

Learning Goals for Today

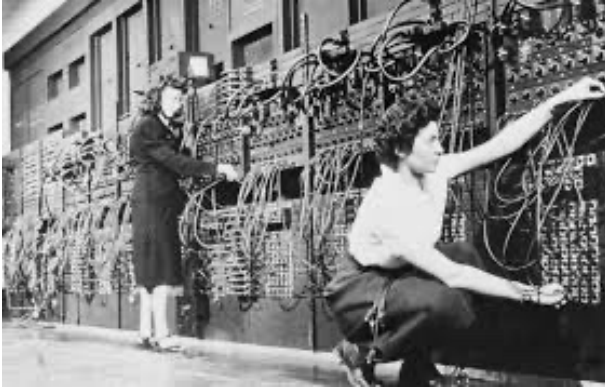
- Build curiosity for quantum computers + what they can do
- Discuss the learning process

Announcements

- Office Hours: Tues 11-2, Thurs 11-12
- What I did over the summer → Fri 9/12, 9/19, 12:30-1:45, 753HS 102 PIZZA
- Sign-up: go/WIDTSAS
- ① Job/Project ② How you got it ③ Best/Worst
- Upcoming Assignments: Rough Draft, Getting to know you quiz, exit tix, complex numbers self test
- Lecture notes, video ↖ Private
- Tech policy

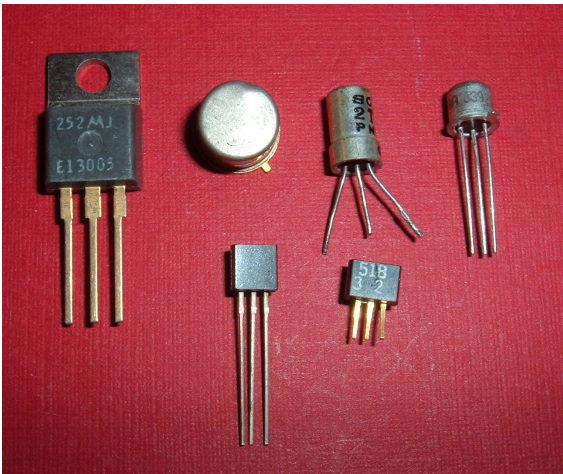
Classical Computers

Vacuum Tubes



{ Bamford, 2024, "The Fascinating History..." }
The Quantum Record

Transistors



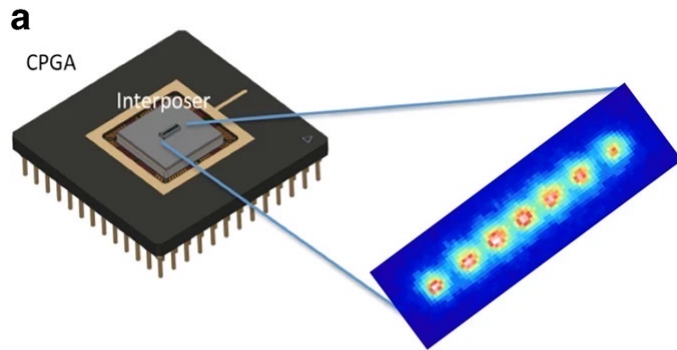
[wikipedia]

0, 1

AND, NOT, OR

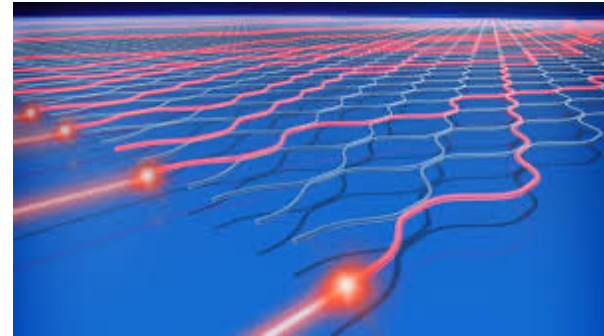
Quantum Computers

Levitated Ion Vibrations



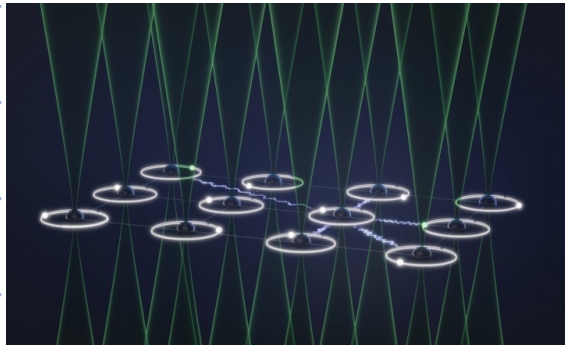
[Brown, Kim, Munroe ; 2016 ; NPS Quantum]

Interacting Photons



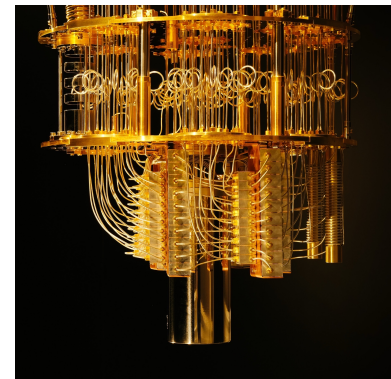
[Yihuan Luo (image), Conover, 2020
Science News, "The New
Light-based Quantum Computer"]

Electronic Orbitals



[University of Stuttgart]

Superconducting Circuits



[IBM]

↓
 $|0\rangle, |1\rangle$

↙
Unitary logic

But... quantum computers that are large enough + accurate enough to solve useful problems do not exist. ☹

We'll use math to understand the expected behavior of these large scale devices

What do you know about quantum computers?

- There are problems a quantum computer can solve that no classical computers can solve.

A) True

B)

False

C) Unknown

What do you know about quantum computers?

- Quantum computers can efficiently solve NP-Hard problems, like traveling salesperson

A) True

B) False

C) Unknown

↑
99% of

QC researches

Course Learning Goals

go/c5333

Learning Goals

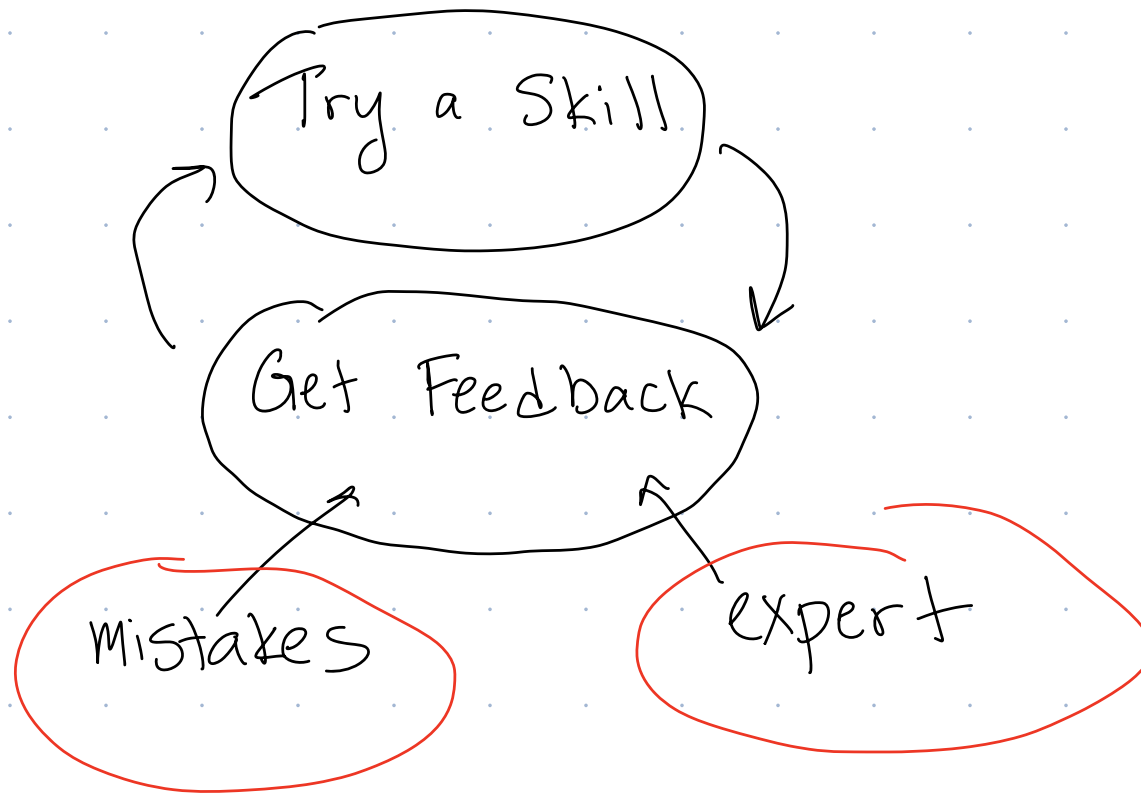
- Use standard terminology and mathematical tools of quantum computing to effectively describe and analyze quantum algorithms and protocols for cryptography, game-playing, disturbance-free detection, factoring, searching, and error correction.
- Describe properties of quantum mechanics (like entanglement, measurement, no-cloning, superposition, negative and complex phases), and build intuition as to why these properties lead to advantages over standard computation in computing and information tasks.
- Appreciate the limits of quantum computation and recognize when hype is used to minimize those limitations.

Learning

1. What is something you are good at?
(That requires effort)

go/ SKPoll

Learning



- Sets for effort
- Reattempts to demonstrate skills

[We will discuss syllabus next class.]

- Group Work on next slide deck

Announcements ↗