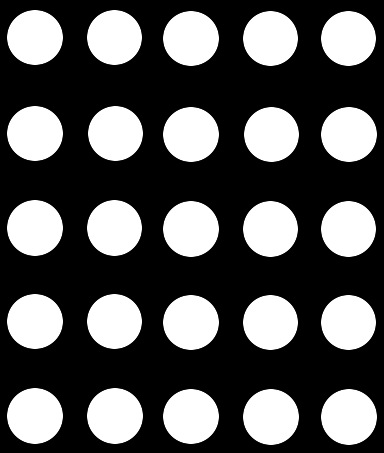
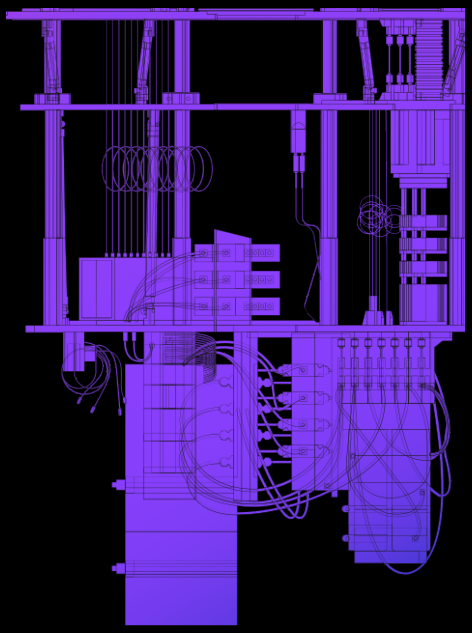
Quantum Dots



Kadir Uraz Alacali

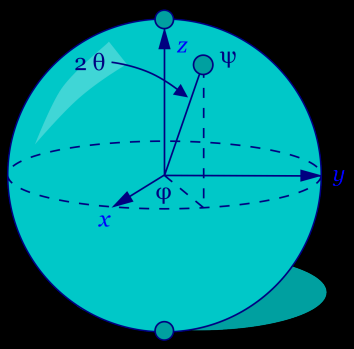


What is a quantum computer ?

Quantum computers perform calculations based on the probability of an object's state before it is measured - instead of just 1s or 0s - which means they have the potential to process exponentially more data compared to classical computers.

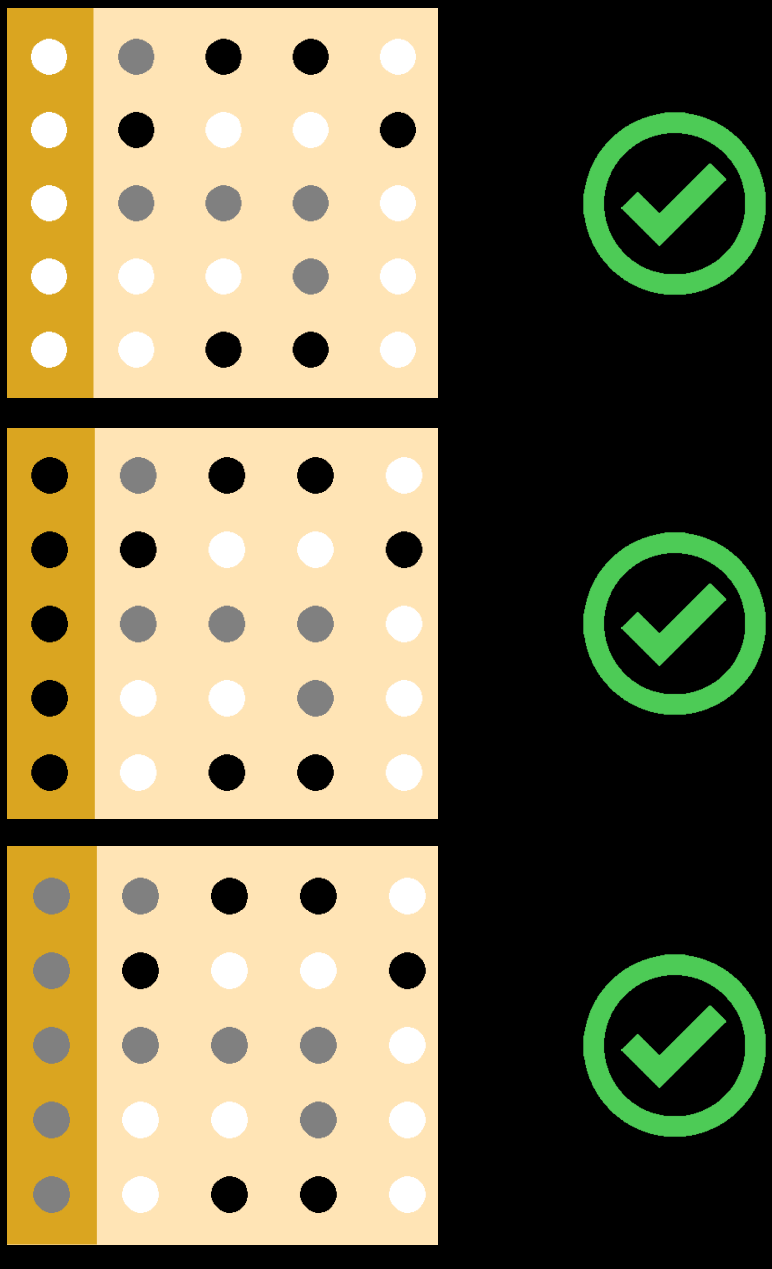
We use Qubits…

A qubit (or quantum bit) is the quantum mechanical analogue of a classical bit. In classical computing the information is encoded in bits, where each bit can have the value zero or one. In quantum computing the information is encoded in qubits. A qubit is a two-level quantum system where the two basis qubit states are usually written as $|0\rangle$ and $|1\rangle$. A qubit can be in state $|0\rangle$,$|1\rangle$ or (unlike a classical bit) in a linear combination of both states. The name of this phenomenon is **superposition**

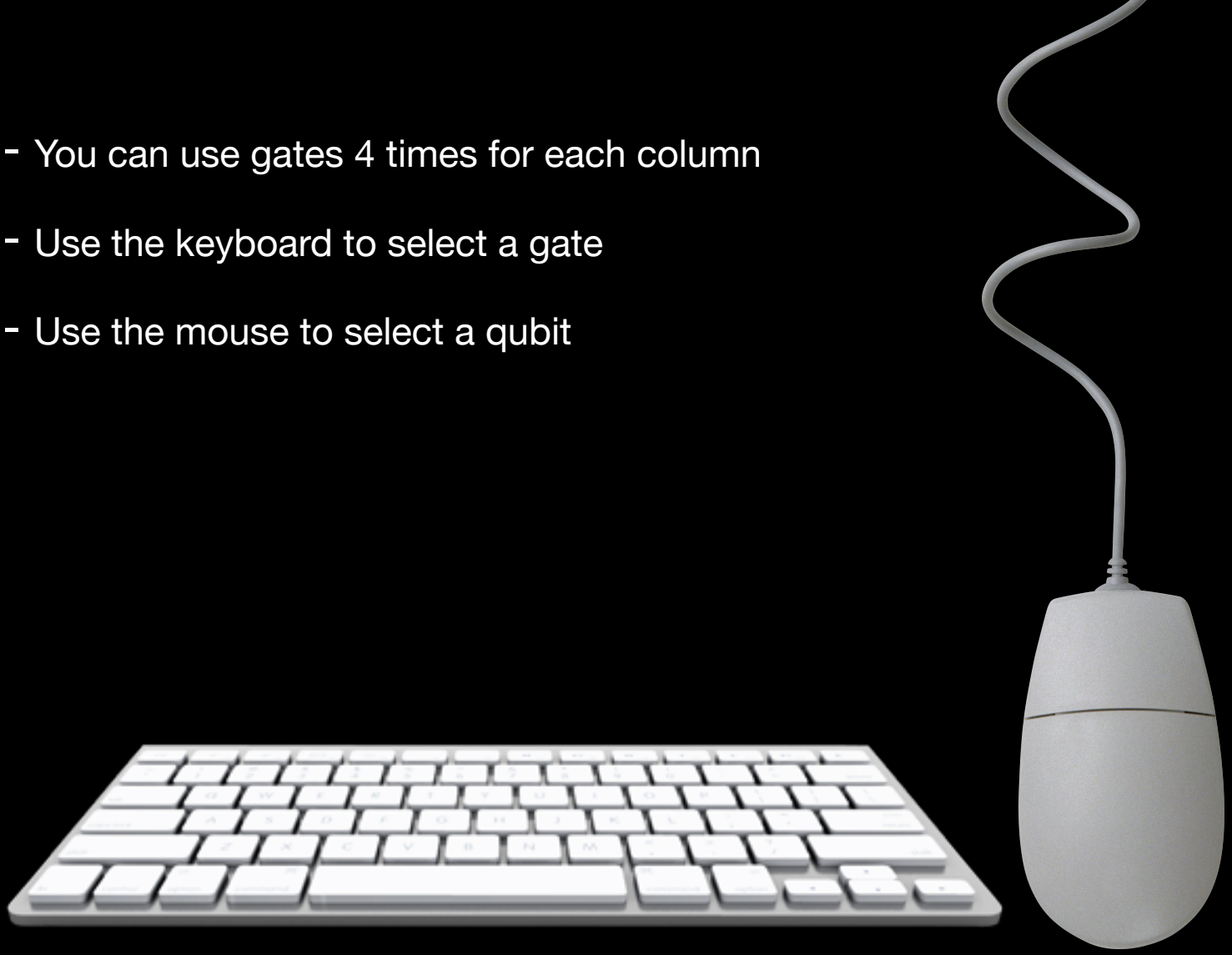


How to play ?

- Collect the same colored dots (qubits) in the yellow column to earn points
- When the same colored dots are collected in the yellow column, they are deleted and the next column replaces them
- Use gates to move dots
- Each gate (X,H,CX,Swap,Reset) performs a different action upon the state. As you play your gates , keep track of how they affect the states



- You can use gates 4 times for each column
- Use the keyboard to select a gate
- Use the mouse to select a qubit



Pauli X gate

controlled-X gate

Hadamard gate

Reset

Swap

A bit more about gates

H gate

It is useful for making superpositions. converts black and white dots to gray

X gate

The Pauli X gate has the property of flipping the |0⟩ state to |1⟩, and vice versa. So it converts white dots to black and black dots to white.
In our game you can only apply this gate to the columns

CX gate

It acts on a pair of qubits, with one acting as ‘control’ and the other as ‘target. It performs an X on the target whenever the control is in state |1⟩
In our game we use the qubit which is on the right as ‘control’ qubit

Swap

Apply SWAP from the clicked qubit to the qubit on the right.

Reset

Set the qubit to |0⟩
In our game you can only apply reset on grey dots

Learn more :

https://quantum-computing.ibm.com/support/guides/gate-overview?section=5d00d964853ef8003c6d6820#cx-gate

SETUP

Please check this site to download qiskit for Python

https://qiskit.org/documentation/install.html

You can download the game from GitHub

https://github.com/kadiruraz/quantumgame