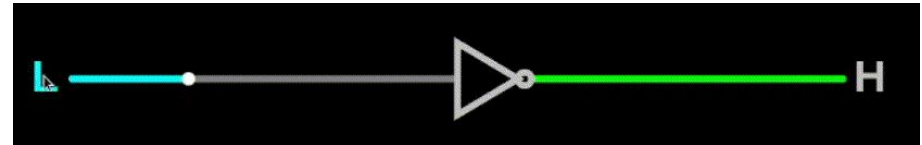


Fonte: [YouTube\(Kurzgesagt\)](#)

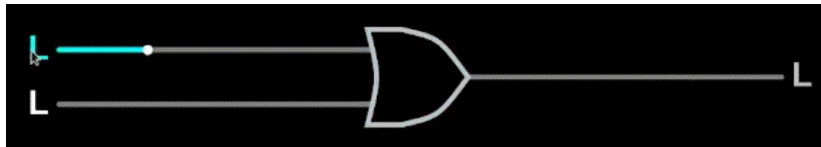
AND



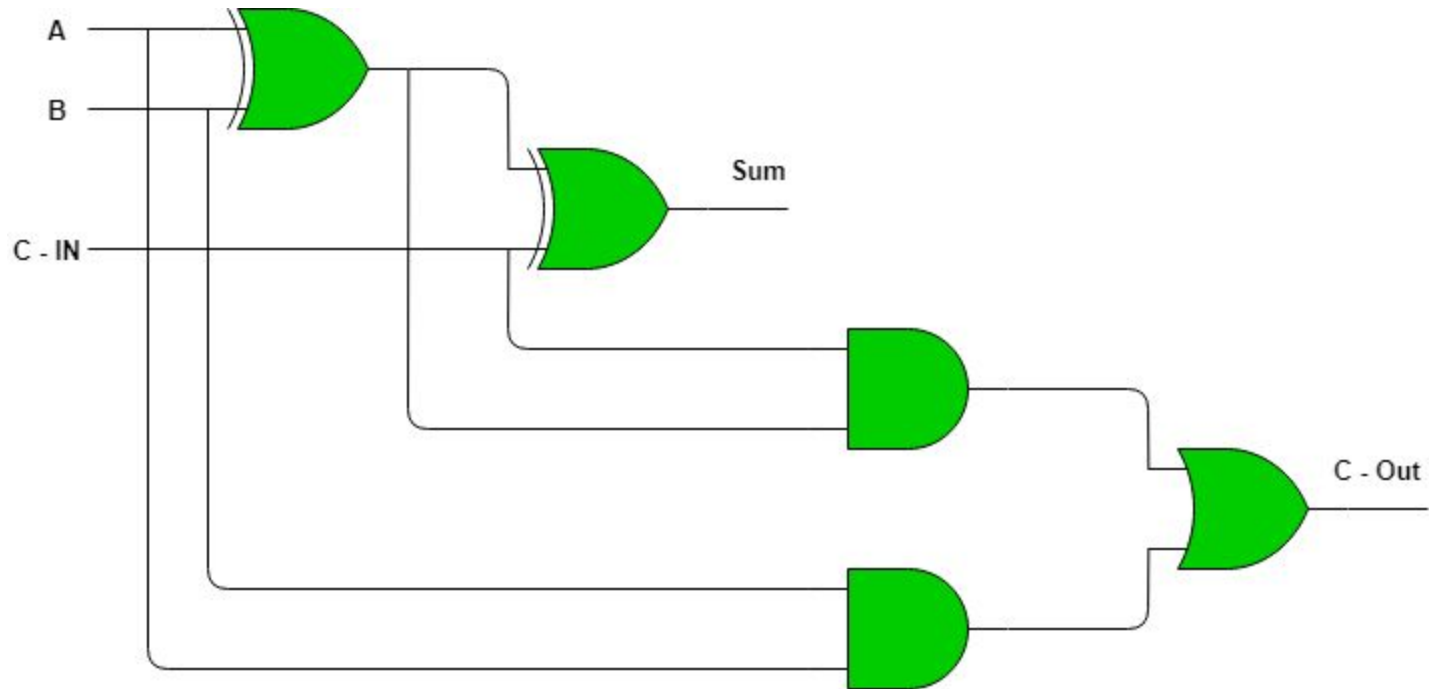
NOT



OR



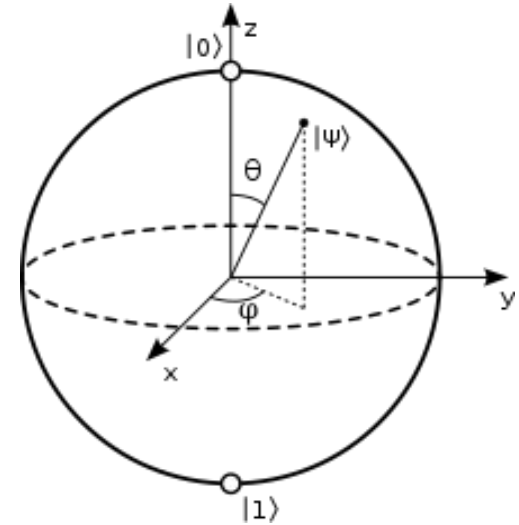
Somador completo



Fonte: [GeeksForGeeks](https://www.geeksforgeeks.org/full-adder-circuit/)

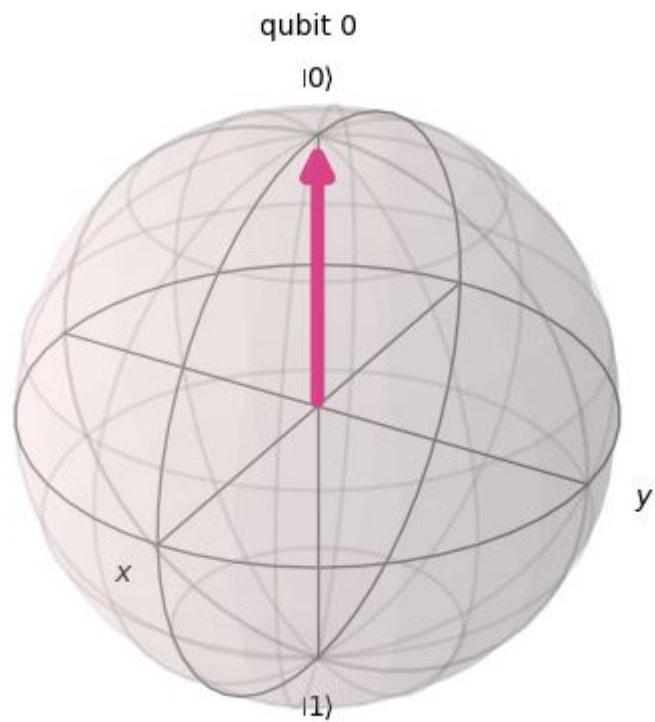
Computação Quântica

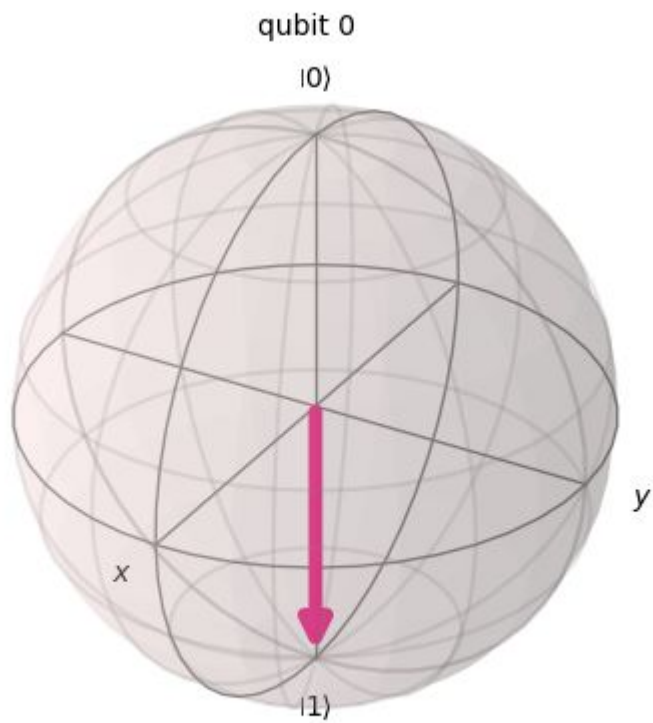
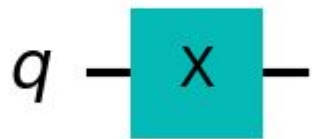
- Qubits (0, 1 e tudo entre isso);
- Representa Amplitudes/probabilidades;
- Pode ser visto como um ponto em uma esfera (Bloch Sphere);
- Precisa de várias medições:
 - Perturbações;
 - Princípio da incerteza de Heisenberg.

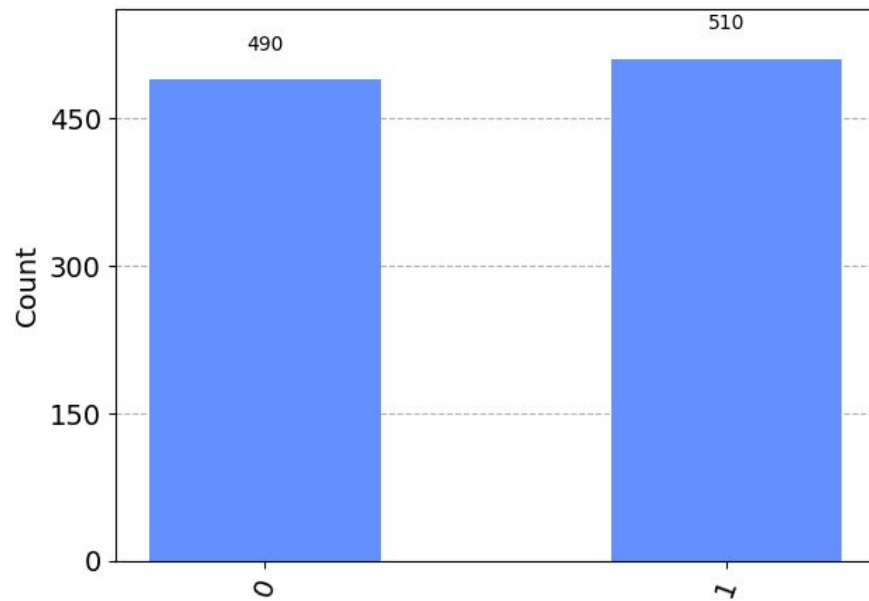
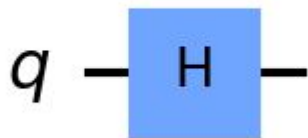


Fonte: [Wikipedia](https://en.wikipedia.org/wiki/Bloch_sphere)

q —

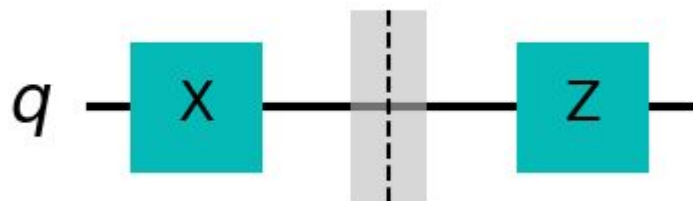




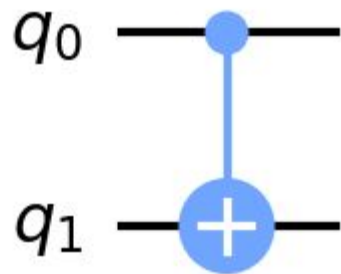


q — z —

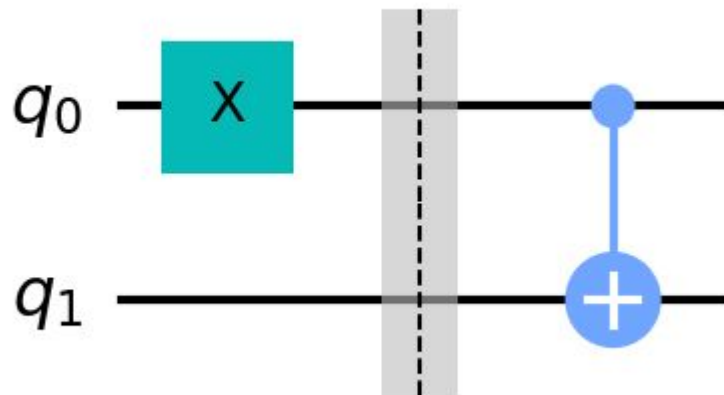
$|0\rangle$



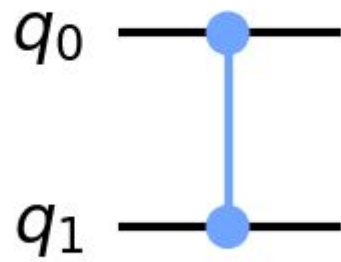
$-|1\rangle$



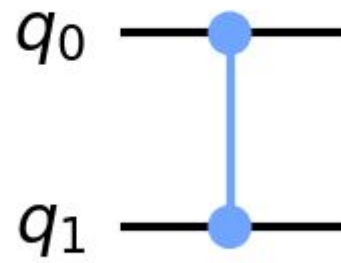
$|00\rangle$



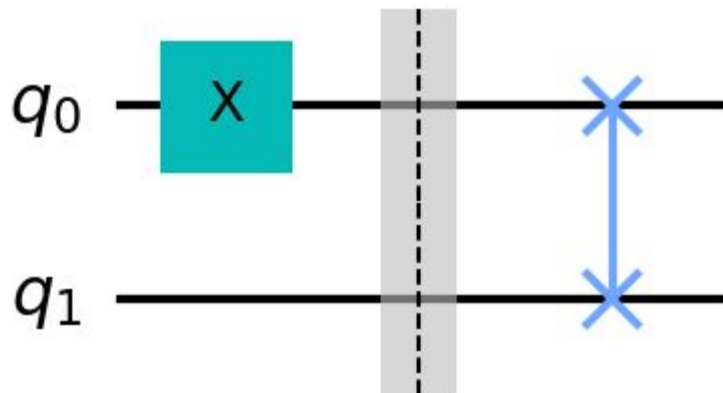
$|10\rangle$



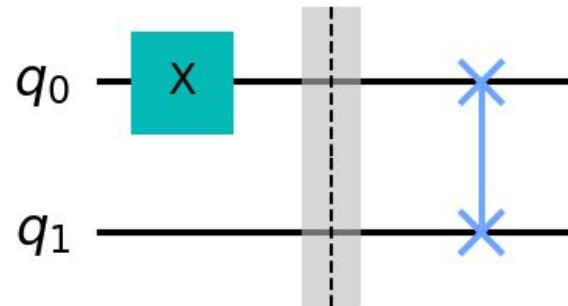
$|00\rangle$



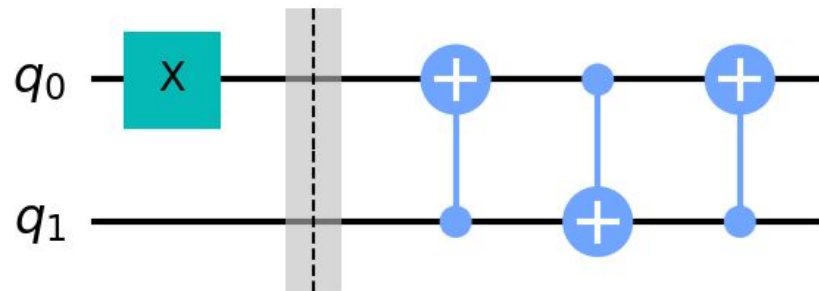
$$-|11\rangle$$

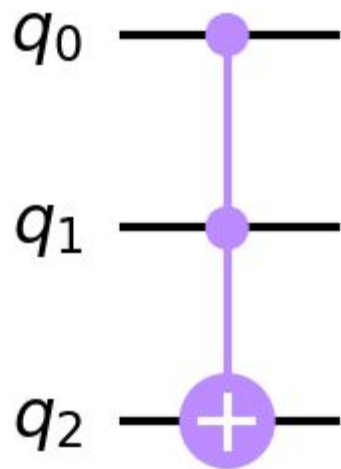


$|10\rangle$

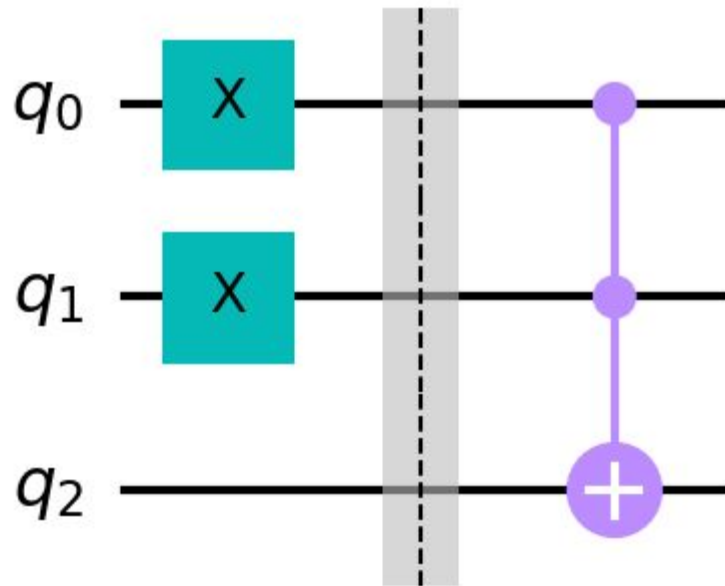


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








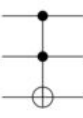




$|000\rangle$



$|111\rangle$

Operator	Gate(s)		Matrix
Pauli-X (X)			$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
Pauli-Y (Y)			$\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$
Pauli-Z (Z)			$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$
Hadamard (H)			$\frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$
Phase (S, P)			$\begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix}$
$\pi/8$ (T)			$\begin{bmatrix} 1 & 0 \\ 0 & e^{i\pi/4} \end{bmatrix}$
Controlled Not (CNOT, CX)			$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix}$
Controlled Z (CZ)			$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix}$
SWAP			$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
Toffoli (CCNOT, CCX, TOFF)			$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

Fonte: [Wikipedia](https://en.wikipedia.org/wiki/Quantum_logic_gate)

😈DEMOS😈

Próximos passos?

🔥 Qiskit is getting a new documentation and learning experience on IBM Quantum! [Learn more](#) ↓



Qiskit

[quiss-kit] *noun, software*

1. open-source toolkit for useful quantum computing.
2. production-ready circuit compiler.

Get started



qiskit 0.44.1

[see release notes](#)

```
# Build a circuit
from qiskit import QuantumCircuit
circuit = QuantumCircuit(2, 2)
circuit.h(0)
circuit.cx(0,1)
circuit.measure([0,1], [0,1])

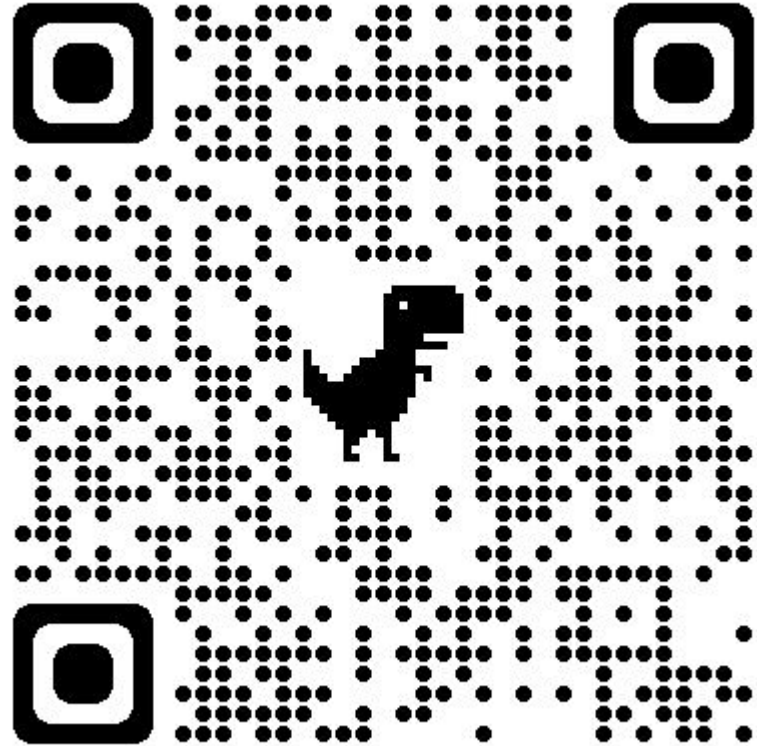
# Connect to your quantum provider
from <quantum provider> import Sampler
sampler = Sampler()

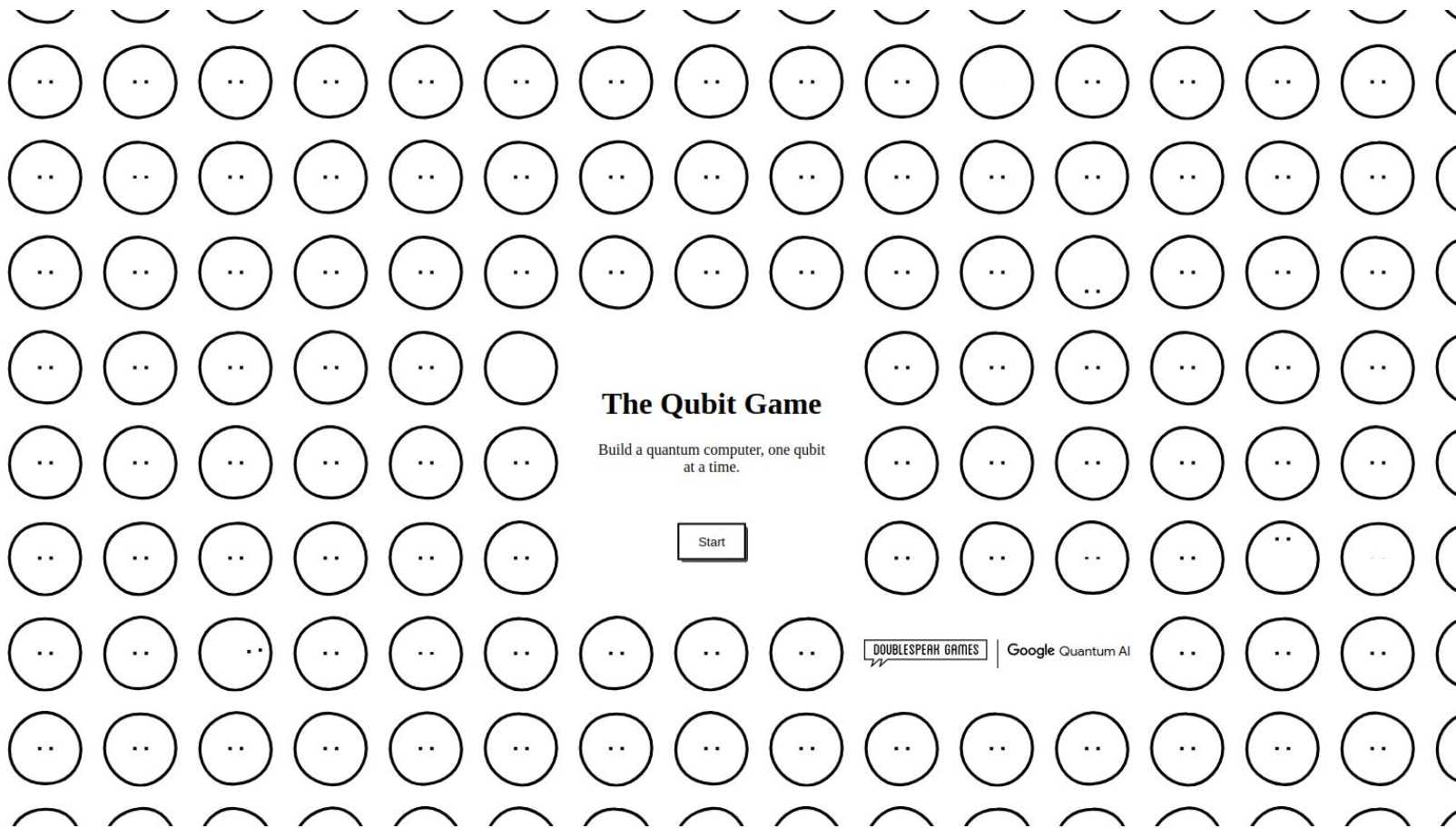
# Run the circuit and get the result
job = sampler.run(circuit)
quasi_dist = job.result().quasi_dists[0]
print(quasi_dist)
```

What Can Qiskit Do

qiskit.org

github.com/Dpbm/quantum





quantumai.google/education/thequbitgame

kiedos.art/quantum-games-list/



Obrigado pela
Atenção 😊