

Learning Goals for Today

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

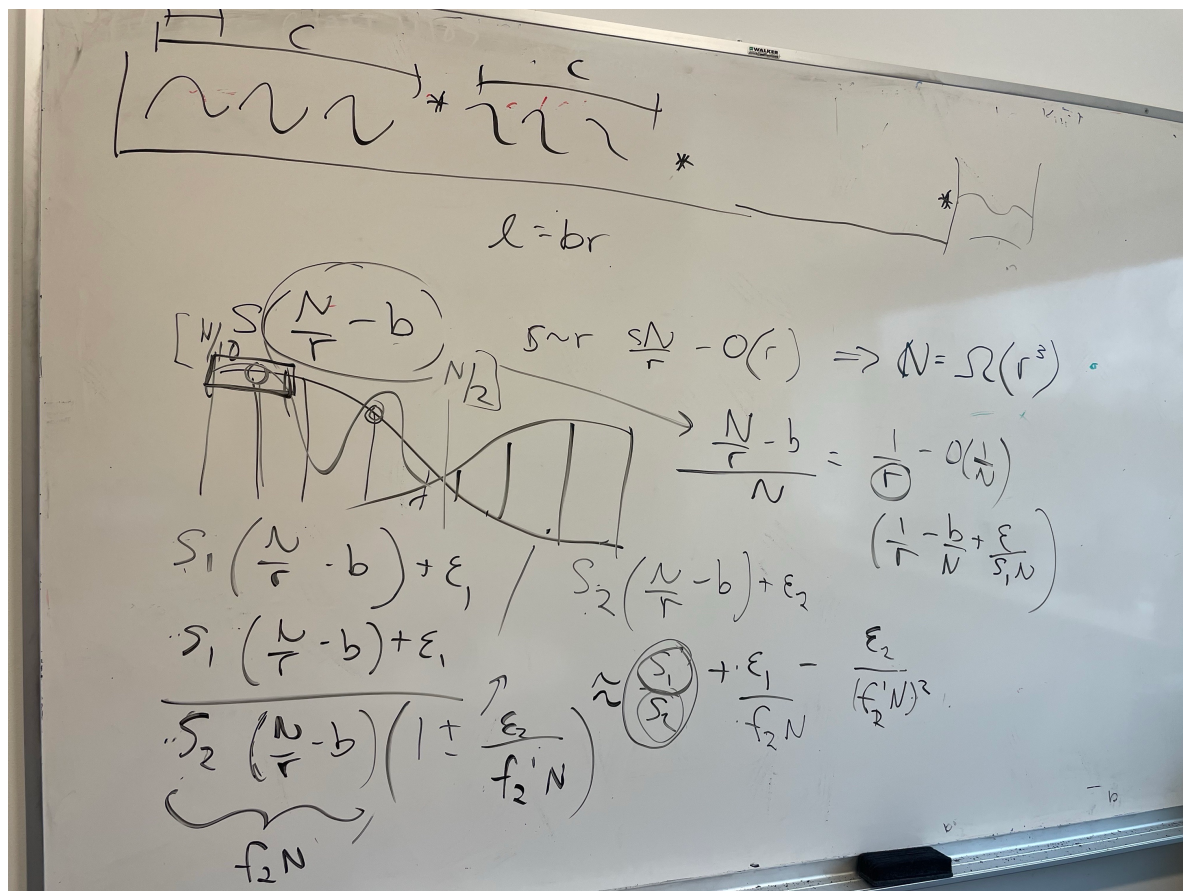
Announcements

- Friday 12:20 - 1:20 in 102, Pizza + CS + Friends + What I Did This Summer
- Do something with CS over the summer?

[go/widts](https://go.widts)

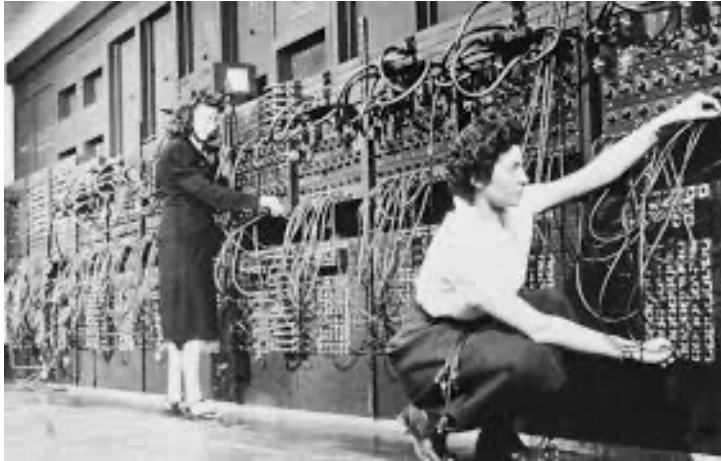
- Upcoming Assignments
- Lecture notes, video
- No devices. Want me to print out prenotes? Let me know.

Shelby Kimmel she/hers



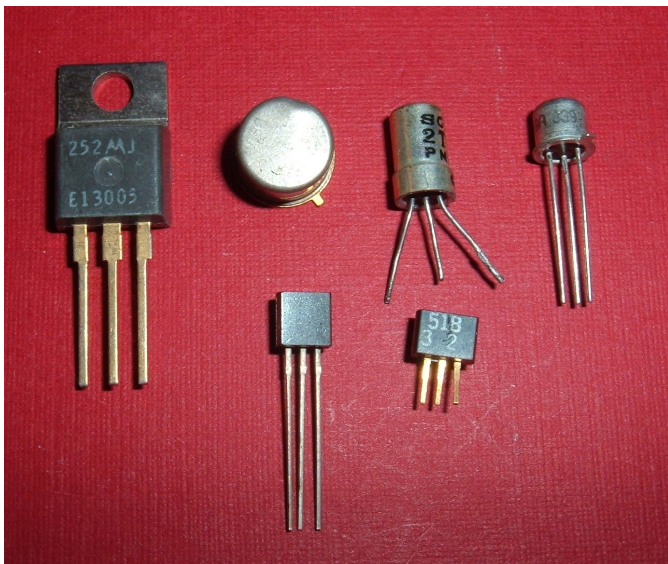
Classical Computers

Vacuum Tubes



[Bamford, 2024, "The Fascinating History..."]
[The Quantum Record]

Transistors



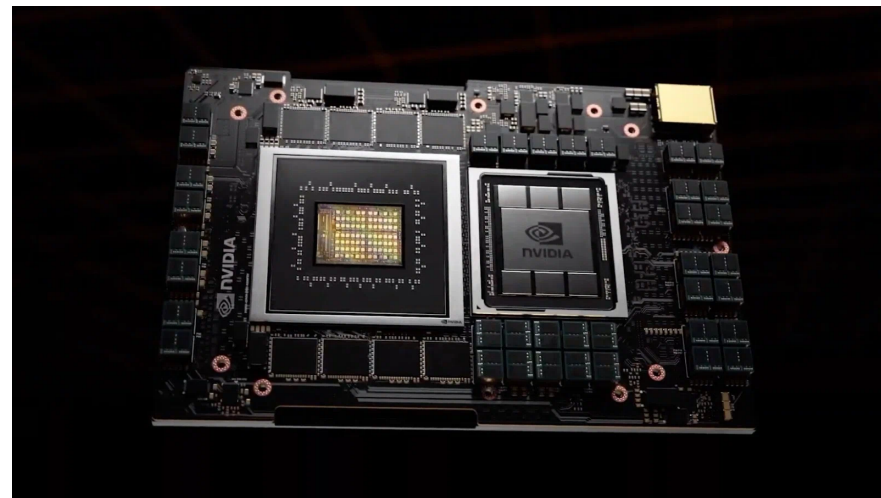
[wikipedia]



0, 1 (bits)



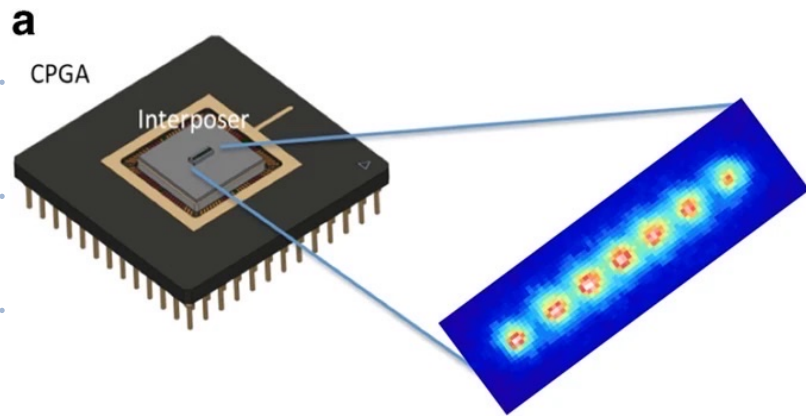
Boolean Operators
(AND, OR, NOT)



[NVIDIA]

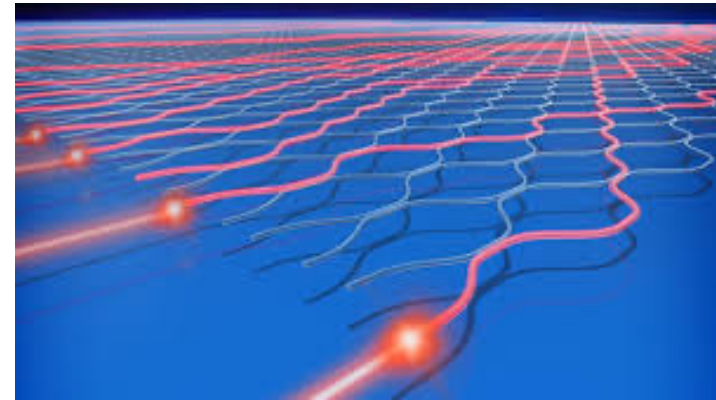
Quantum Computers

Levitated Ion Vibrations



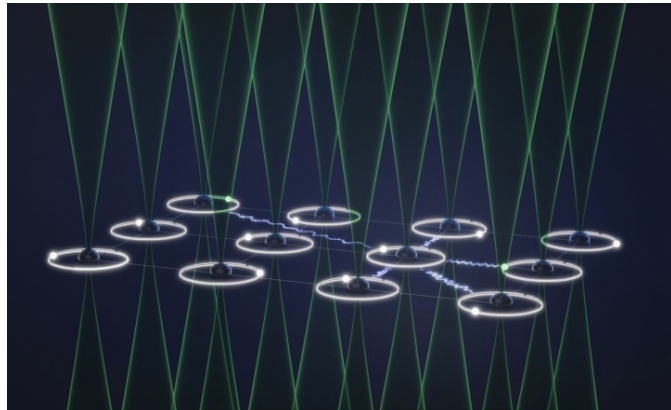
[Brown, Kim, Munroe; 2016; NPS Quantum]

Interacting Photons



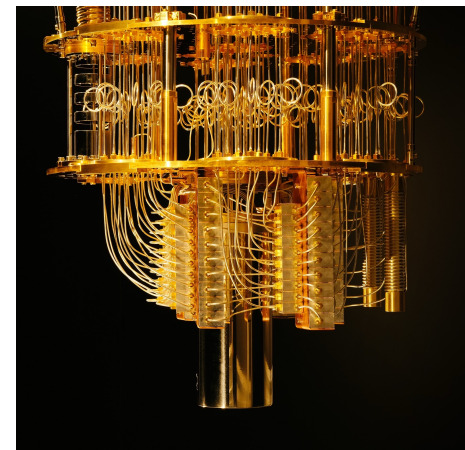
[Yihuan Luo (image), Conover, 2020
Science News, "The New
Light-based Quantum Computer"]

Electronic Orbitals



[University of Stuttgart]

Superconducting Circuits



[IBM]

qubits $10^7, 10^8$ + Unitary Operations

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~~^{complete} problems, like traveling salesperson

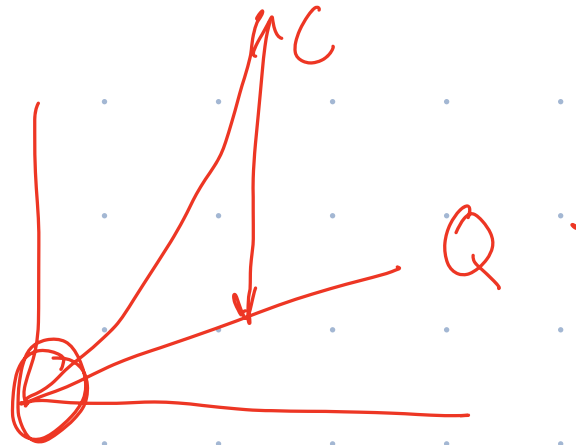
A) True

B) False
95%

C) Unknown

There a problems !

What do you know about quantum computers?



- There are problems for which there is an exponential time advantage for a quantum computer

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.

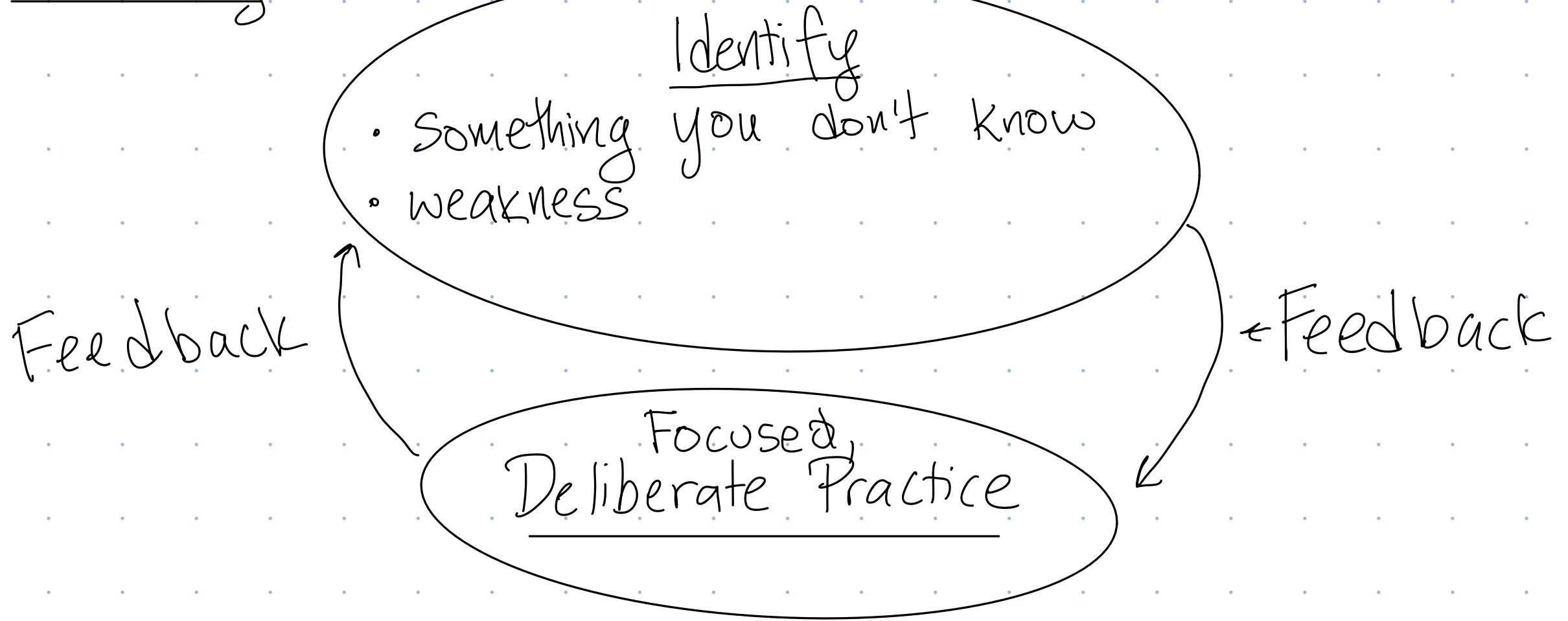
Learning

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

2. How did you get good at it?

go/skPoll

Learning



- Psets for efforts
- Reattempts to demonstrate a skill

[We will discuss syllabus next class.]

Announcements ↗