Quantum computer games

Junye Huang

Quantum Developer Advocate

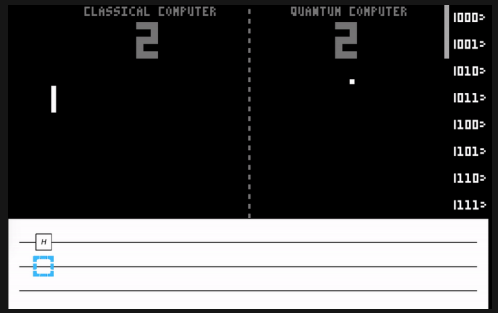
IBM **Quantum**

About me

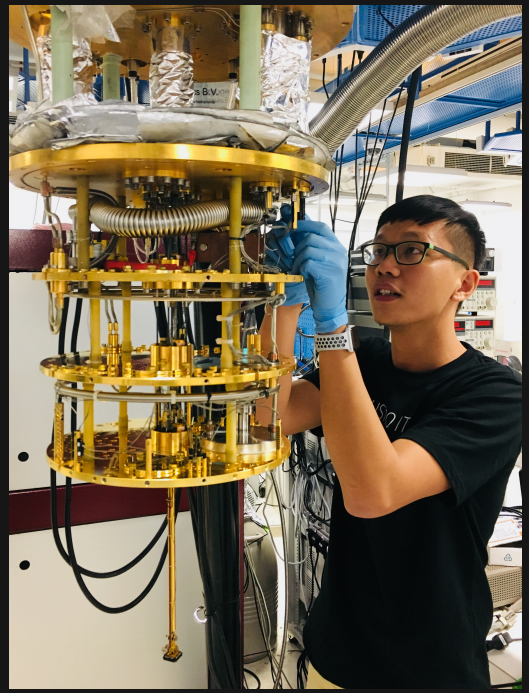
IBM Quantum Developer Advocate

- Promote quantum education in Asia Pacific
- Conduct quantum talks and workshops
- Organize hackathons and game jams
- Develop open source quantum education projects

Qiskit hackathon @ SG (with COT)



QPong



@HuangJunye

Why do we care about games?

Fun

Games are fun. Period.

- Mario
- Pokémon
- League of Legends

Technology

Games can showcase technological advances.

- Deep Blue (Chess)
- AlphaGo (Go)
- AlphaStar (StarCraft)

Educational

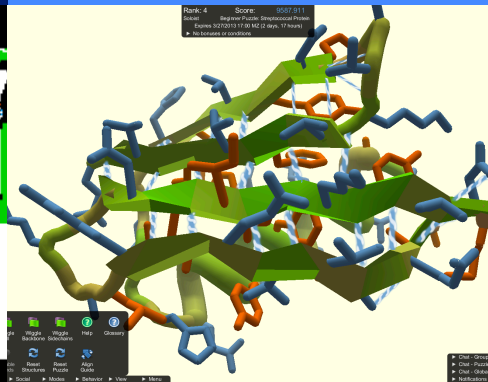
Games can teach you something.

- Oregon Trail
- SimCity
- Civilization

Useful

Games can do useful stuff.

- Fold.it
- Microsoft Flight Simulator
- PeaceKeeper



History of computer games

1950s

What can games do for computers?

1956

IBM Checkers

- Checkers with AI on IBM 700 series
- Built to demonstrate the power of computers
- Play existing games

Bertie the Brain (1950)

Nimrod (1951)

Noughts and Crosses (1952)

Image: www.ibm.com/ibm/history/ibm100/us/en/icons/ibm700series/impacts

1960s

What can computers do for games?

1962

Spacewar!

- First novel computer game, running on PDP-1
- Built to
  - Test out the new device (and later, new installations)
  - Showcase its capabilities
  - Be fun!

Baseball simulation (IBM, 1960)

The Sumerian Game (IBM, 1964)

Lunar Lander (1969)

Image: Wikimedia

1970s

Commercial success for computer games!

1972

Pong

- First commercial success
- Helped to establish the video game industry
- Built to be fun and make money!

Magnavox Odyssey (1972)

Breakout (1976)

Space Invaders (1979)

Image: Wikimedia

Back to quantum computers

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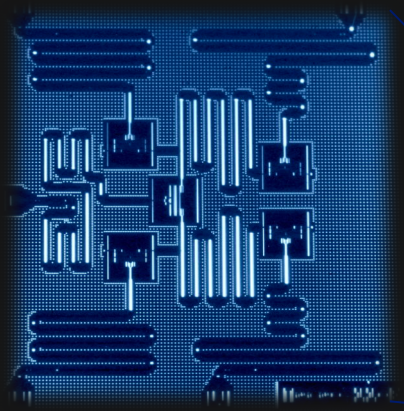
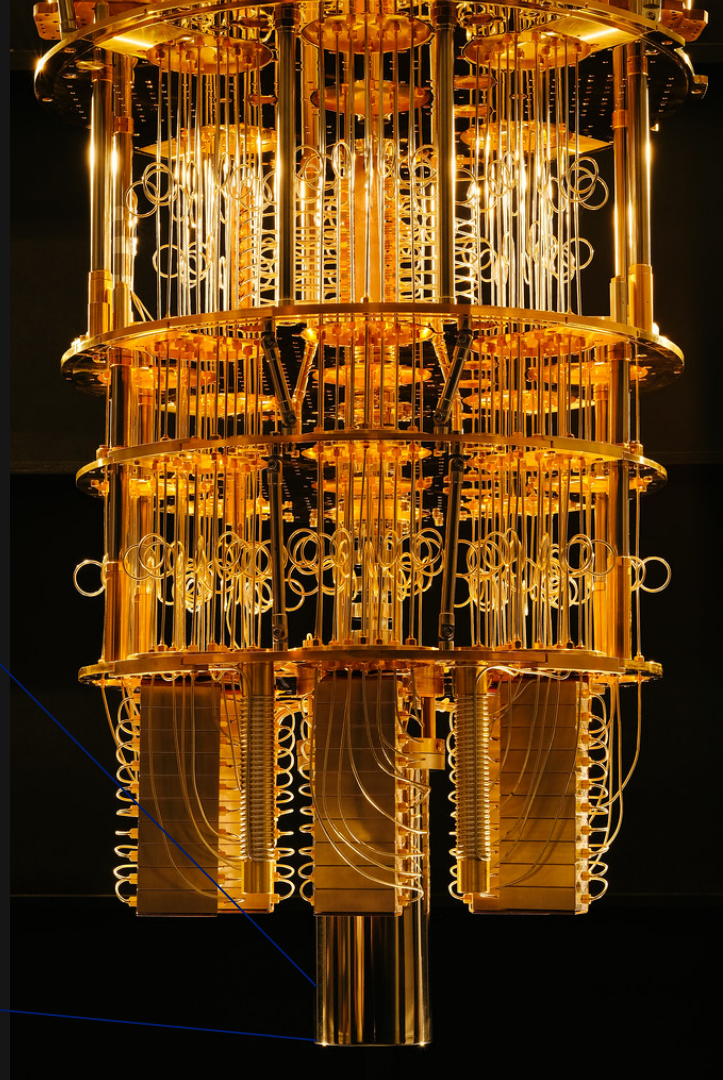
What are quantum computers?

- A different set of basic operations
- Different hardware
- Will solve certain problems even better than supercomputers
  - Chemical simulations
  - Optimization
  - Machine learning





IBM Quantum Experience

Quantum circuits

175 B

Users

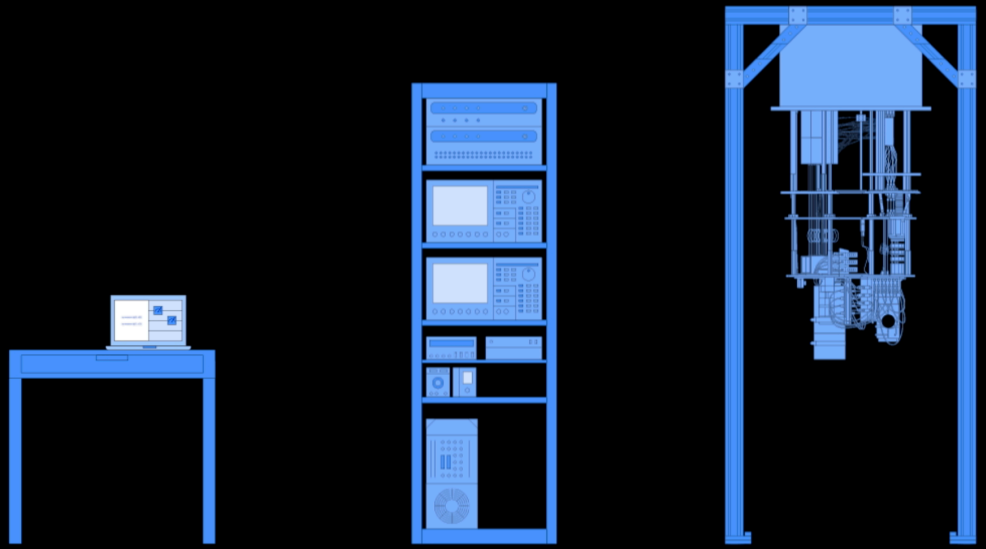
200 k

Client partners

105

Quantum systems

18

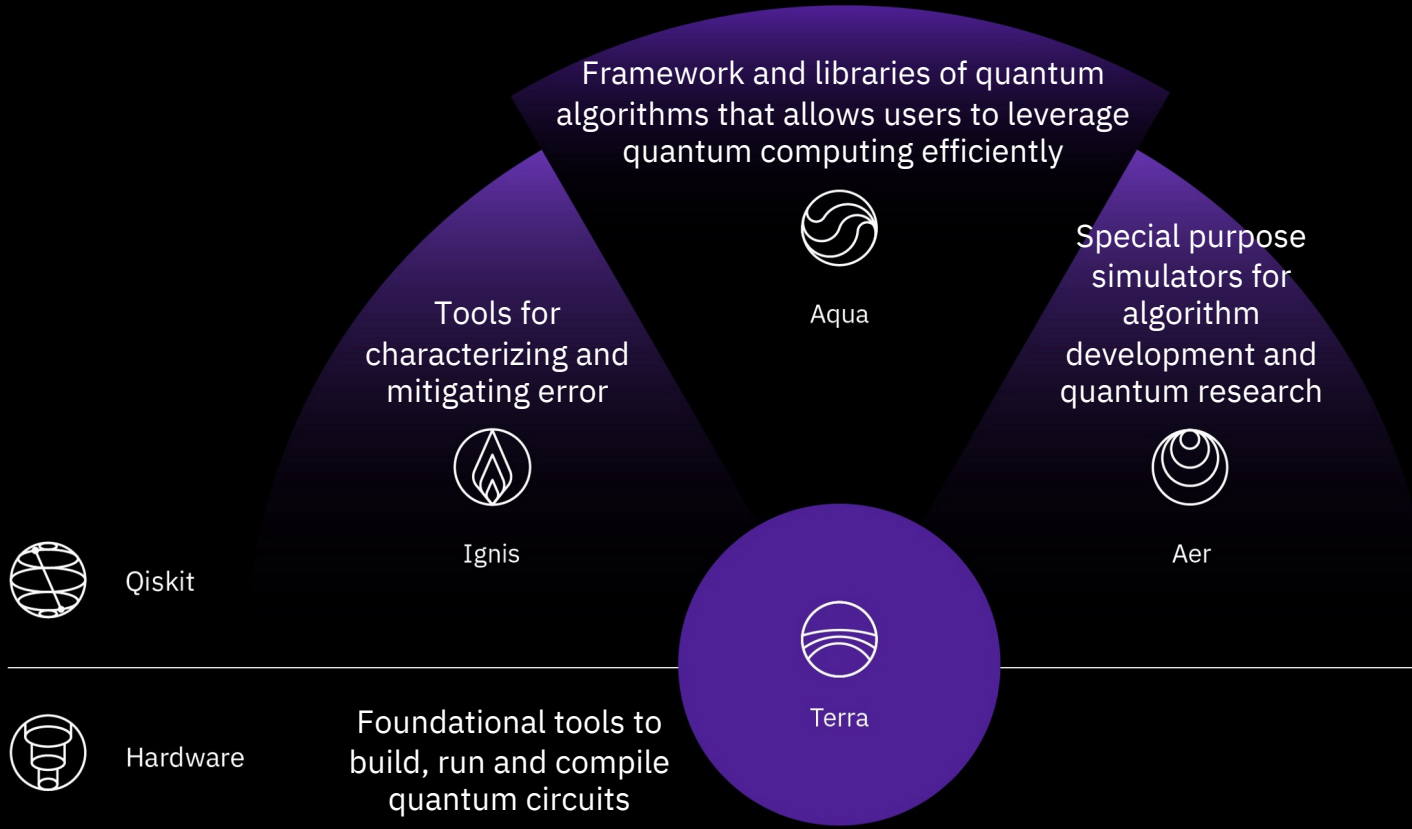


IBM Q

Qiskit software stack

Brings quantum computing out of the laboratory and into the hands of developers

- Open Source (Apache 2.0)
- Written in Python 3
- Modular and extendible



https://qiskit.org/

Quantum computing eras

IBM **Quantum**

Quantum ready era (2010s)

Prototype devices

Accessible via cloud

NISQ era (2020s)

Noisy (no error correction)

Intermediate scale (~100s qubits)

Fault-tolerant era (2030s?)

Fault tolerant (error corrected)

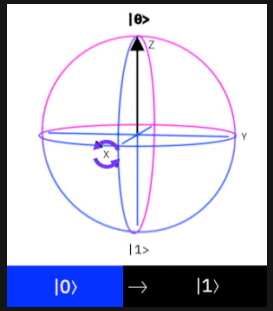
Large scale (>10^6 qubits)

2010s

What can games do for quantum computers?

2017

Cat/Box/Scissors



- Quantum version of rock/paper/scissors
- Forms the heart of a simple quantum programming tutorial
- Games to teach programmers:
  - Implement game mechanic with quantum operations

Dr. James Wootton

Quantum Battleships (2017)

Quantum Awesomeness (2017)

```
===== Welcome to Cat/Box/Scissors! =====

  ~~ A game by the Decodoku project ~~

When in doubt, press any key to continue!

You and your opponent choose one of two possible moves.

You win if your moves are the same.

Your opponent wins if they are different.

Which qubit will be your opponent? (1,2,3, or 4)
4

Choose your move (s or sdg)
sdg

We'll now send your move to the quantum referee at IBM.

It will take your opponents move and compare them.

But first you'll have to sign in...

Authenticating...
IBM QE user (e-mail) >
IBM QE password >
Saving code...
Running code...
Waiting for results...
Done.
01000 with p = 1*

The referee has decided...

You win!
```

2019

Q|Cards⟩

- A physical card game
- Each player is a qubit
- Each card is a quantum gate
- Quantum computer is used at the end game to judge who played their gates best.
- A fun game to teach people about quantum gates

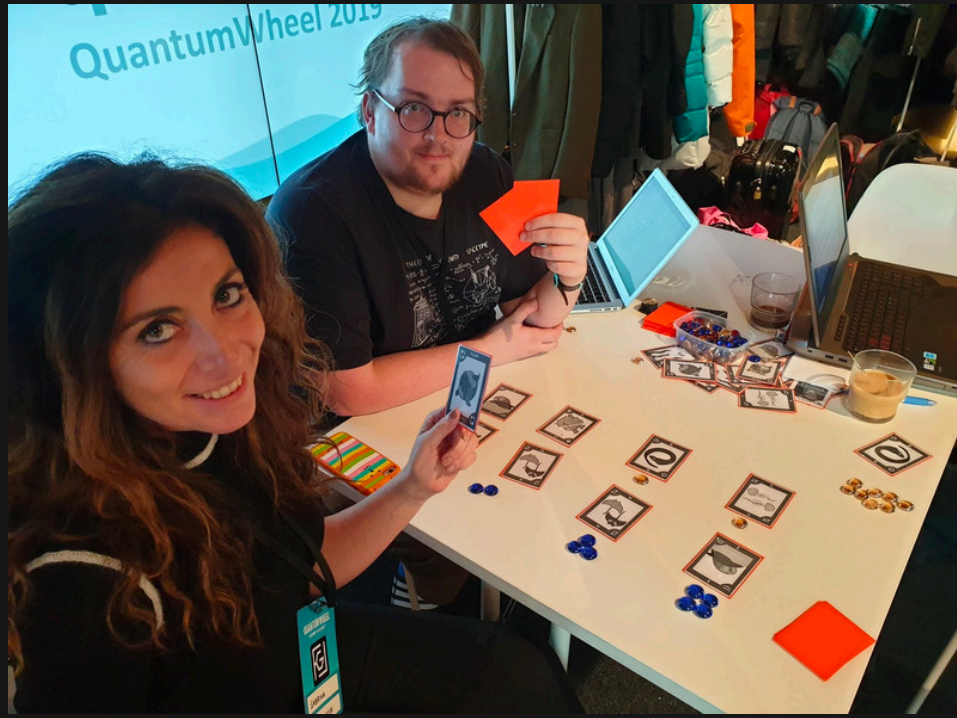
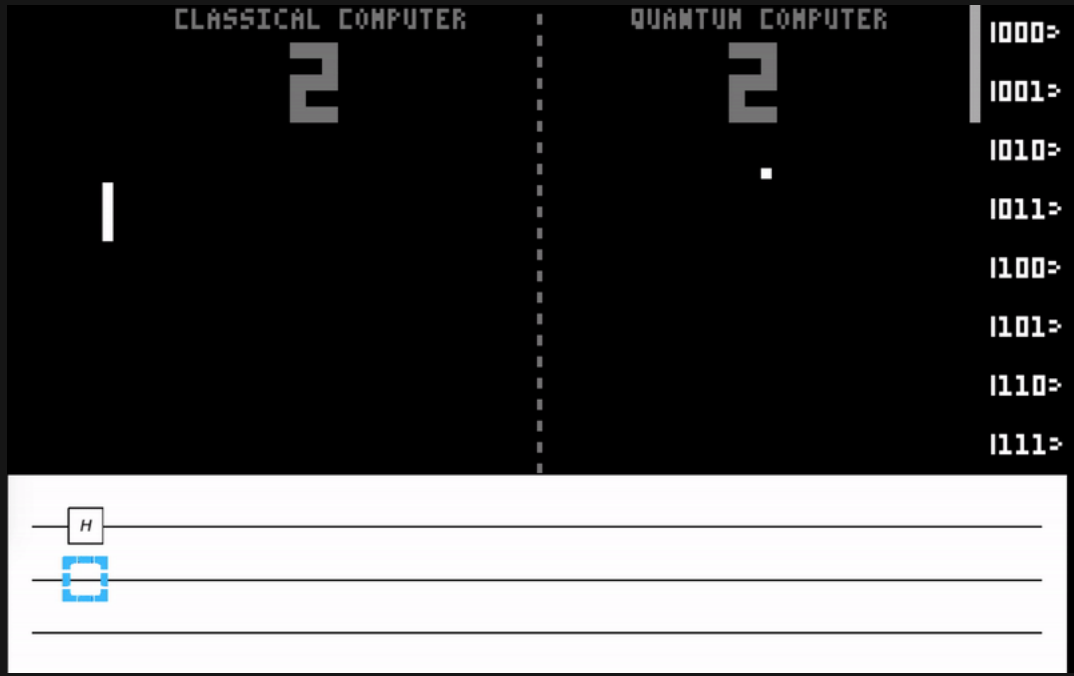


Image: http://www.finnishgamejam.com/quantumwheel/

2019

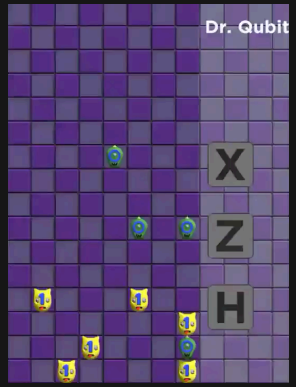
QPong

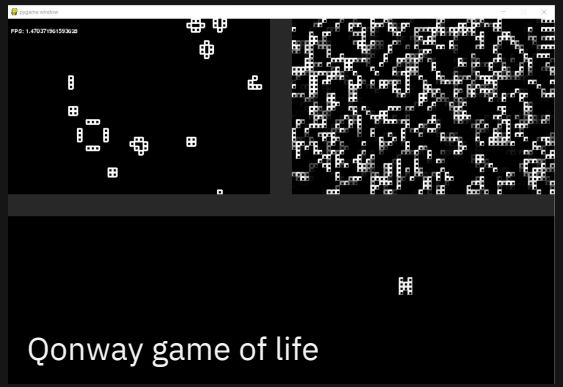
- Runs on simulator
- Introduce unfamiliar concepts in familiar setting
- Simple game to teach players:
  - Quantum circuits
  - Superposition

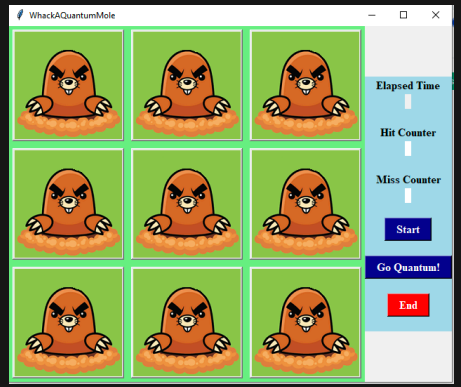


Source: https://github.com/HuangJunye/QPong

Many more games







Whack A Quantum Mole

IndiQ

[Quantum game jam]

Find more: https://github.com/HuangJunye/Awesome-Quantum-Games

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2020s

IBM **Quantum**

What can quantum computers do for games?

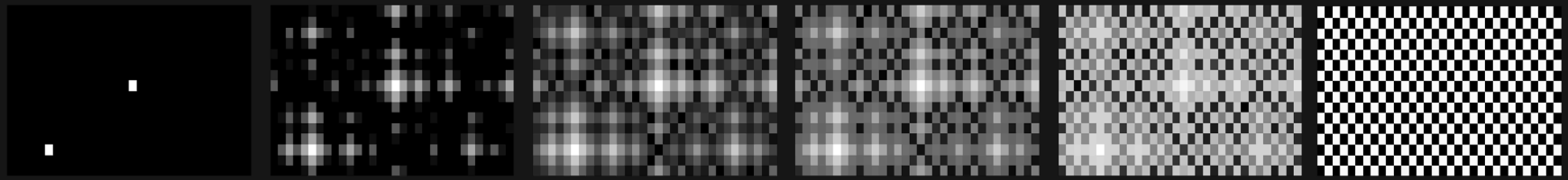
How to find applications in the NISQ era

IBM **Quantum**

Recipe:

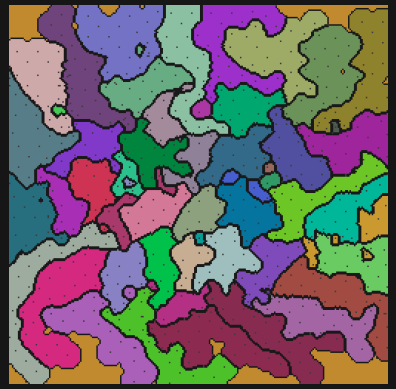
1. Don’t be too harsh to NISQ devices
2. Let NISQ devices be their natural quantum selves
3. Find application for it

1. Shallow circuits
2. Interference pattern
3. Procedural generation

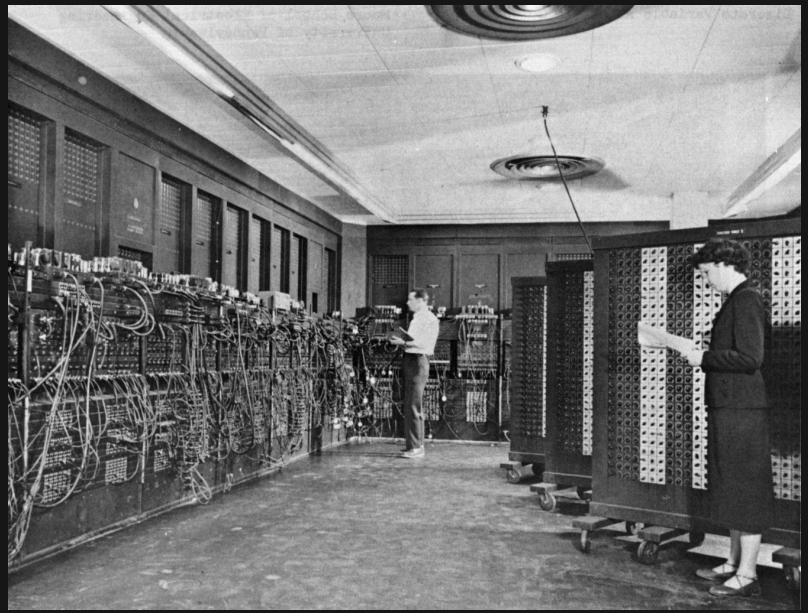


Procedural generation gallery

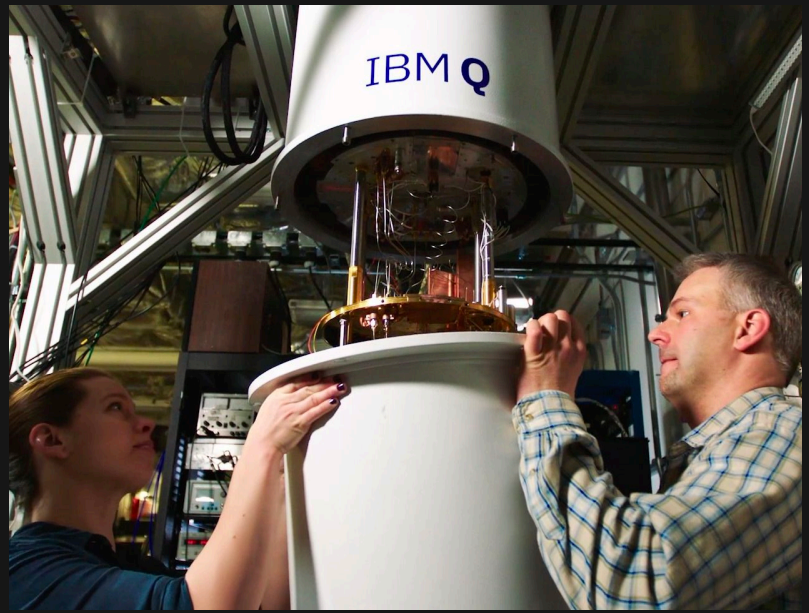
[Link to tweet]



History is repeating itself



ENIAC, 1950s



IBM Quantum, 2010s

Qiskit learning resources

Follow @Qiskit on social networks

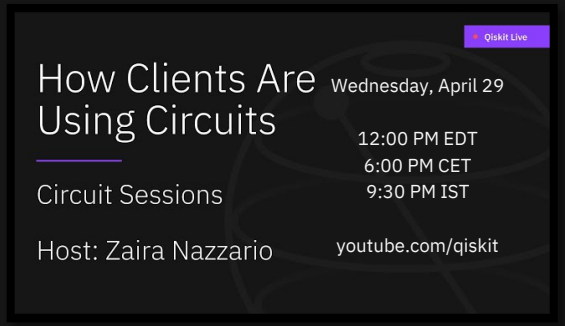
Twitter YouTube Slack

Open source
Qiskit textbook

[Coding with Qiskit](#) series

[Every Monday](#)

Every [Wednesday](#) & [Friday](#)



IBM Quantum Challenge

IBM **Quantum**

4th year anniversary of the IBM Quantum Experience

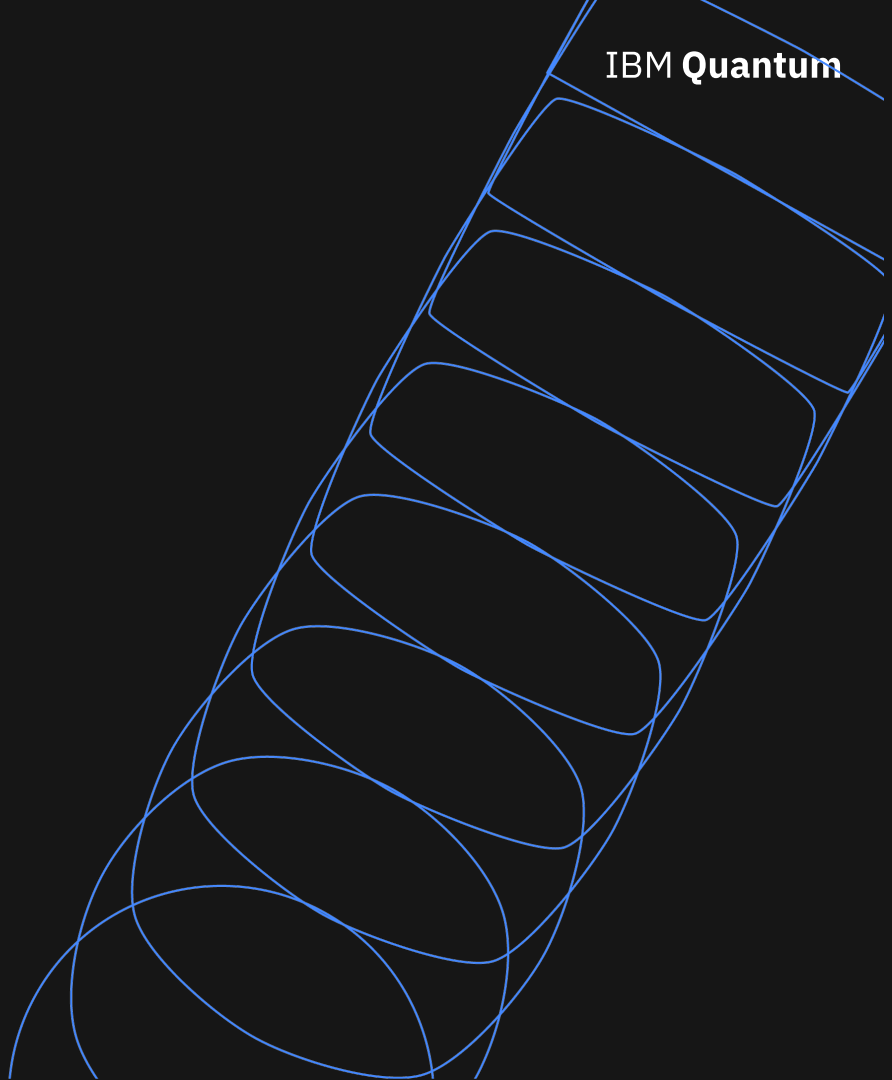
4 quantum programming exercises to solve

in 4 days!

May the 4th be with you!

https://quantum-computing.ibm.com/challenges

Quantum circuits	Client partners
175 B	105
Users	**Quantum systems**
200 k	18



Acknowledgement

Dr. James Wootton @decodoku

- Research Staff Member at IBM Research Zurich
- “father of quantum computer games”
- Making games with quantum computers @ Medium

IBM **Quantum**