



Quantum Computation and Information

A Gentle Introduction

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Quantum Computing is the application of **Quantum Information Science (QIS)** to the development of *machines* capable of performing operations and calculations based on quantum logic instead of the usual classical logic.

The usefulness of this kind of computation lays not only on the ability to engineer exponentially faster machines, but also on things such as being able to **efficiently simulate nature at the quantum level**, or creating encryption systems which are fundamentally secure.

CLASSICAL LOGIC

Set Theory (Boolean algebra)

- **AND** $\Rightarrow A \cup B$
- **OR** $\Rightarrow A \cap B$
- **NOT** $\Rightarrow \bar{A}$
- **XOR** $\Rightarrow A \cap B - A \cup B$

QUANTUM LOGIC

Quantum Theory (Non-Commutative)

- **Probabilistic measurement**
- **Measurement causes disturbance**
- **Superposition**
- **Entanglement**
- **Uncertainty principle**

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Quantum Software: IBM's Qiskit

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"The only thing demonstrated by an impossibility proof is a lack of imagination."
– John Stewart Bell –



