ACCELERATE **CHICAGO**

Craft software with confidence in 2026

A day in the life of a quantum software engineer

Victory Omole

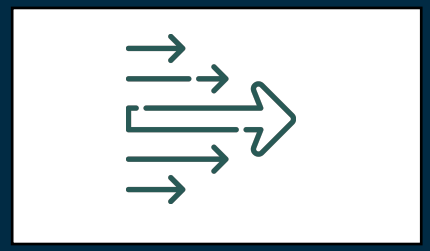
Quantum Software Engineer
victory.omole@infleqtion.com

Infleqtion is a **Quantum Technology Pioneer**

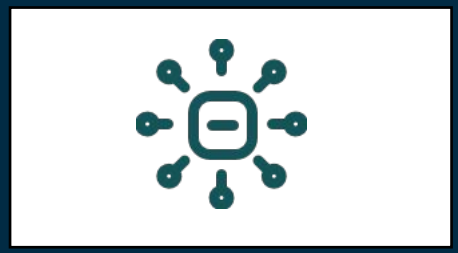
Founded in

2007

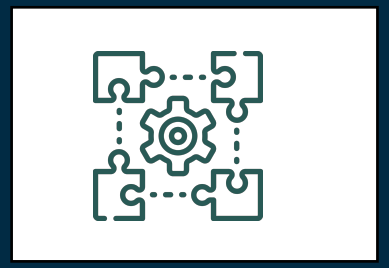
As ColdQuanta



Leaders in quantum sensing and computing



Quantum software force-multiplies hardware across modalities



Critical component supplier to the industry

Trusted Partner of the AUKUS Defense Community

Growing Global Presence

World-Class Development Centers & Research Partners



International Space Station

Melbourne, Australia

Okazaki, Japan

Oxford, United Kingdom

Madison, WI

Chicago, IL

Boulder, CO

United States

University of Colorado **Boulder**

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

THE UNIVERSITY OF CHICAGO

Massachusetts Institute of Technology

UC **SANTA BARBARA**

Working at Infleqtion

- Diverse and talented team of 200+ worldwide, **with over 90 scientists working in a variety of roles**
  - Research and development
  - Engineering and manufacturing
  - Business development
  - Product and program management

- **Wide array of projects and programs** spanning a range of Technology Readiness Levels (TRLs)
  - Academic partnerships on fundamental research
  - Government-sponsored research programs
  - Industry collaborations for use-case development
  - Market-aware product development

Quantum Basics

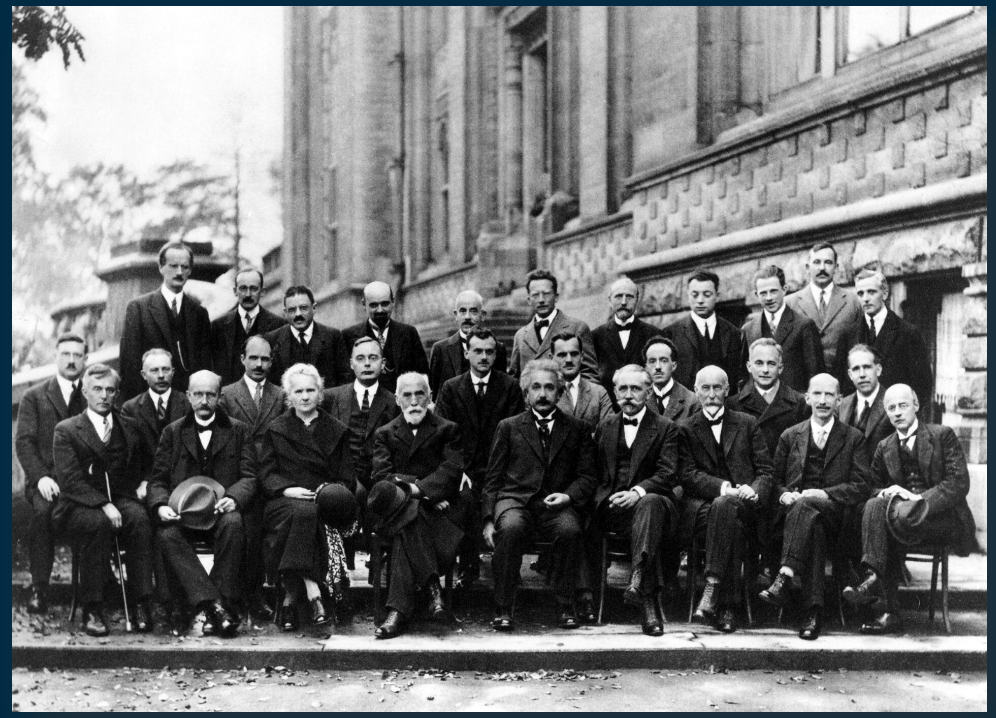
- Quantum mechanics is not science fiction – it's all around us!
  - It is the *true* mechanics of all matter and light
  - One of the most successful modern scientific theories of all time

Fundamental concepts

Quantization

Superposition

Entanglement



Electrons and Photons: The 1927 Solvay Conference in Brussels. Over half of attendees would go on to win Nobel Prizes for their contributions.

Quantum 101 in 2 minutes

Quantum mechanics is not science fiction – it's all around us!
It's the dominant physics of the very small.

Quantization

States of quantum particles are not continuous but rather exhibit discrete, or *quantized*, values.

Superposition

Quantum particles can exist in multiple states simultaneously *until they are measured*.

Entanglement

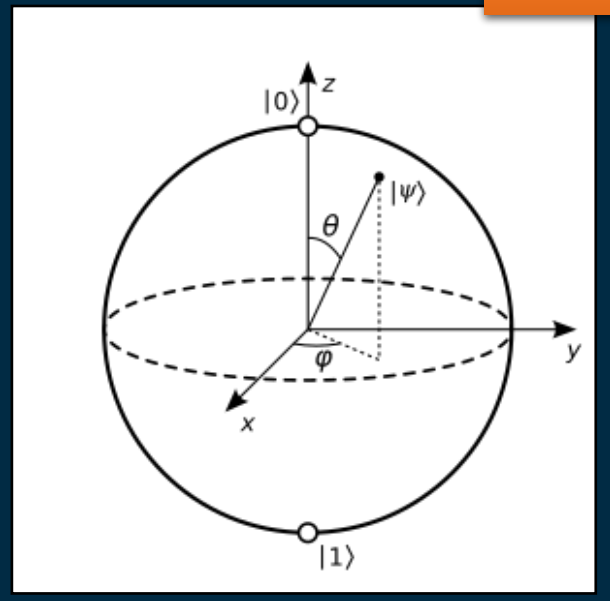
Measuring the state of one entangled particle instantly determines the state of the other.

Quantum 101 for Computing

Entanglement and **superposition** are the *key ingredients*



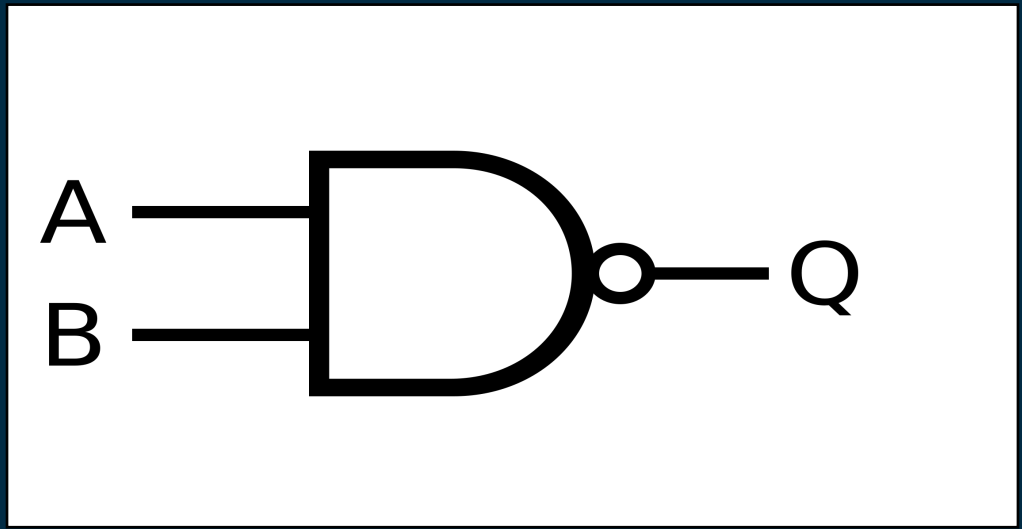
Digital information: classical **bits** can be in either the 0 or 1 state (*off* or *on*)

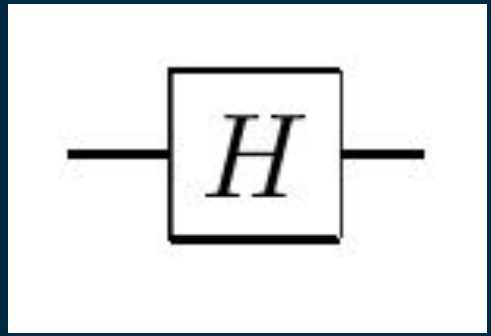


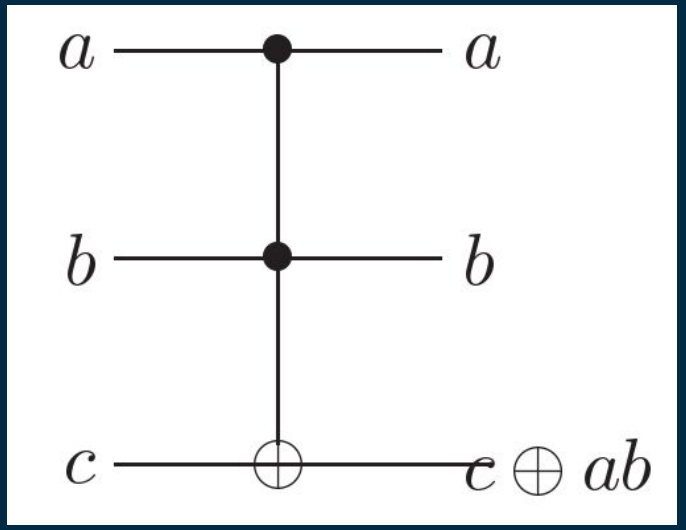
Quantum information: **qubits** can be in the state 0, state 1, *or any complex combination thereof.*

Quantum computers promise to solve *certain classes of problems* that are intractable for today's most powerful classical computers.

Gates







Nielsen & Chuang 2010

Classical circuit logic gates:

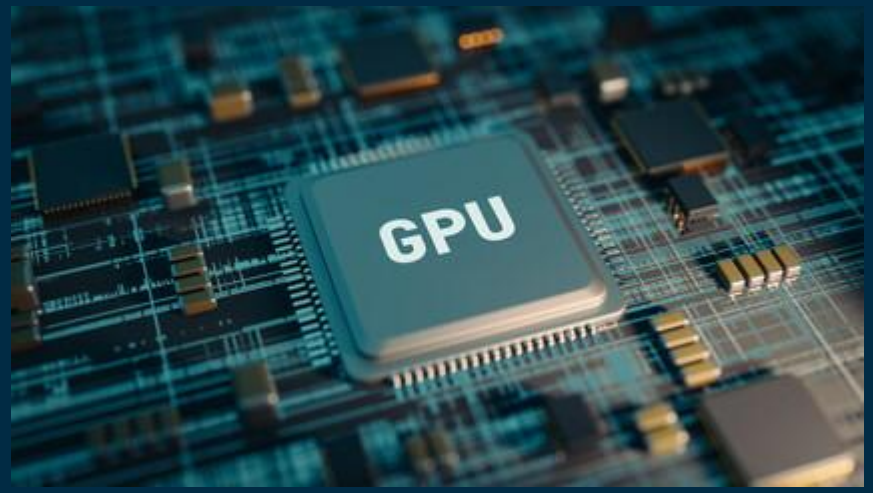
- Example – Classical NAND logic gate
- Implemented with transistors

Quantum circuit gate model:

- Examples – Hadamard Gate and Quantum NAND gate
- Hadamard creates the superposition, Quantum NAND creates the entanglement
- Implemented with atoms and light (qubits)

GPUs

- GPUs are *specialized* processors
- Built for graphics processing
- Turned out to be useful for AI, Mining Bitcoin e.t.c



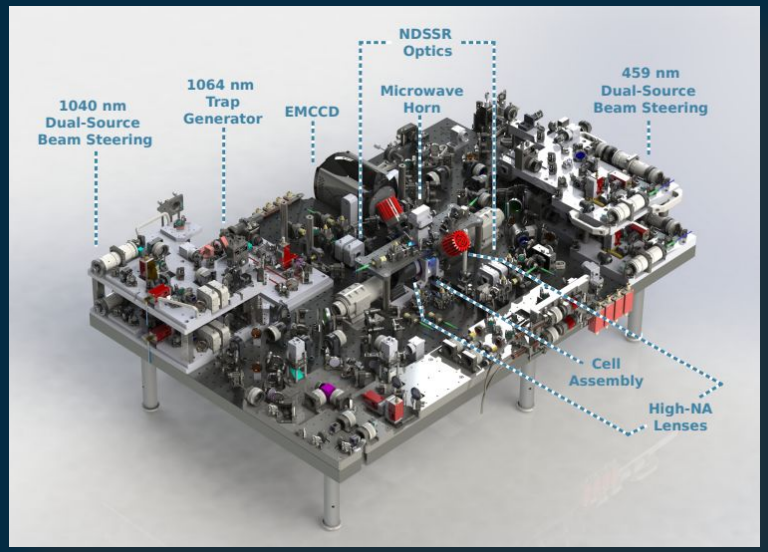
GPU software engineering

- Profile applications to find out where GPU acceleration is most needed
- Implement algorithms that map well to GPU hardware
- Manage interactions between CPU and GPU
- Debug issues across hardware, drivers and software layers
- Collaborate with domain experts to find out what real-world applications would most benefit from GPUs



QPUs

- QPUs are *specialized* processors
- Built for efficiently simulating quantum mechanics
  - Scientists love this! It turbocharges their research.
  - "My P.h.D. wouldn't have taken me 5 years to do if I had a medium size quantum computer to perform simulations on."- Victory's Friend
- Turns out to be useful for breaking cryptography
- Might turn out to be useful for other things like AI, but as of now, **we don't know**.



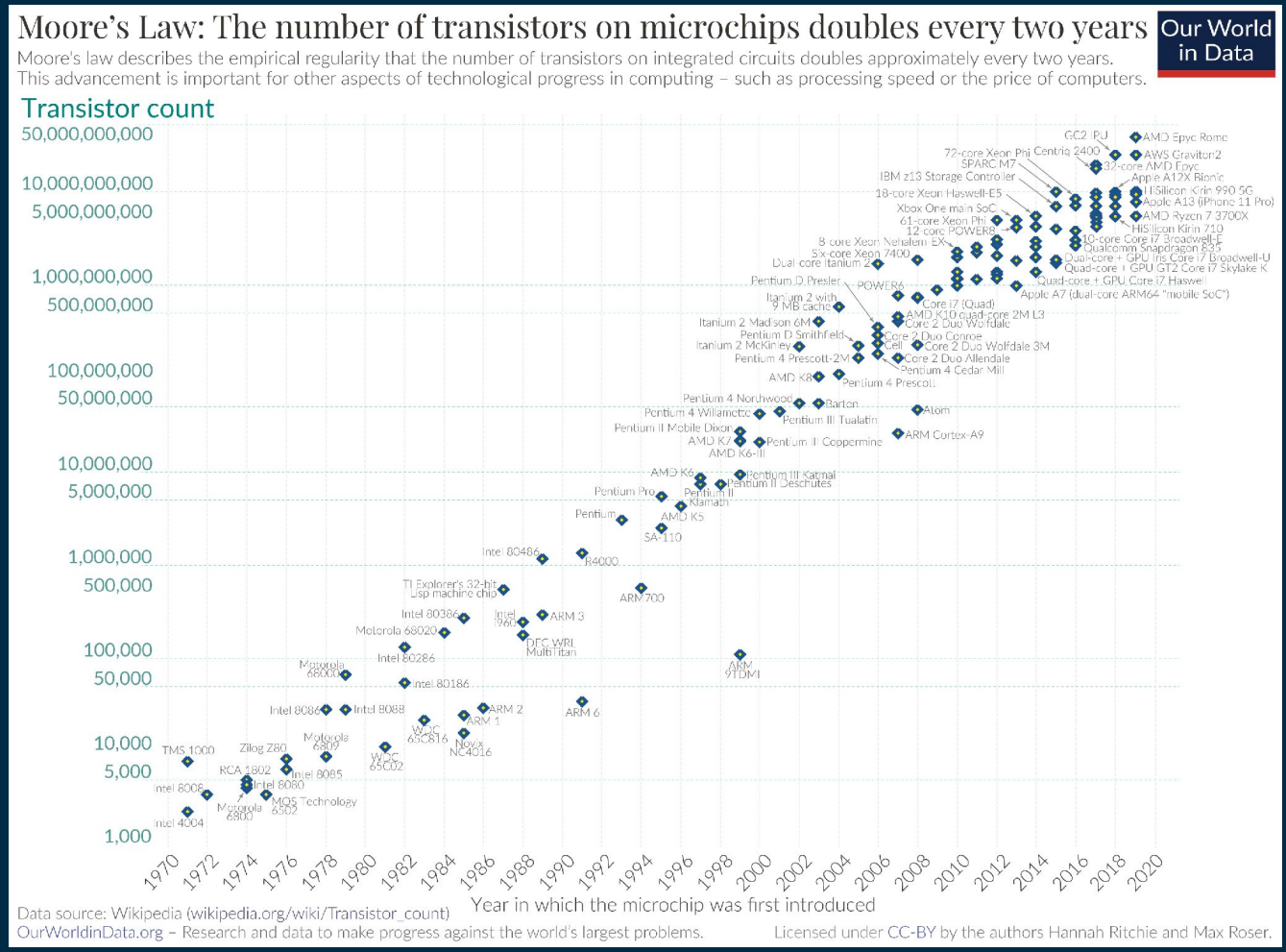
Comparisons

	NVIDIA A100 GPU	State-of-the-art neutral atom QPU
Memory	54 billion transistors	280 qubits
Error probability	1/1 million billion	1/1000
Gate speed	Less than 1 nanosecond	1 microsecond

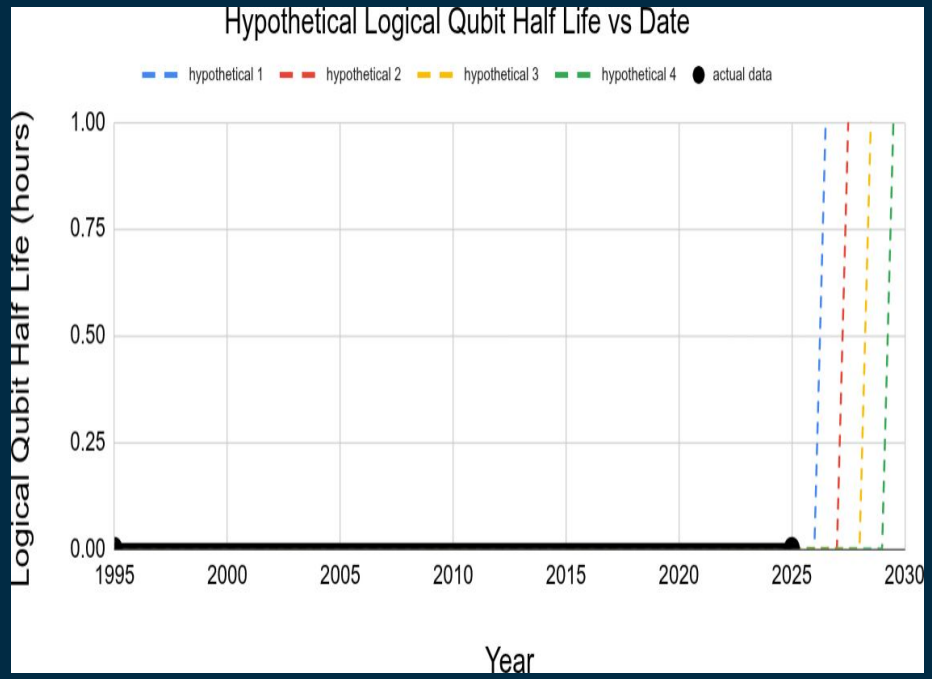
To match GPUs across all axes at once, we need quantum computers to improve by **over 10 orders of magnitude**

Silver linings

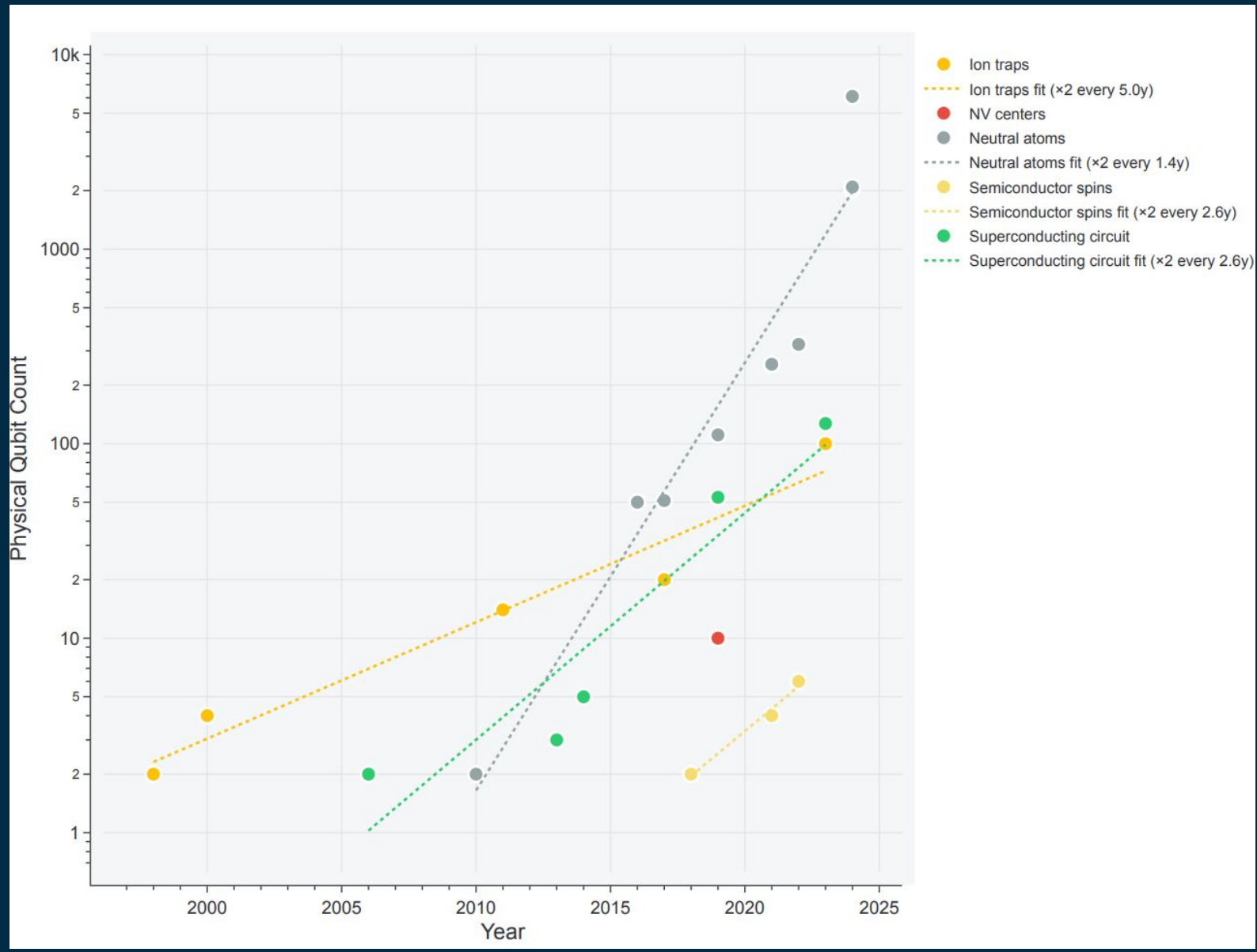
History has shown that classical computers improve exponentially



There are hints this exponential growth will apply to quantum computers as well



https://algassert.com/post/2503



https://arxiv.org/abs/2507.03678

Existing quantum computers already useful to quantum researchers

Observation of Time-Crystalline Eigenstate Order on a Quantum Processor

Google Quantum AI and collaborators[†,*]

Demonstrating an unconditional separation between quantum and classical information resources

William Kretschmer,[1,2,*] Sabee Grewal,[1] Matthew DeCross,[3] Justin A. Gerber,[3] Kevin Gilmore,[3] Dan Gresh,[3] Nicholas Hunter-Jones,[4,1] Karl Mayer,[3] Brian Neyenhuis,[3] David Hayes,[3] and Scott Aaronson[1]

[1] *Department of Computer Science, The University of Texas at Austin, Austin, TX 78712, USA*
[2] *Simons Institute for the Theory of Computing, University of California, Berkeley, Berkeley, CA 94720, USA*
[3] *Quantinuum, Broomfield, CO 80021, USA*
[4] *Department of Physics, The University of Texas at Austin, Austin, TX 78712, USA*

(Dated: May 15, 2026)

Quantum error correction below the surface code threshold

Google Quantum AI and Collaborators

(Dated: August 27, 2024)

Article | Published: 23 October 2019

Quantum supremacy using a programmable superconducting processor

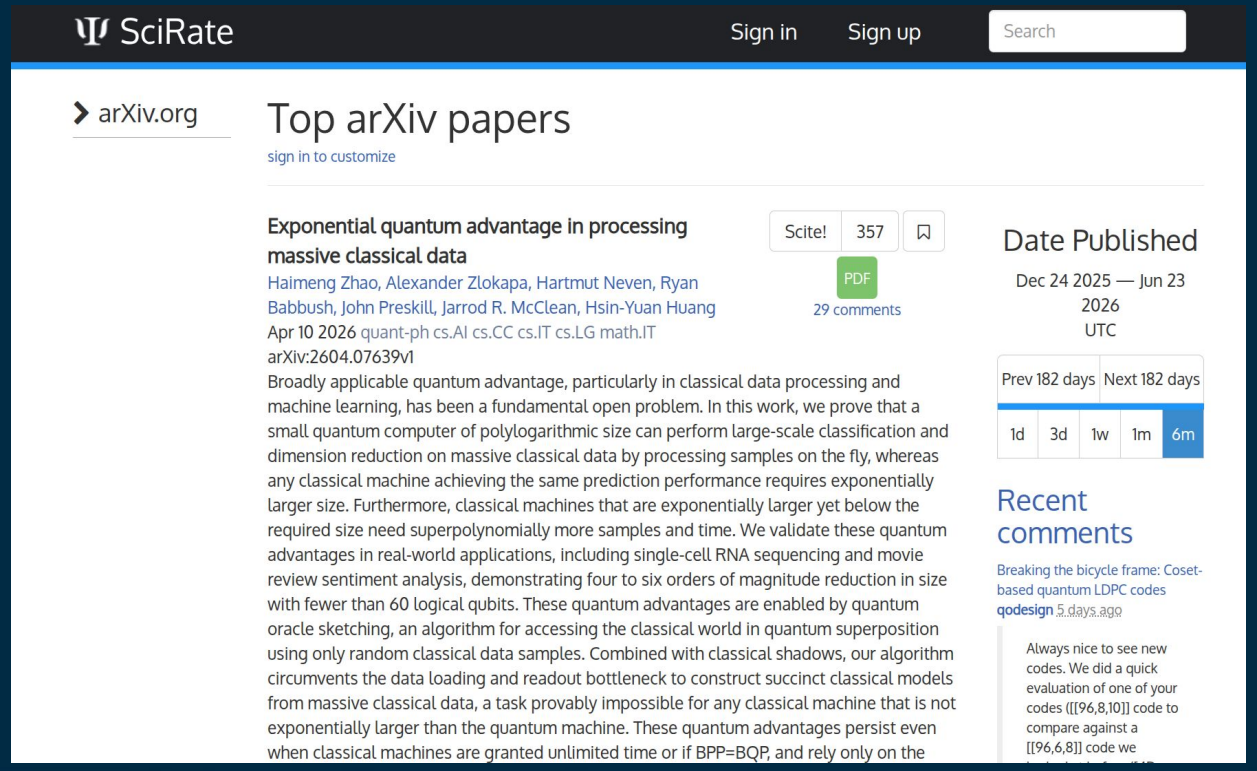
Frank Arute, Kunal Arya, Ryan Babbush, Dave Bacon, Joseph C. Bardin, Rami Barends, Rupak Biswas, Sergio Boixo, Fernando G. S. L. Brandao, David A. Buell, Brian Burkett, Yu Chen, Zijun Chen, Ben Chiaro, Roberto Collins, William Courtney, Andrew Dunsworth, Edward Farhi, Brooks Foxen, Austin Fowler, Craig Gidney, Marissa Giustina, Rob Graff, Keith Guerin, Steve Habegger, Matthew P. Harrigan, Michael J. Hartmann, Alan Ho, Markus Hoffmann, Trent Huang, Travis S. Humble, Sergei V. Isakov, Evan Jeffrey, Zhang Jiang, Dvir Kafri, Kostyantyn Kechedzhi, Julian Kelly, Paul V. Klimov, Sergey Knysh, Alexander Korotkov, Fedor Kostritsa, David Landhuis, Mike Lindmark, Erik Lucero, Dmitry Lyakh, Salvatore Mandrà, Jarrod R. McClean, Matthew McEwen, Anthony Megrant, Xiao Mi, Kristel Michielsen, Masoud Mohseni, Josh Mutus, Ofer Naaman, Matthew Neeley, Charles Neill, Murphy Yuezhen Niu, Eric Ostby, Andre Petukhov, John C. Platt, Chris Quintana, Eleanor G. Rieffel, Pedram Roushan, Nicholas C. Rubin, Daniel Sank, Kevin J. Satzinger, Vadim Smelyanskiy, Kevin J. Sung, Matthew D. Trevithick, Amit Vainsencher, Benjamin Villalonga, Theodore White, Z. Jamie Yao, Ping Yeh, Adam Zalcman, Hartmut Neven & John M. Martinis ✉ — Show fewer authors

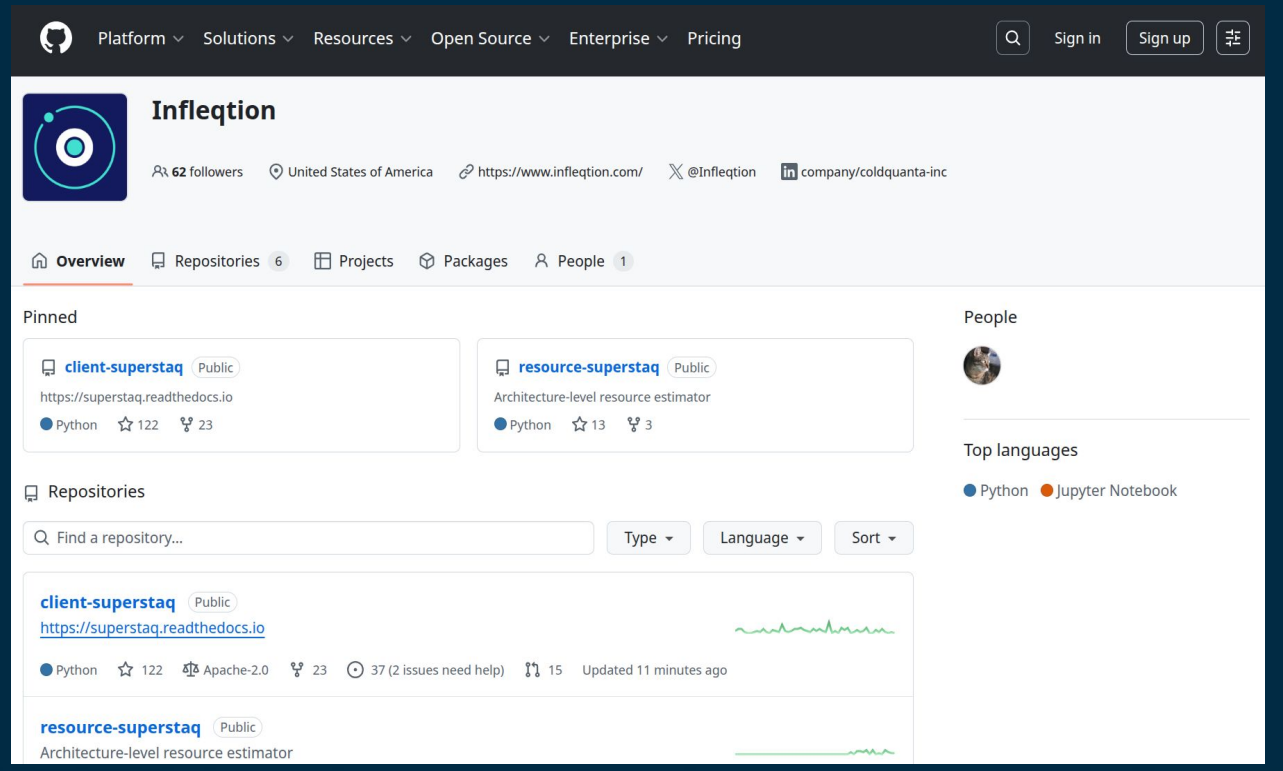
Engineering the Path to Useful QPUs

- Profile applications to find out where QPU acceleration is most needed
  - Run small applications on near-term hardware and extrapolate performance for long-term hardware
- Implement algorithms that map well to QPU hardware
  - Map small algorithms to run on near-term hardware
  - Write architecture papers that map the algorithms to long-term hardware
- Manage interactions between QPU, CPU, and GPU
- Debug issues across hardware, drivers and software layers
- Collaborate with domain experts to find out what real-world applications would most benefit from QPUs

Day-to-Day Quantum software engineering

- 9:00-10:00: Scirate for keeping up with the latest and greatest of quantum computing research
- 10:00-12:00: GitHub for software development; programming, code reviews, software architecture design
- 12:00-13:00: Lunch
- 13:00-15:00: Meetings/Emails/Teams
- 15:00-17:00: GitHub for software development; programming, code reviews, software architecture design





Navigating the Quantum Industry

- Leverage your **multidisciplinary** background

- **Connect** with the quantum community on LinkedIn and elsewhere

- Engage in **personal and open-source projects** to grow and showcase your quantum skills

- There are roles at all degree levels. Quantum is **not** just for PhDs!

- Unbiased bold statement: **Chicago is the quantum capital of the world!**
  - Attend Chicago Quantum Exchange events
  - Keep an eye out for exciting developments nearby
  - Engage with IQMP and NQAC

QUESTIONS?

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