

# Introdução a Quantum Computing

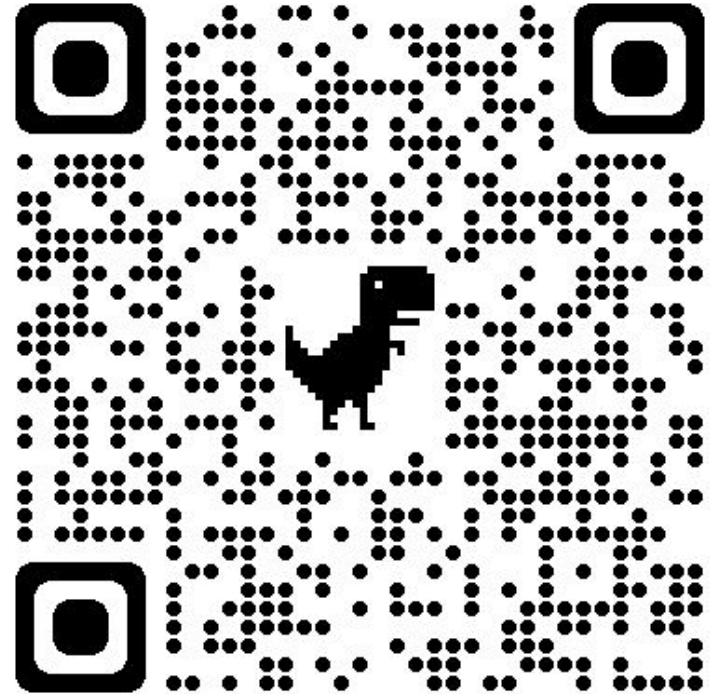
Alexandre Silva - BCC

# 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/](https://github.com/Dpbm/introduction-to-quantum-computing/)



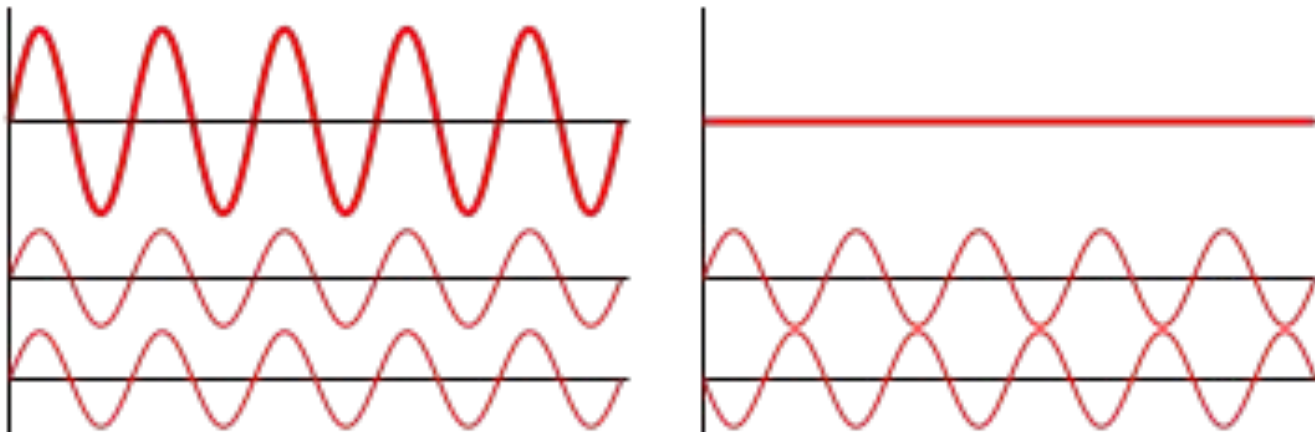
O que é computação  
quântica?

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

Fonte: [IBM](#)

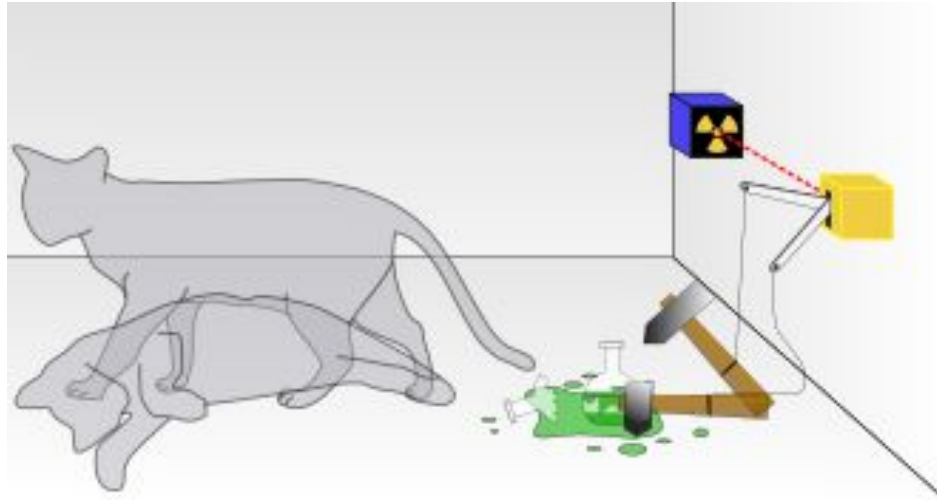
**Quais efeitos ela se**  
**aproveita?**

## Interferência



Fonte: [Wikipedia](#)

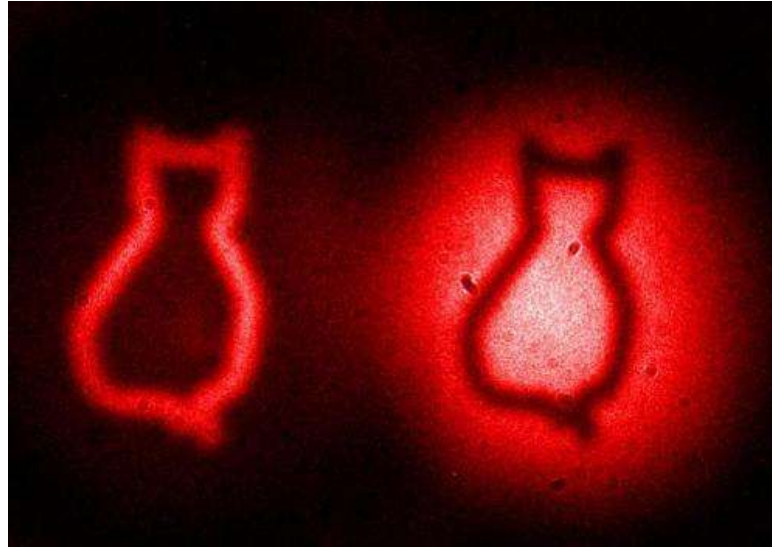
## Superposição



Fonte: [Wikipedia](#)



## Entanglement



Fonte: [PhysOrg](#)

## Princípio da incerteza de Heisenberg



Fonte: [Caltech](#)

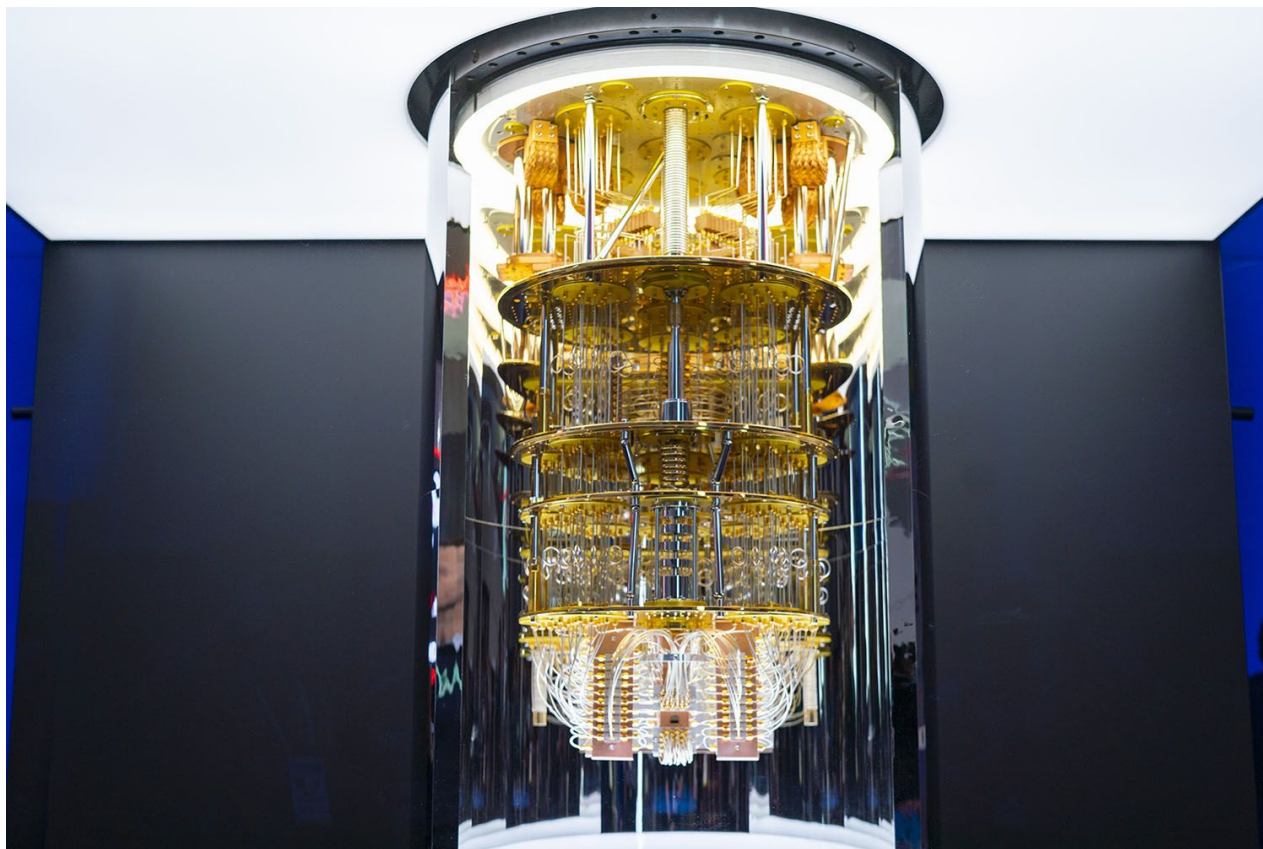
# Tipos de Computadores Quânticos



Fonte: [YouTube](#)

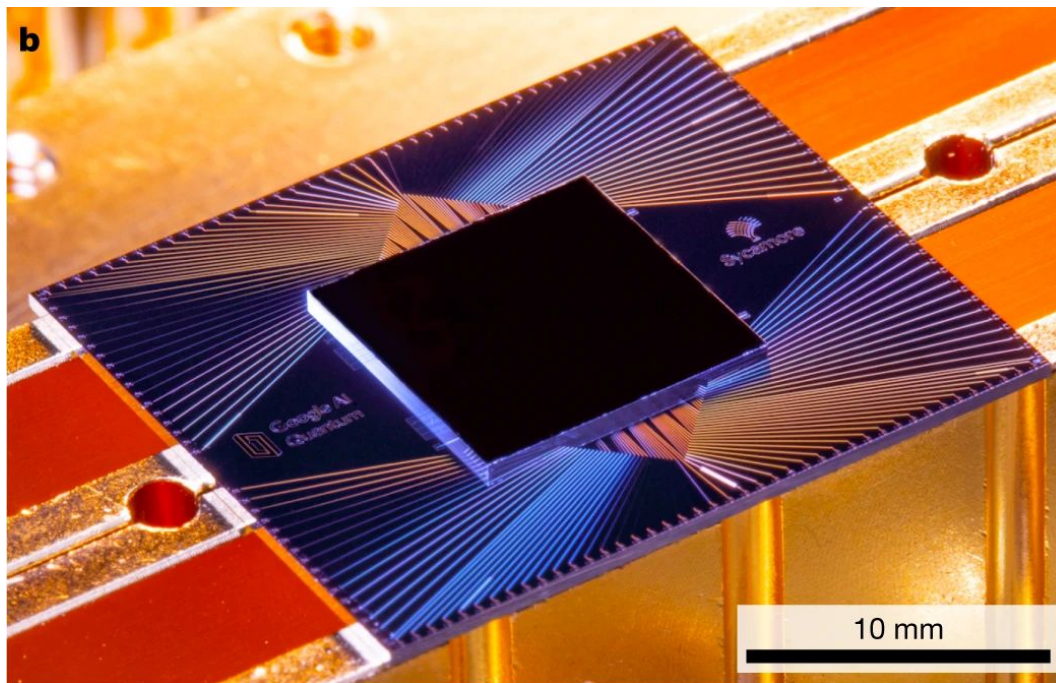


Fonte: [Pasqal](https://www.pasqal.com/)



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





Fonte: [Nature](#)



Fonte: [Youtube](#)





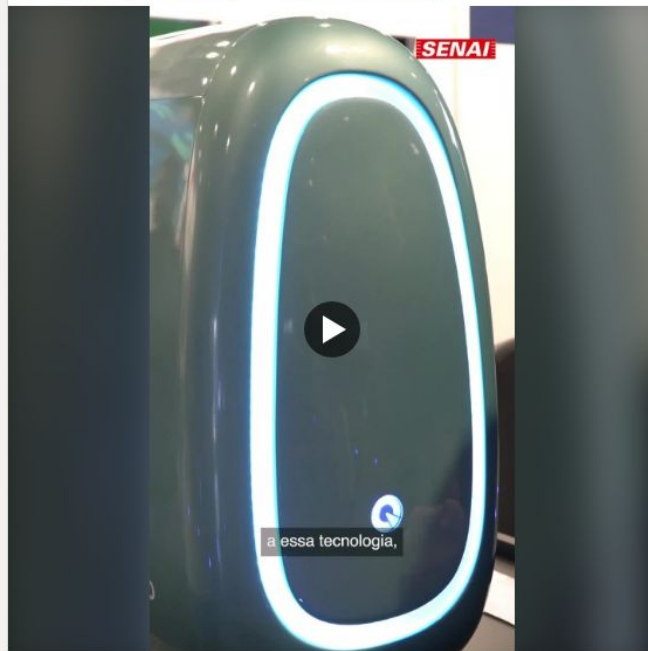
Senai São Paulo

353,714 followers

2d • 🌐

O SENAI-SP recebeu o primeiro computador educacional quântico do Brasil! Com a missão de democratizar o acesso a essa tecnologia, vamos mobilizar grupos de estudantes, pesquisadores, professores e empresários para propagar o conhecimento básico e possibilitar o desenvolvimento de novas aplicações para o seu uso. Assista e saiba mais!

#SENAISP #quântico #computadorquântico #tecnologia



🔄❤️👍1,144

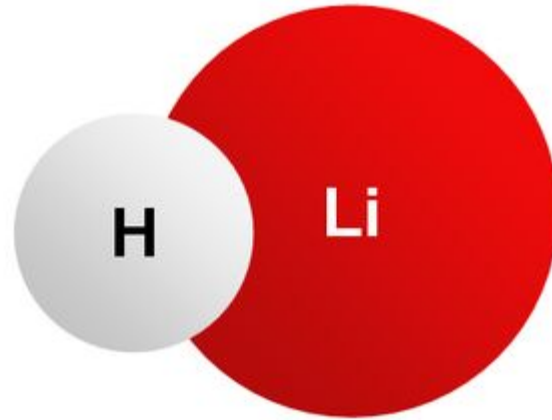
27 comments • 150 reposts

<b>Tipo</b>	<b>Prós</b>	<b>Contras</b>
Superconducting	Facil de produzir; Veloz.	Erros; Preço.
Trapped ions	Estável; Rearranjo de conexões; Mais barato.	Camára de vácuo; Mais lento;
Neutral atoms	Flexível; Escalável.	Mais lento; Estados são perdidos.
NMR	Teoricamente estável; Escalável para certas aplicações.	Limitados; Erros(tempo gates/tempo de coerencia);

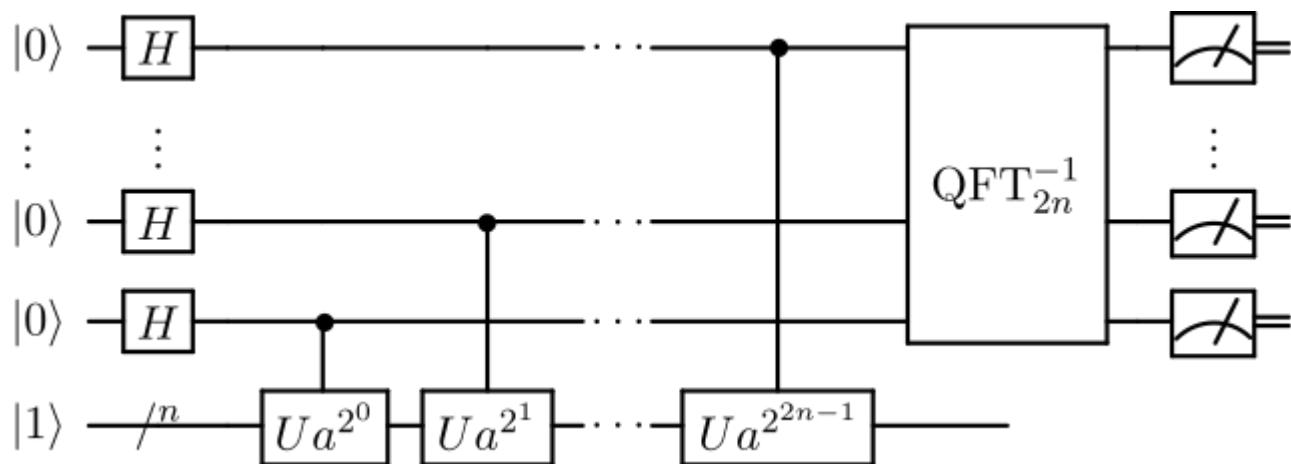
# Aplicações

# Alguns casos de uso

- Química;
- Física;
- Criptografia;
- Banco de dados;
- Machine learning;
- Problemas NP.



Fonte: [Wikipedia](#)



Fonte: [Wikipedia](#)

REALITY CHECK —

## RSA's demise from quantum attacks is very much exaggerated, expert says

Expert says the focus on quantum attacks may distract us from more immediate threats.

DAN GOODIN · 1/25/2023, 10:15 PM

[Enlarge](#)

64

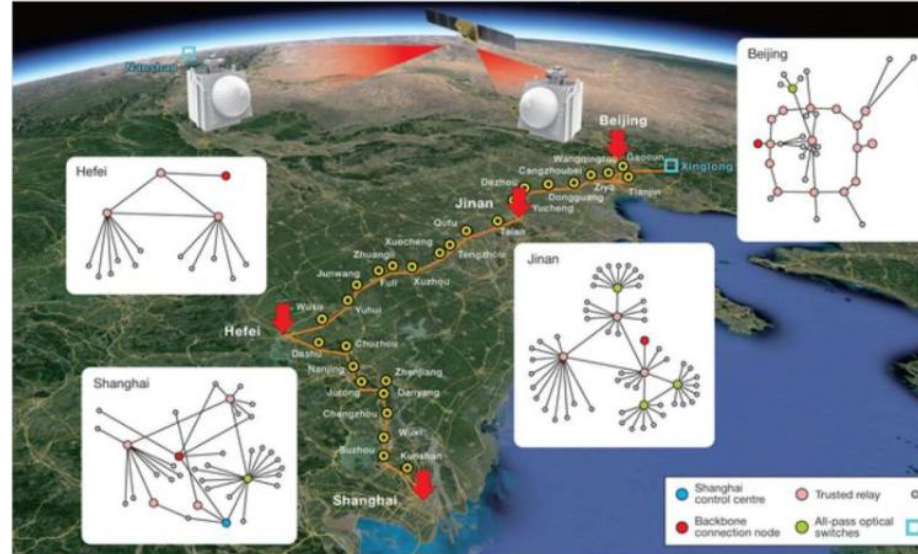
Three weeks ago, panic swept across some corners of the security world after researchers discovered a breakthrough that, at long last, put the cracking of the widely used **RSA encryption** scheme within reach by using quantum computing.

Fonte: [ArsTechnica](#)

1 JANUARY 6, 2021

# The world's first integrated quantum communication network

by University of Science and Technology of China



Chinese scientists have established the world's first integrated quantum communication network, combi...

Chinese scientists have established the world's first integrated quantum

Fonte: [PhysOrg](#)

# Ferramentas



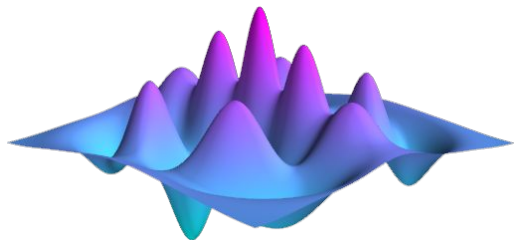
# Plataformas

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



# Programação

- [Braket](#);
- [Q#](#);
- [Cirq](#);
- [Qiskit](#);
- [tket](#);
- [openqasm](#);
- [PennyLane](#);
- [QuTip](#).



**Qiskit**

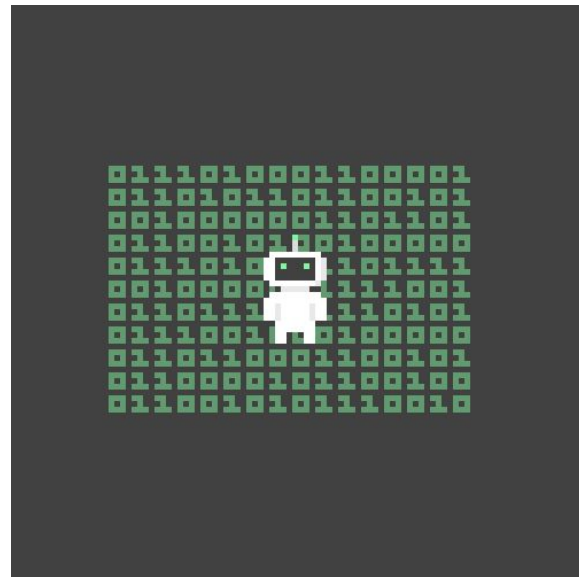


PENNYLANE

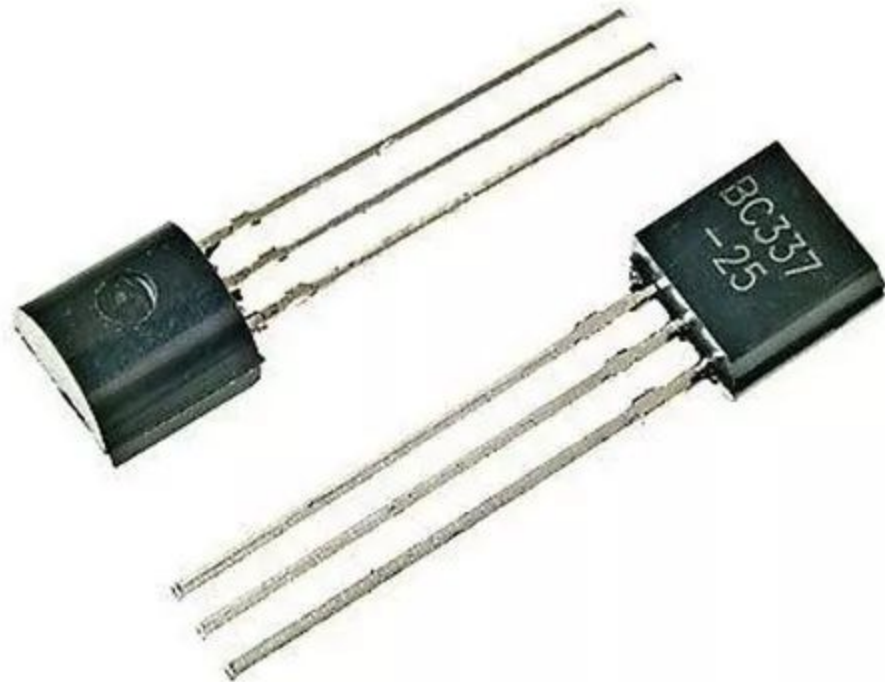
**Como funciona?**

# 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](#)

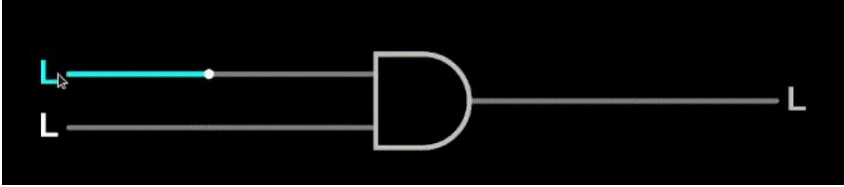


Fonte: [MercadoLivre](#)

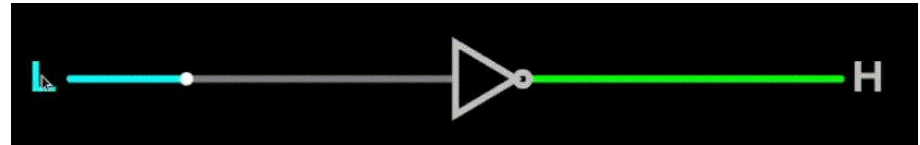


Fonte: [YouTube\(Kurzgesagt\)](#)

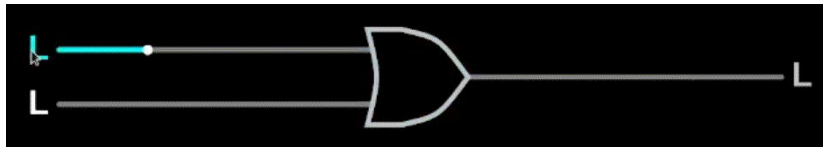
AND



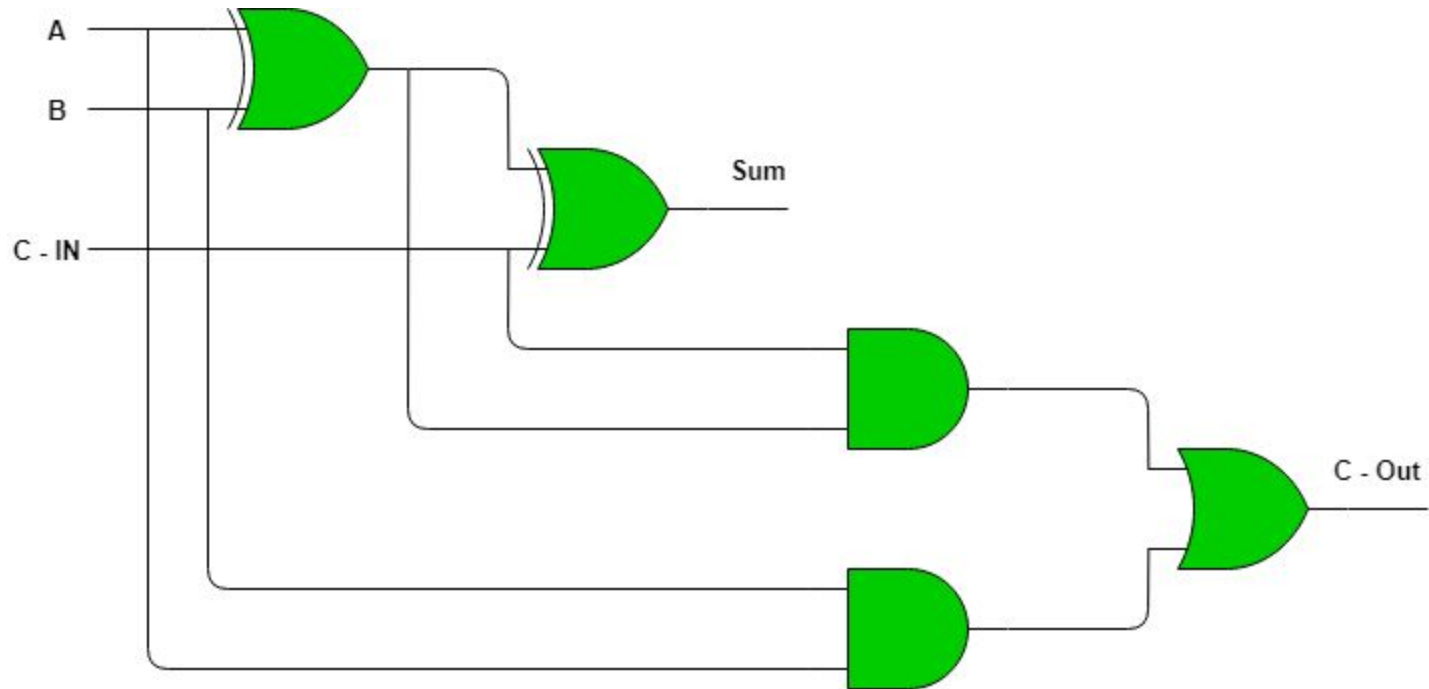
NOT



OR



## Somador completo

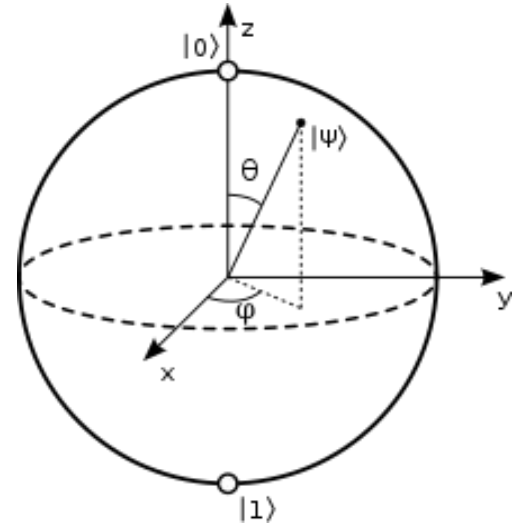


Fonte: [GeeksForGeeks](https://www.geeksforgeeks.org/)



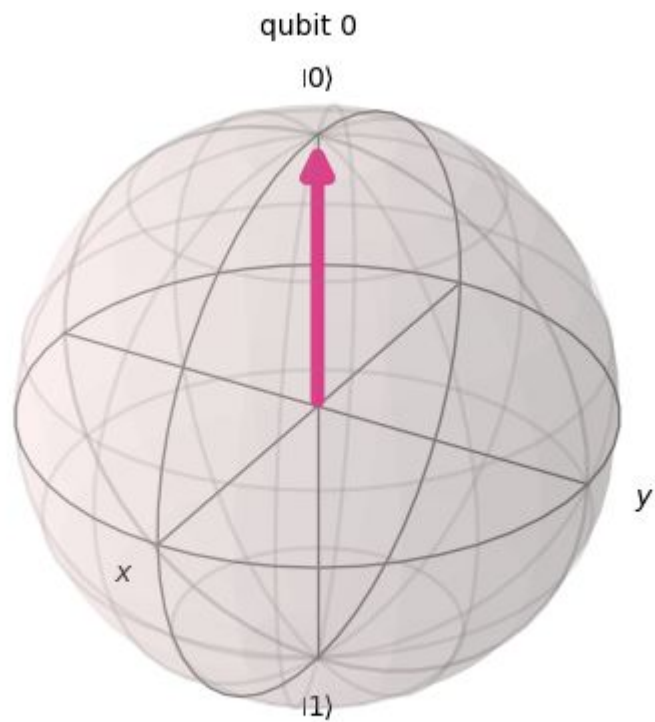
# Computação Quântica

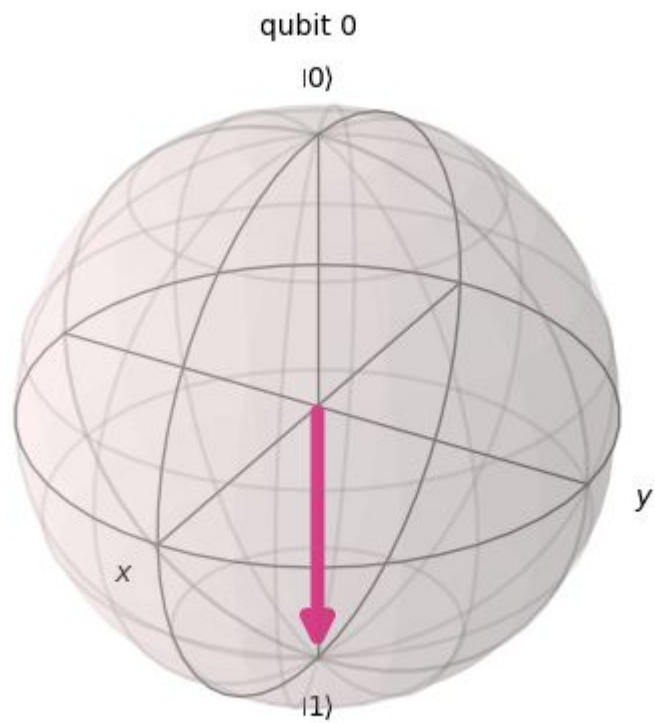
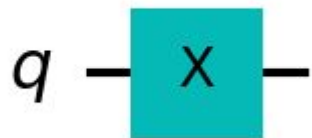
- Qubits (0, 1 e tudo entre isso);
- Representa Amplitudes/probabilidades;
- Pode ser visto como um ponto em uma esfera (Bloch Sphere);
- Precisa de várias medições:
  - Perturbações.

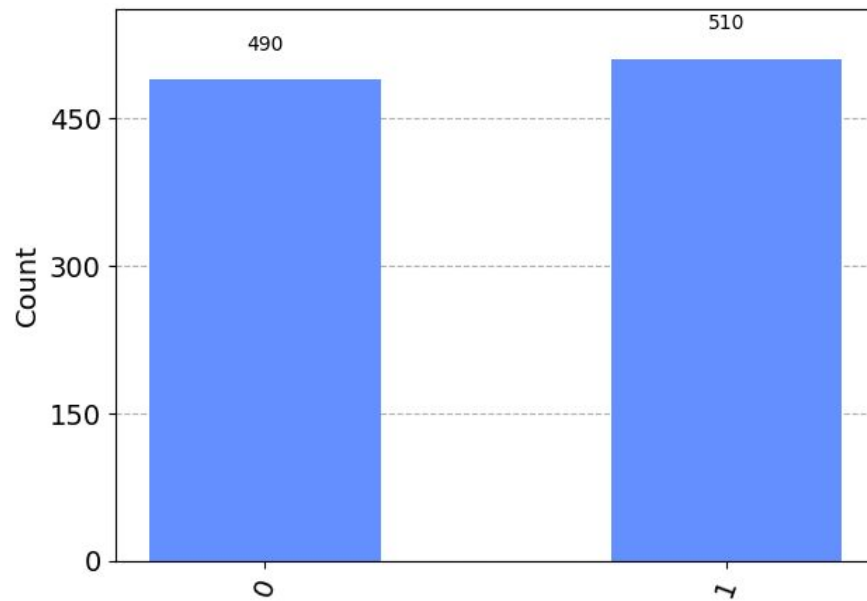
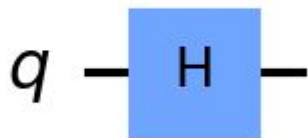


Fonte: [Wikipedia](https://en.wikipedia.org/wiki/Bloch_sphere)

$q$  —





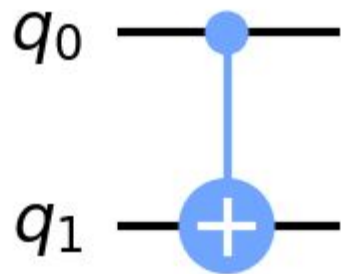


$q$  —  $z$  —

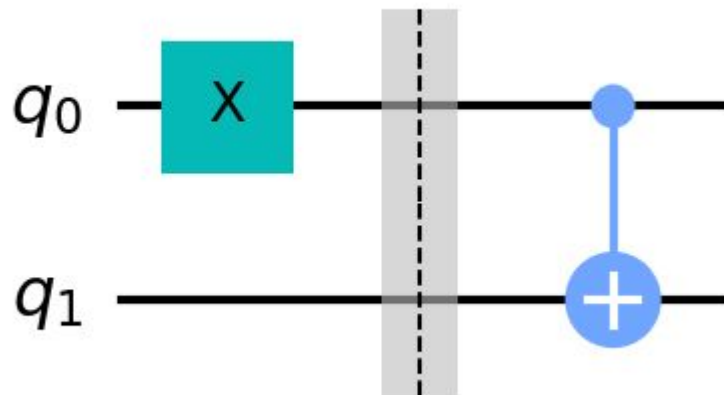
$|0\rangle$



$-|1\rangle$

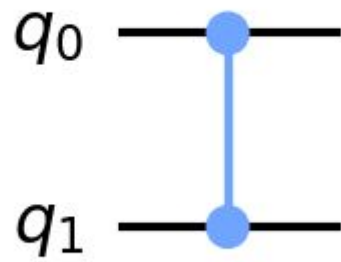


$|00\rangle$

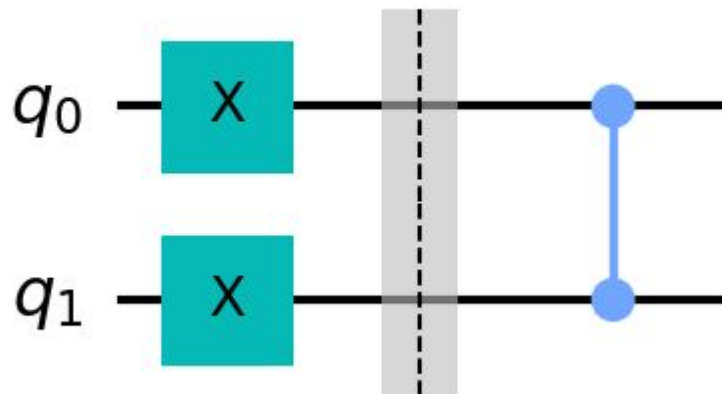


$|11\rangle$

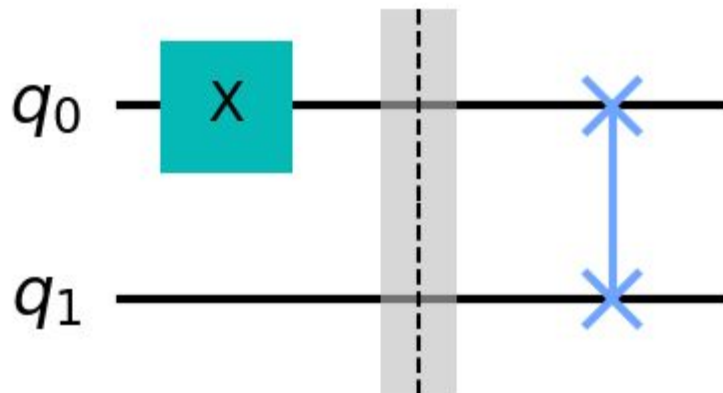




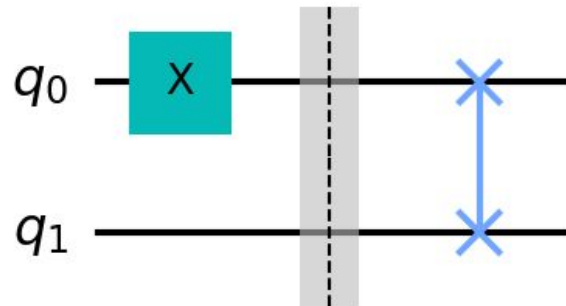
$|00\rangle$



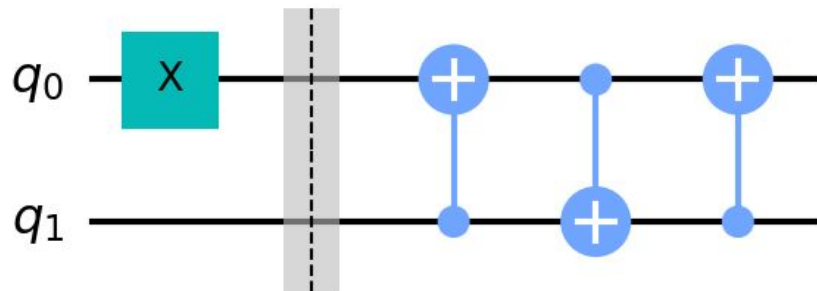
$-|11\rangle$

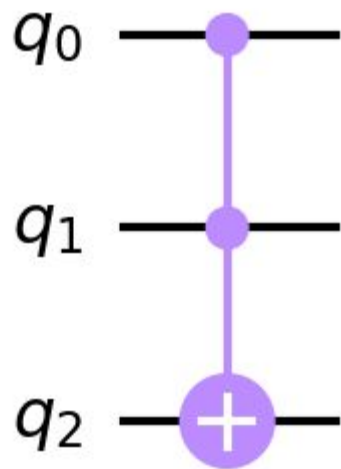


$|10\rangle$

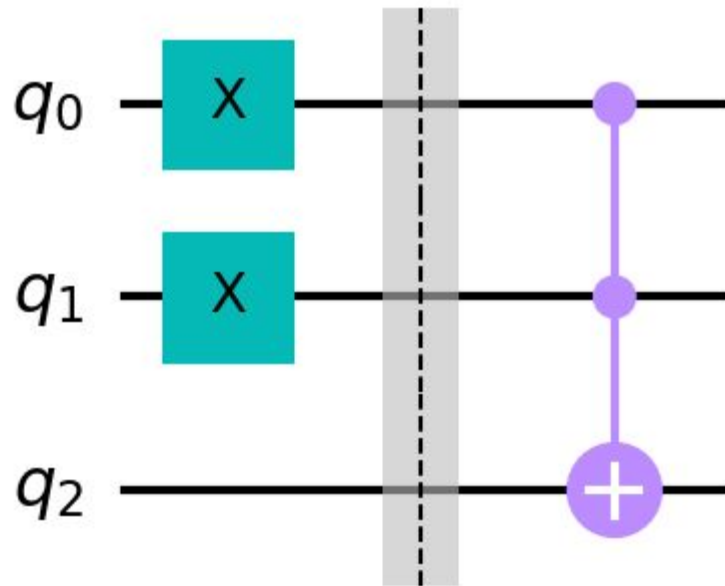


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






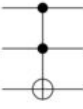




$|000\rangle$



$|111\rangle$

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])

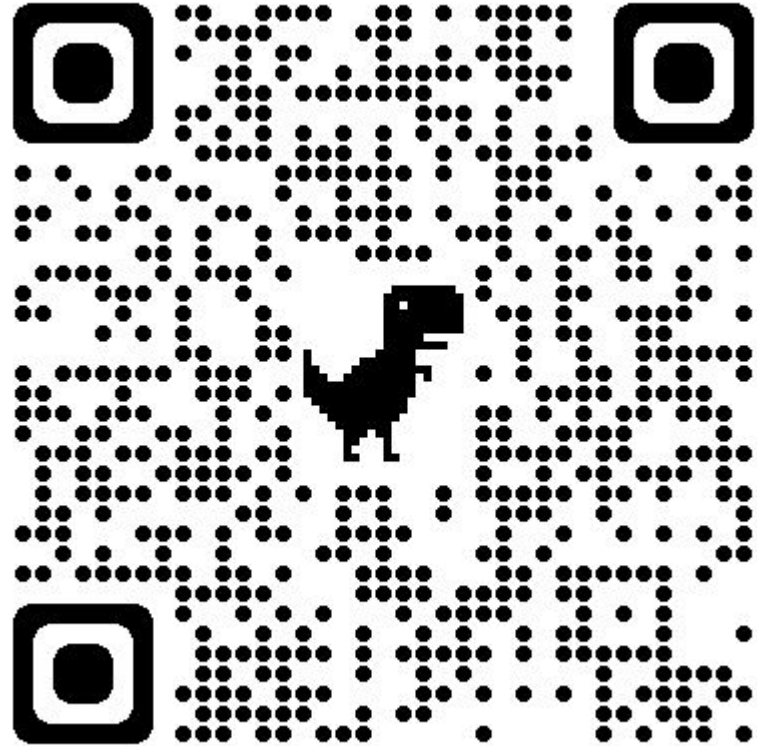
# Connect to your quantum provider
from <quantum provider> import Sampler
sampler = Sampler()

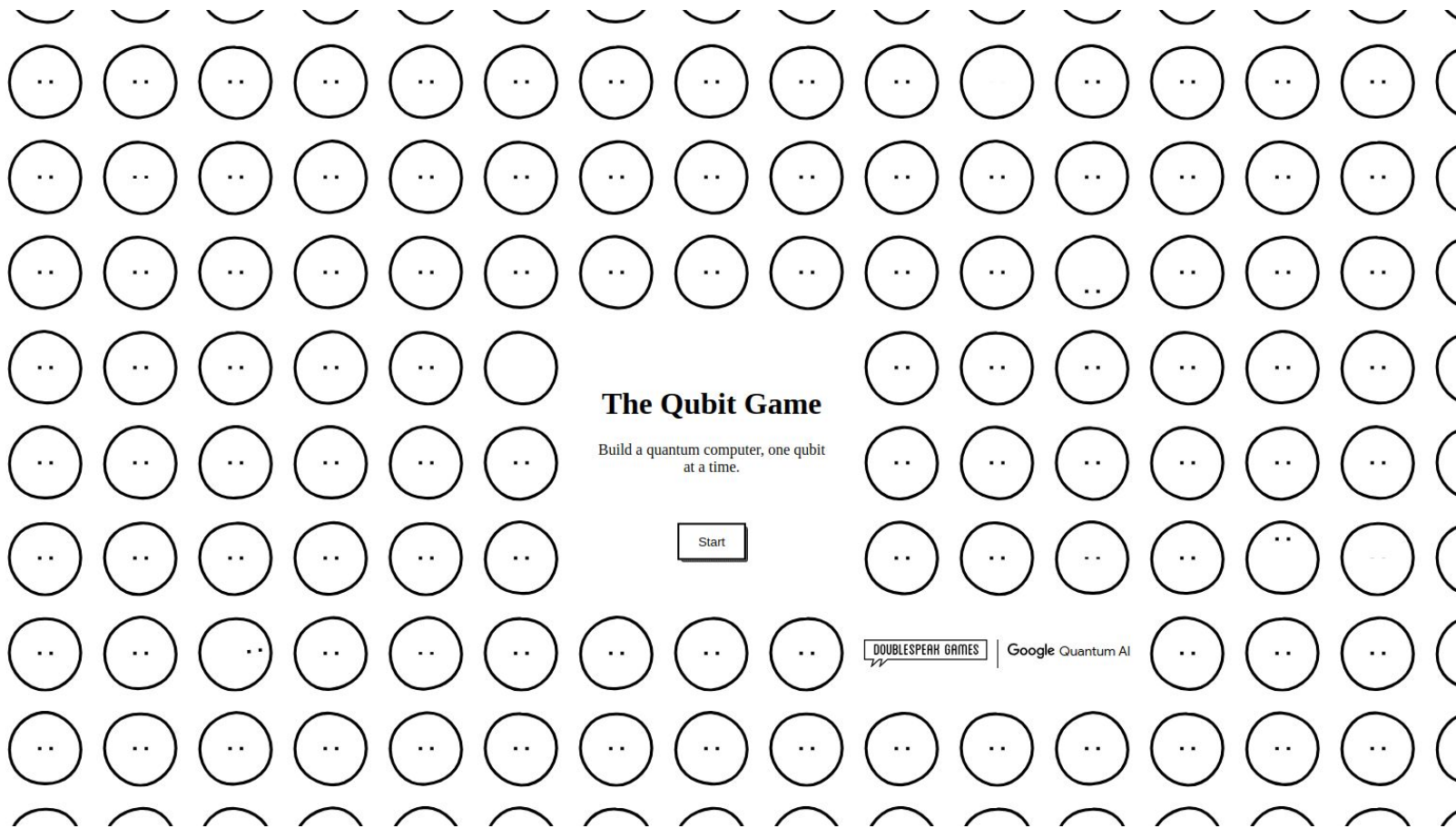
# Run the circuit and get the result
job = sampler.run(circuit)
quasi_dist = job.result().quasi_dists[0]
print(quasi_dist)
```

## What Can Qiskit Do

[qiskit.org](https://qiskit.org)

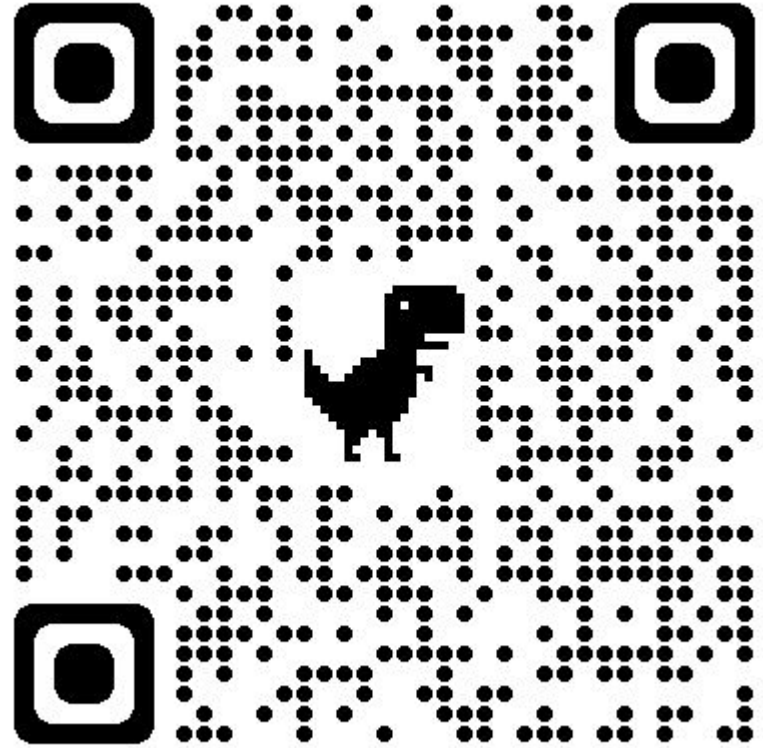
[github.com/Dpb  
m/quantum](https://github.com/Dpbm/quantum)





[quantumai.google/education/thequbitgame](https://quantumai.google/education/thequbitgame)

[kiedos.art/quantum-games-list/](https://kiedos.art/quantum-games-list/)



Obrigado pela  
Atenção 😊