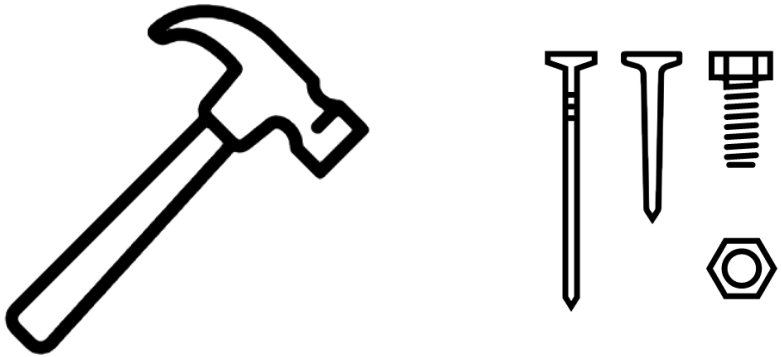
Quantum Operations

Based on Q is for Quantum, Terry Rudolph

Development of Quantum Computers



Development of Quantum Computers

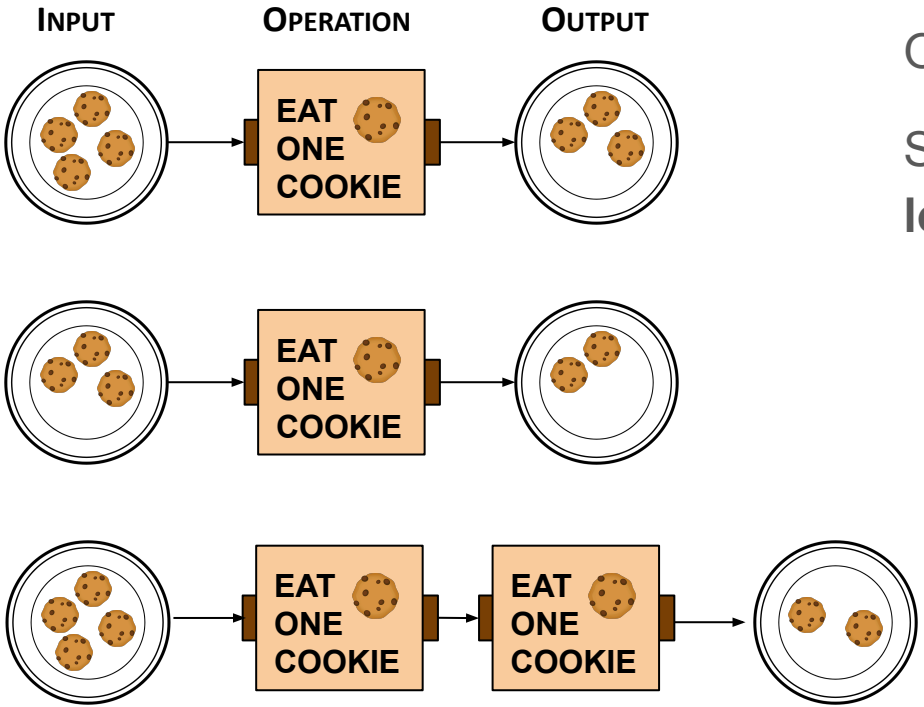
The differences are at the most basic level

We don’t yet have languages that hide those basic level details

To understand how quantum computers perform computation, we need to start with the basic quantum operations.

This is very different from how people learn to program classical computers today.

Imagine we drew operations this way...

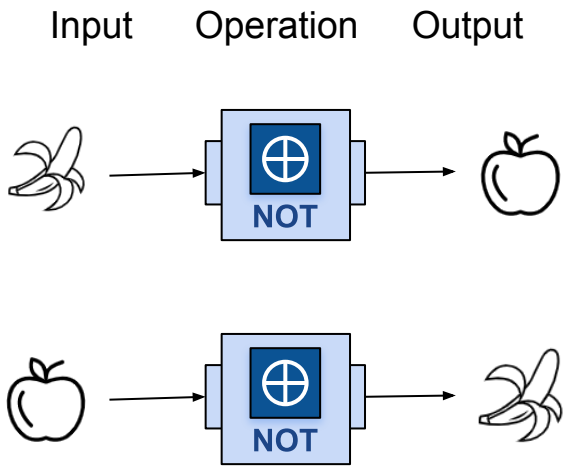


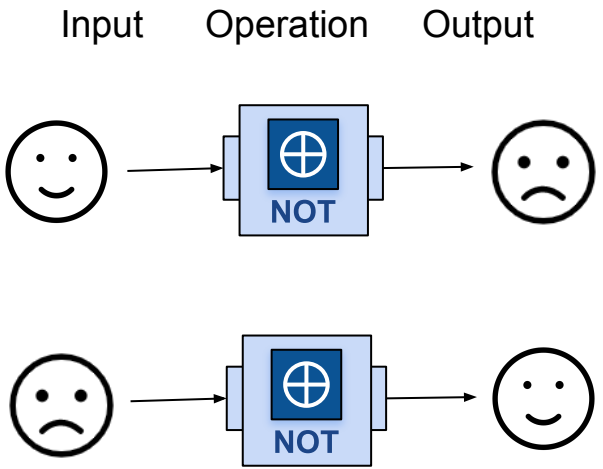
Operations progress from left to right

Shows **order** of operation, **not location** of operation.

Plate may have never moved

Imagine an operation called NOT





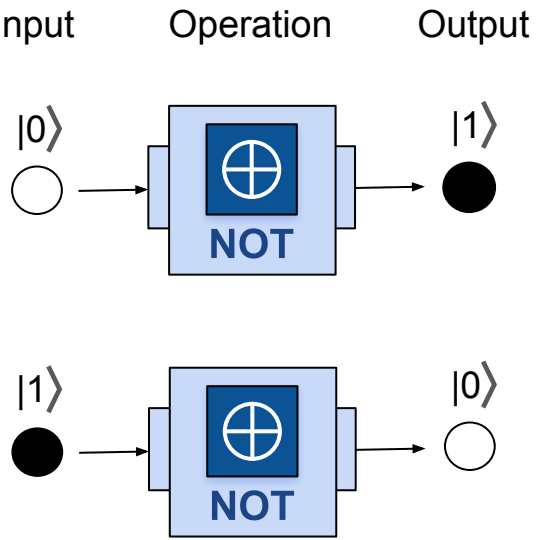
We can use any two items. NOT toggles between them.

Quantum NOT operation

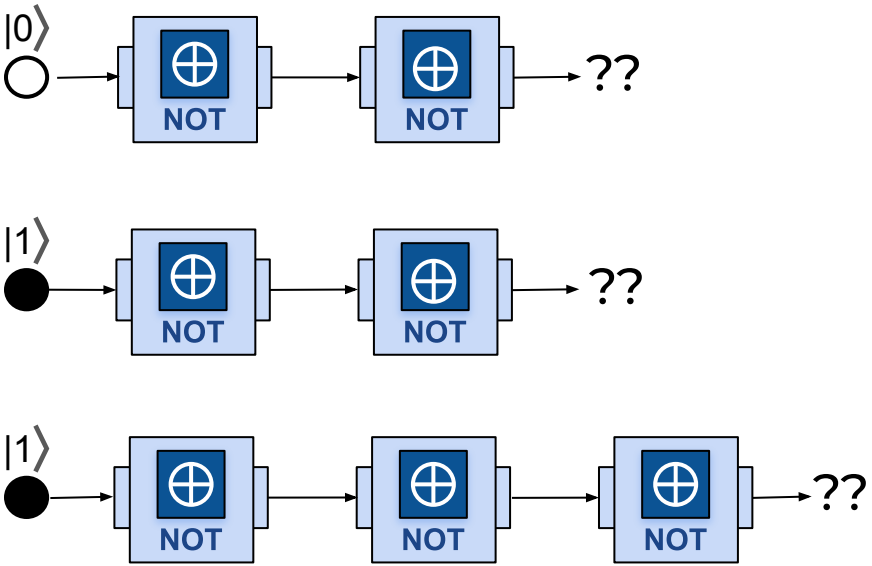
For quantum:

White ball, labeled |0⟩

Black ball, labeled |1⟩



What would be the outcomes of the following?



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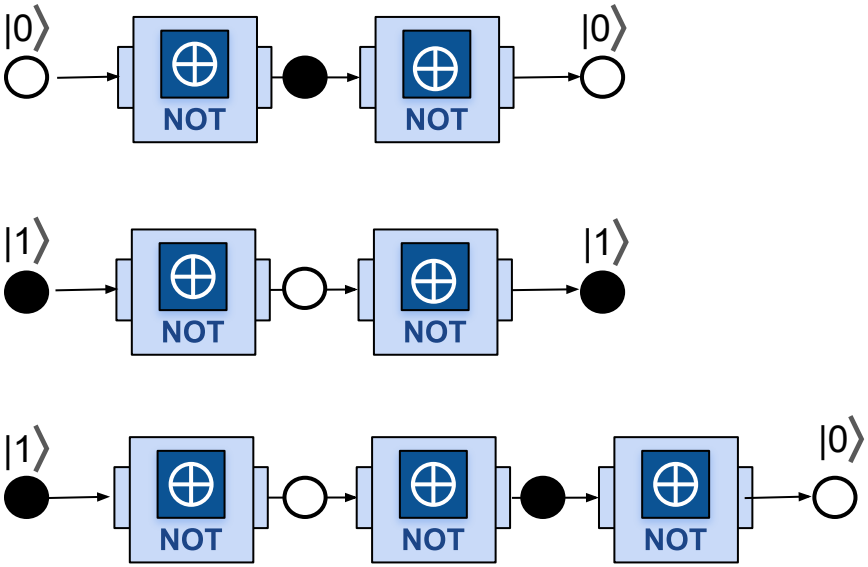
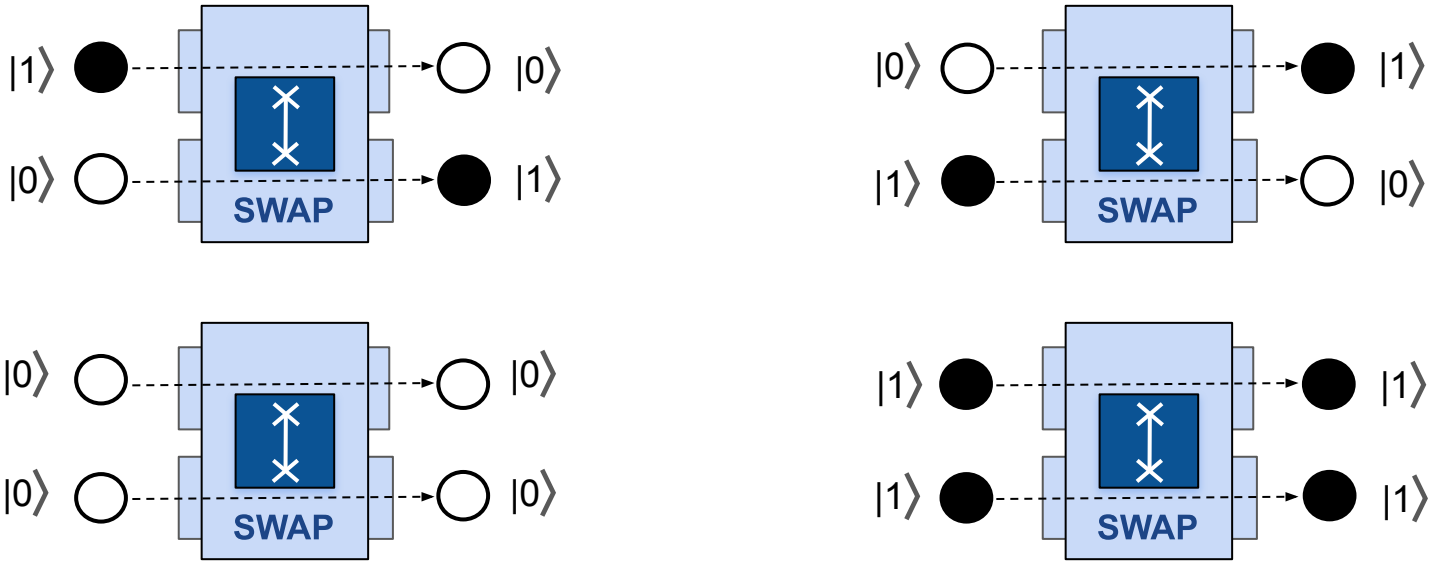


SWAP operation



The balls swap colors *relative to one other*. They do not swap *locations*.

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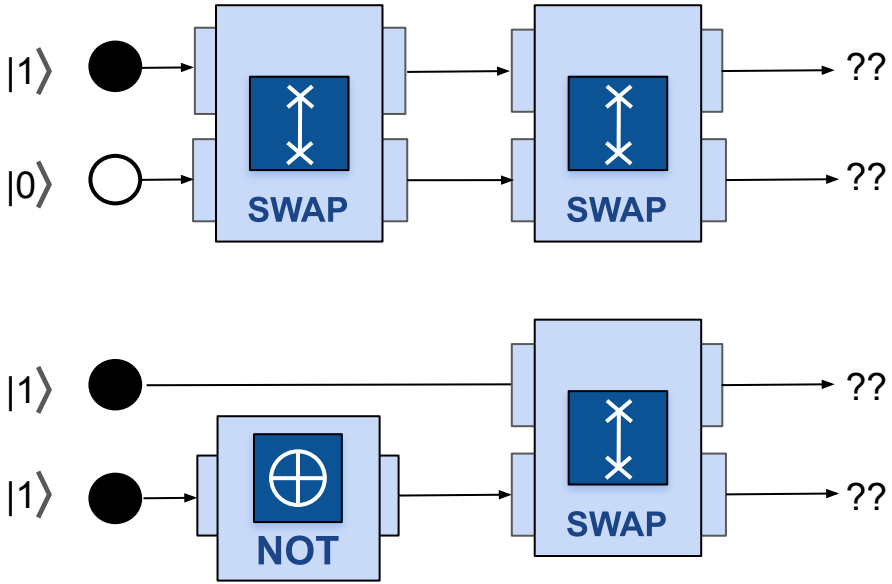

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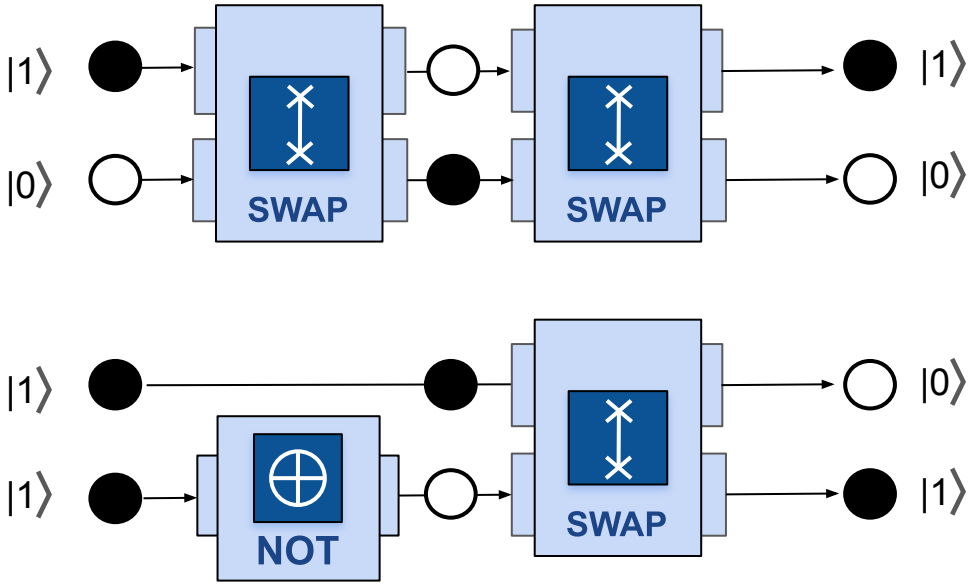
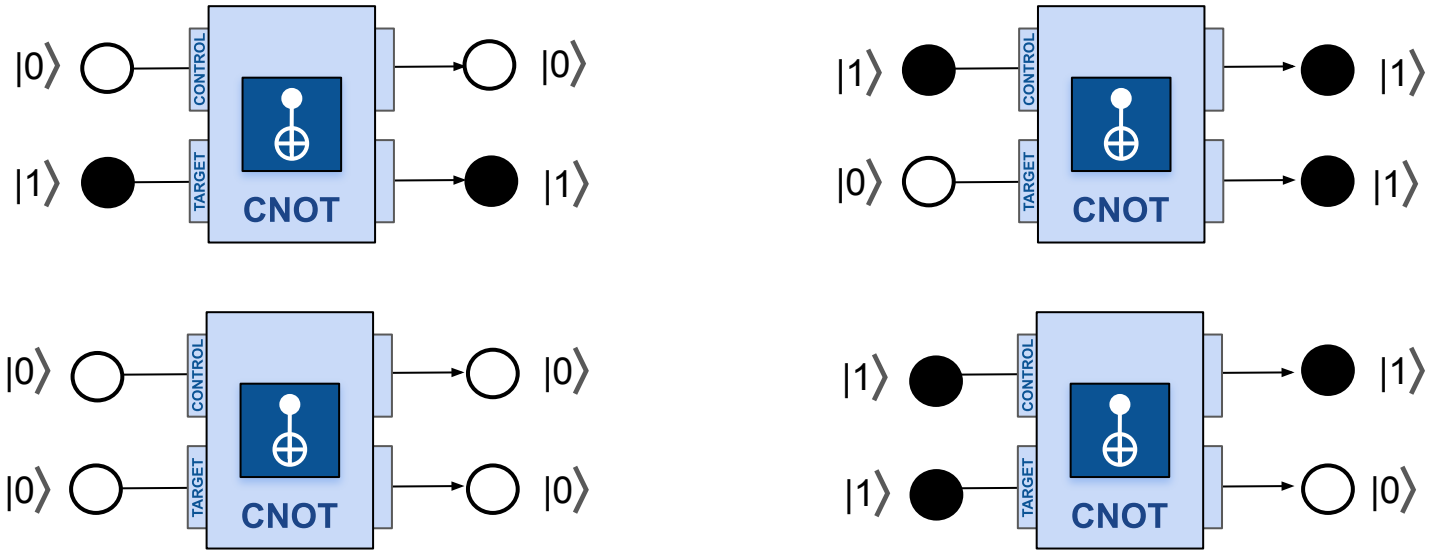


C-NOT operation (Controlled-NOT)



The **TARGET** (⊕) toggles if and *only* if the **CONTROL** (●) is black.

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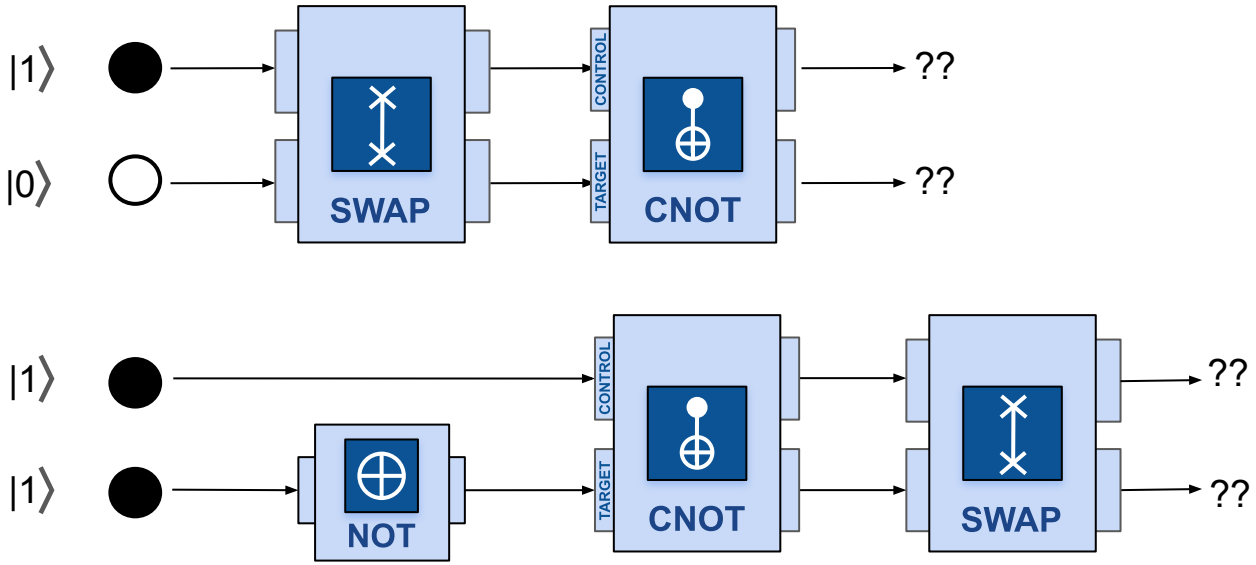

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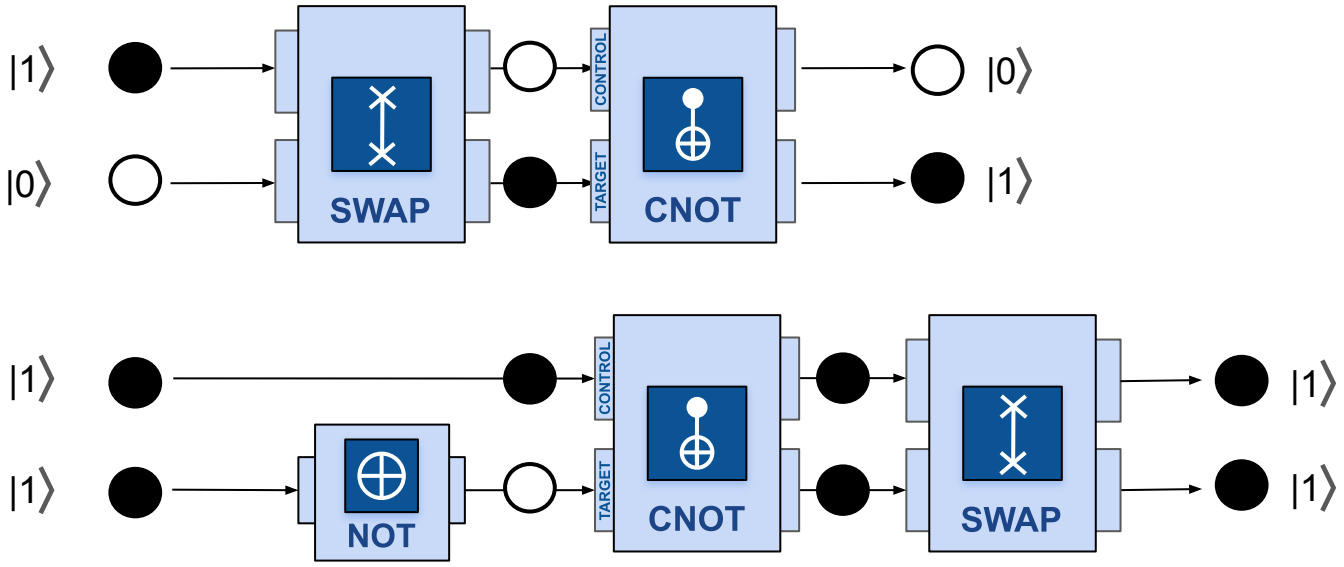

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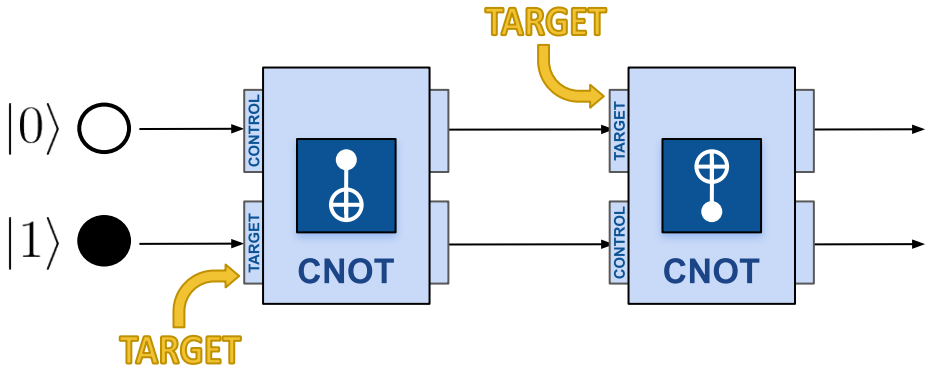

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