qLearn Week 1: Intro to Quantum Algorithms

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University of Toronto Quantum Computing Club

Who am I?

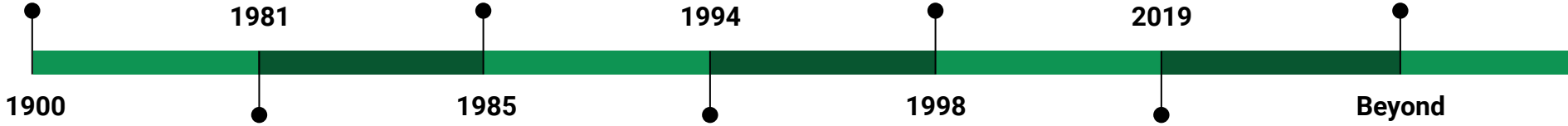
- qLearn Algorithms 2024-2025 Instructor
- ECE 2T6
- Interests in:
  - Quantum Communications
  - Optimization Algorithms
  - Hardware Design
- Discord - msilve86

Course Info

Join UTQC Discord!

UTQC Resources and Sign ups

Quantum Computing Timeline



1900 — Quantum Mechanics Introduced to the World

German physicist Max Planck proposes the concept of energy quanta, laying the groundwork for quantum mechanics advanced by scientists like Albert Einstein, Niels Bohr, and Werner Heisenberg

1981 — The Idea of the Quantum Computer

Theoretical physicist Richard Feinman proposes the idea of a computer that operates on quantum mechanical principles, stating its use in simulation

1985 — The Universal Quantum Computer

British physicist David Deutsch publishes the concept of a universal quantum computer, capable of performing any classical computation with the benefit of quantum properties

1994 — Shor's Algorithm

American mathematician and computer scientist Peter Shor develops the first quantum algorithm, demonstrating the first example of quantum supremacy

1998 — First Experimental Quantum Computations

Physicists Jonathan Jones and Michele Mosca demonstrate the first physical implementation of a quantum algorithm in a 2-qubit system

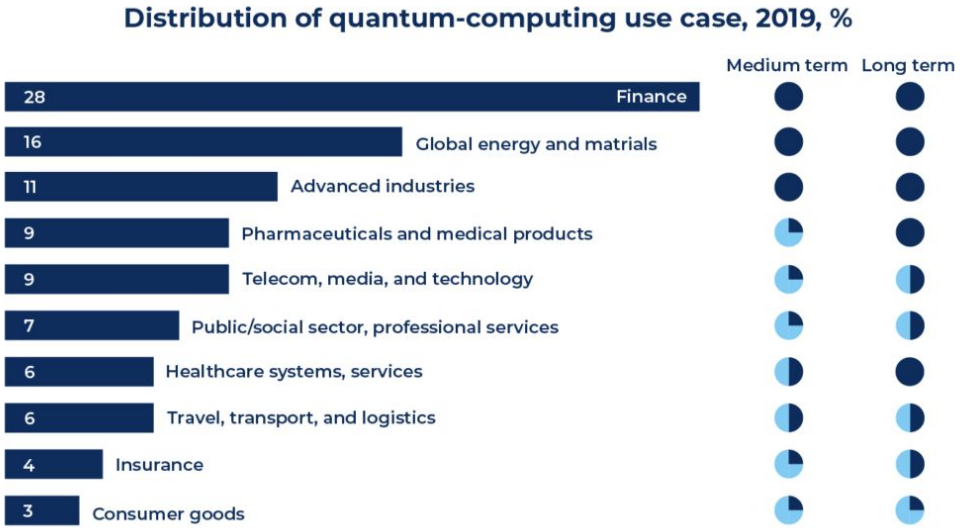
2019 — Quantum Supremacy Demonstrated

Google claims to achieve quantum supremacy with their 53-qubit quantum processor, Sycamore, by solving specific tasks faster than the most powerful classical supercomputers

Beyond — Quantum Engineers and Scientists Continue to Research

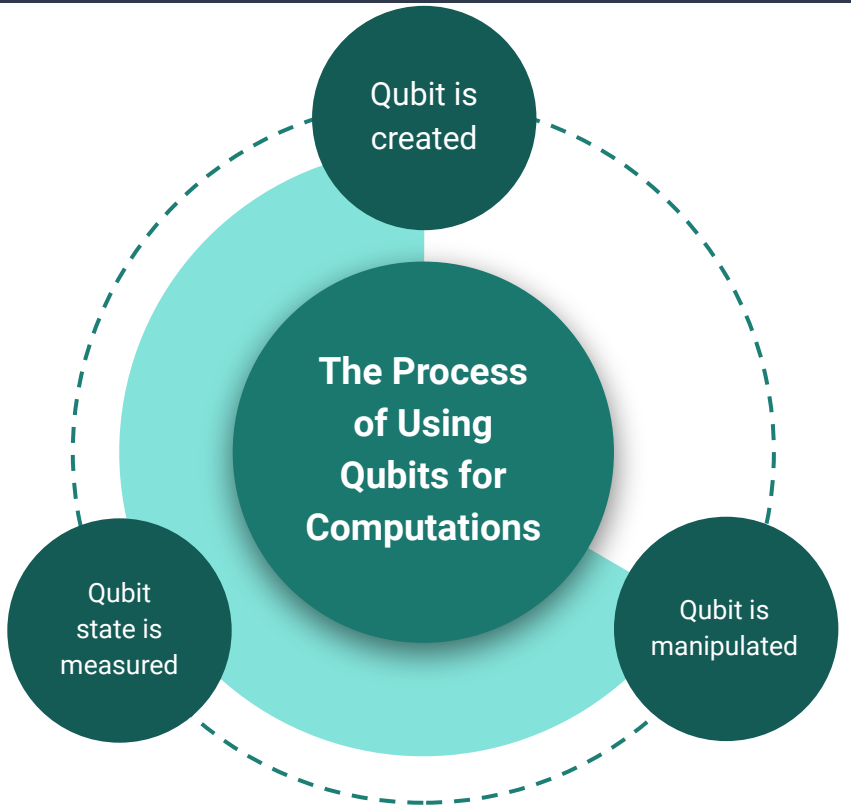
So Why Quantum?

- Key Terms
  - Supremacy Vs. Advantage
  - Qubits (Quantum Bits)
- Computing Advantages
  - Complexity Advantages
  - Simulation
  - Parallelism
  - Cryptography



The Basics of Qubits

- In classical computing, information is stored in **bits**, represented by 0s and 1s
- In quantum computing, its main advantage is the use of **quantum bits (qubits)**, which harness quantum mechanics to create different computational properties
- Qubits are
  - Created
  - Manipulated
  - Measured



Office Hours?
Problem Sets?
Let me know!

Coming Soon:
Github
Jupyter Notes