Quantum Gate Synthesis
- SQUANDER -

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Motivation

- New methods with
  - **exponential** speed up: Shor's quantum Fourier transform
  - **quadratic** speed up: Grover's search algorithm
- Optimization problems

  ⋮
- *Quantum Machine Learning* or *Quantum Neural Networks*

- Qubits instead of classical bits
- Quantum mechanical superposition (mixed state)
- Quantum entangling of qubits

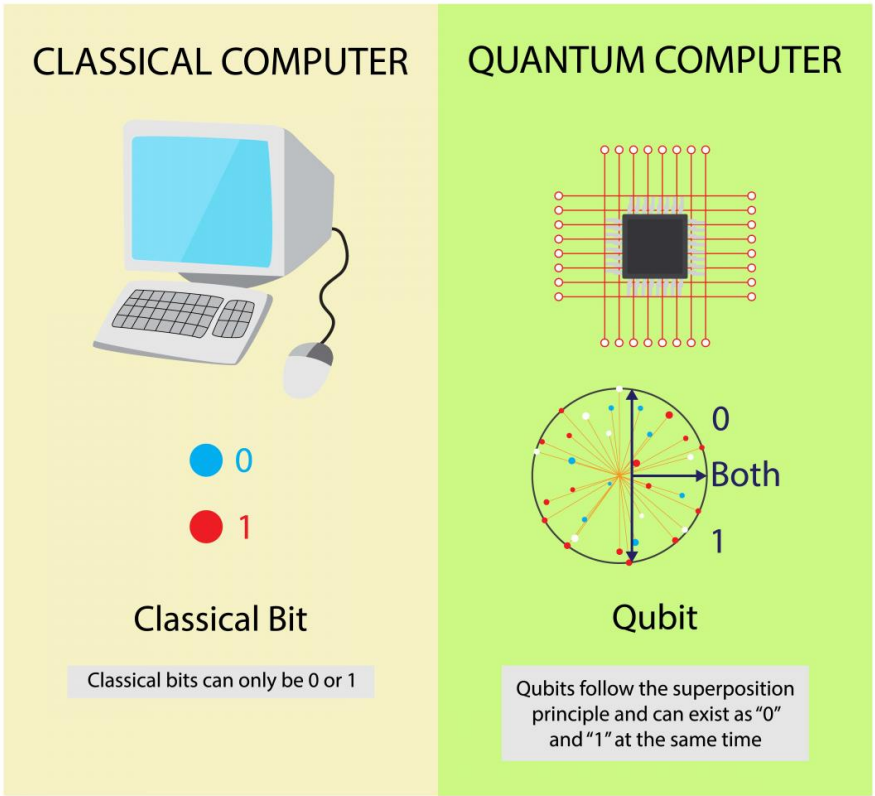

Figure 1: Classical vs Quantum Computing
Source: www.berkeleynucleonics.com

Theoretical background

SQUANDER

- **S**equential **QUAN**tum Gate **DE**compose**R** [1, 2]
- An optimization based quantum compiler.
- Uses C/C++ an Python.
- A tool to decompose quantum circuits.
- Find SQUANDER on GitHub: github.com/rakytap/sequential-quantum-gate-decomposer

Project plans

- Short term plans:
  - Run SQUANDER package with different optimizer methods.
  - Use gradient-free optimizers (e.g Powell's method, Nelder–Mead method)
- Long term plans:
  - Study about quantum optimization methods.
  - Develop Python scripts to decompose unitary matrices using single- and two-qubit gates.

References

Péter Rakyta and Zoltán Zimborás.
Efficient quantum gate decomposition via adaptive circuit compression, 2022.
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Line Search Strategy for Navigating through Barren Plateaus in Quantum Circuit Training, 2024.
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