Intro to Quantum Computing: Qubits

**Qubits vs. Classical Bits:** The video begins by comparing classical bits, which are either 0 or 1, with qubits, which can exist in a "superposition" of both states simultaneously.

**Logic Gates:** Just as classical bits are manipulated by logic gates, qubits are manipulated by quantum logic gates. Key gates discussed include:

* **X Gate:** The quantum equivalent of the NOT gate.
* **Hadamard (H) Gate:** Puts a qubit into a superposition, meaning there is a 50% chance of it being measured as either 0 or 1.

**Measurement and Superposition:** Measuring a qubit in a superposition collapses it into a single, definite state (either 0 or 1). This measurement is "destructive" as it removes the information the qubit was carrying in its superposition.

**Bloch Sphere:** The video introduces the Bloch sphere as a way to visualize all possible states of a qubit. The logic gates are represented as rotations on this sphere.

Computerphile Logic Gates

* **Transistors and Binary:** The video explains that computers use billions of transistors, which act as tiny switches that are either on (1) or off (0), forming the binary system.
* **Logic Gates:** These are the foundational building blocks of computer circuits that process information. The video describes the function of several fundamental logic gates:
  + **NOT Gate:** Inverts a single input (0 becomes 1, 1 becomes 0).
  + **AND Gate:** Outputs 1 only if both inputs are 1.
  + **OR Gate:** Outputs 1 if at least one of its inputs is 1.
  + **NAND, NOR, XOR, and XNOR Gates:** The video also explains the function of these more complex gates, which are variations of the basic AND and OR gates.

By combining these simple logic gates, computers can perform complex calculations and operations.