DATA
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SUMMIT

Quantum Breakout Game

REVOLUTIONIZING QUANTUM LEARNING THROUGH GAMIFICATION

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www.dssconf.pl

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About Me

I am an **Engineering Physics** Undergraduate at the **National Institute of Technology Hamirpur** passionate about Quantum Computing, Machine Learning, UI/UX, and Web Development.

I have been a **QIntern** at QWorld. I am also a **Qiskit Advocate** and a **Microsoft Learn Student Ambassador**.

I have worked on numerous projects , participated in hackathons, and am a part of great organisations in these fields. Explore my portfolio website for more information about me, my work, and my experiences with various organizations: https://jaisarita.vercel.app/ 🌕

Overview

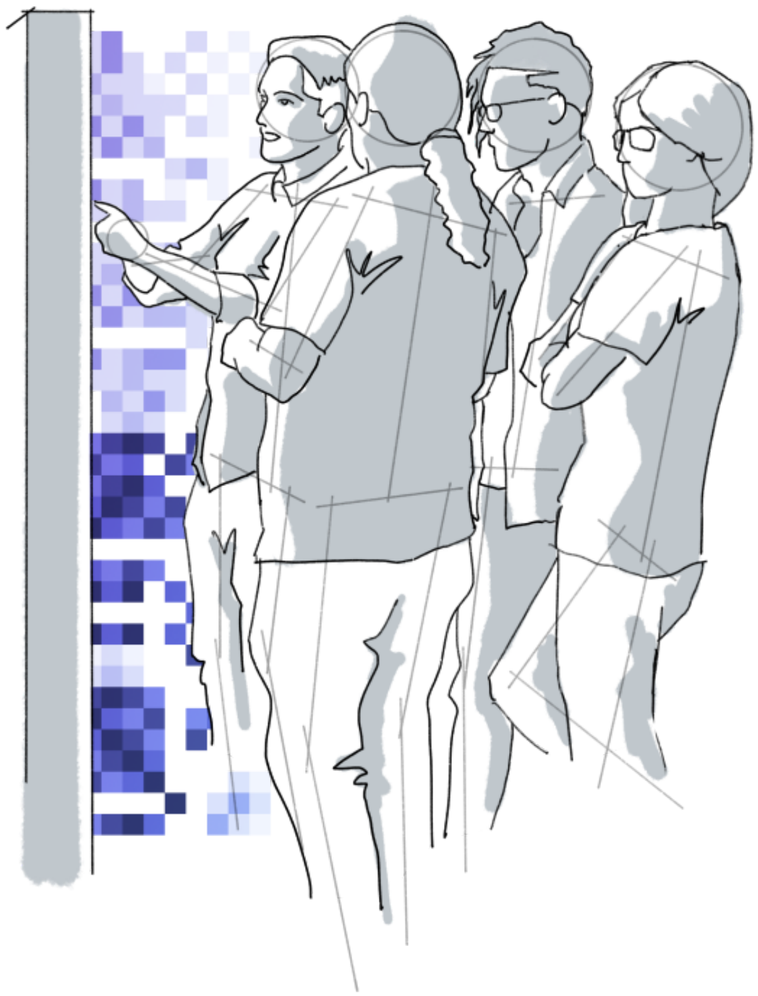


Image Source: Qiskit Textbook

- Introduction to Quantum Computing
  - What is Quantum Computing?
  - Why Quantum Computing?
  - Underlying Quantum Physics
  - How we implement them?
  - How Quantum Computing Works?
- Quantum Games
  - Why Quantum Games?
  - Quantum Breakout Game
  - Demo: Quantum Breakout Game
  - Similar Quantum Games for Beginners
- Resources
  - Study resources for beginners
  - Surprise for Quantum Game Developers

Introduction to Quantum Computing

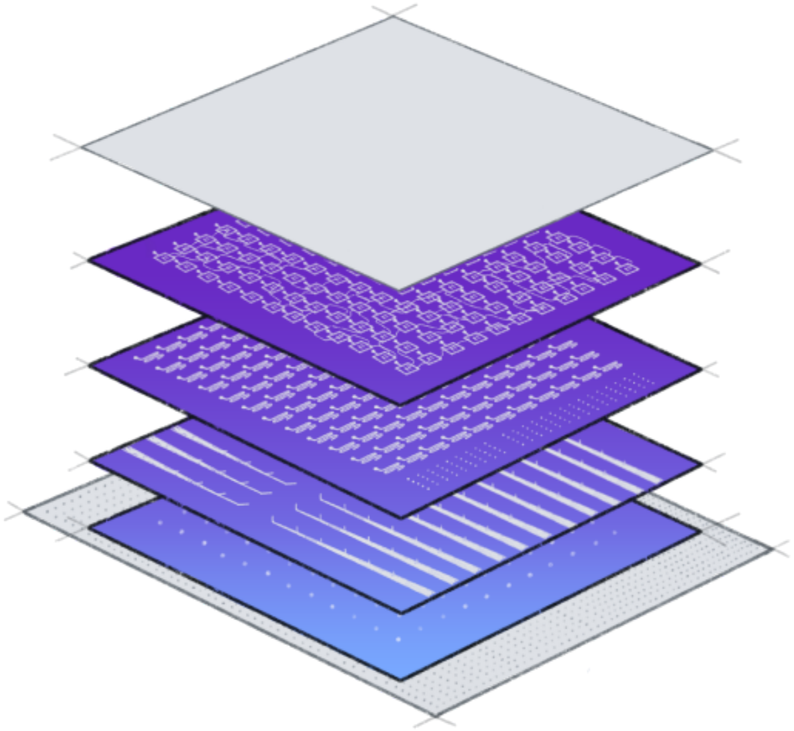


Image Source: Qiskit Textbook

What is Quantum Computing?

Quantum computing harnesses the principles of quantum mechanics to process information in ways unimaginable in classical computing.

The strength of quantum computing lies in two key principles of quantum mechanics, namely **superposition**, **interference**, and **entanglement** that highlight the wave- and particle-like aspects of quantum computation, respectively.

We leverage these phenomena to solve problems with a space and time complexity unattainable by classical computers.

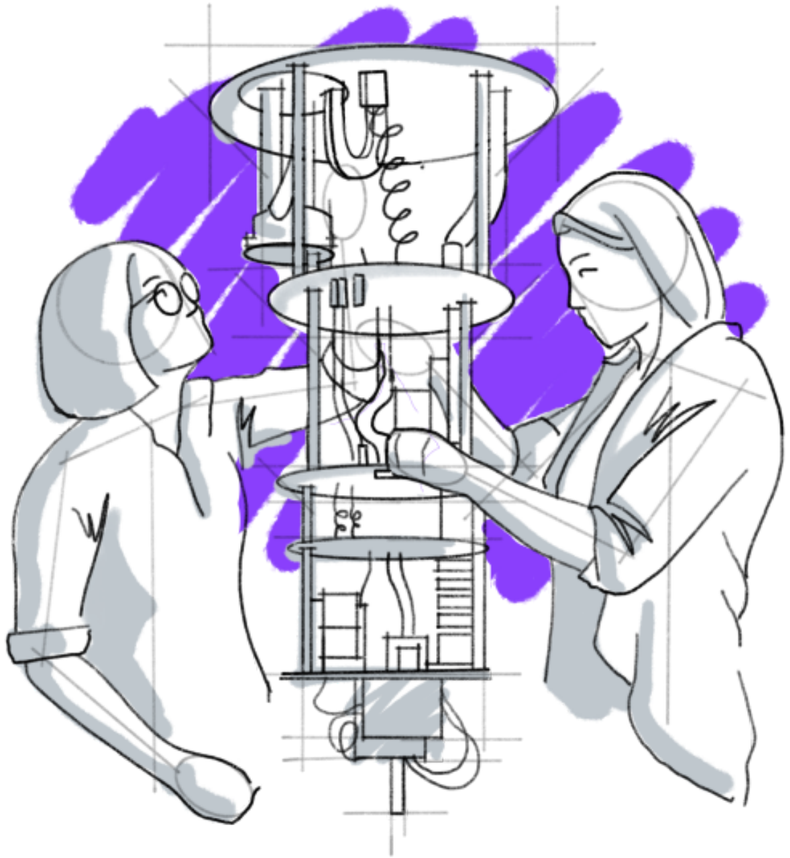


Image Source: Qiskit Textbook

Why we need Quantum Computing?

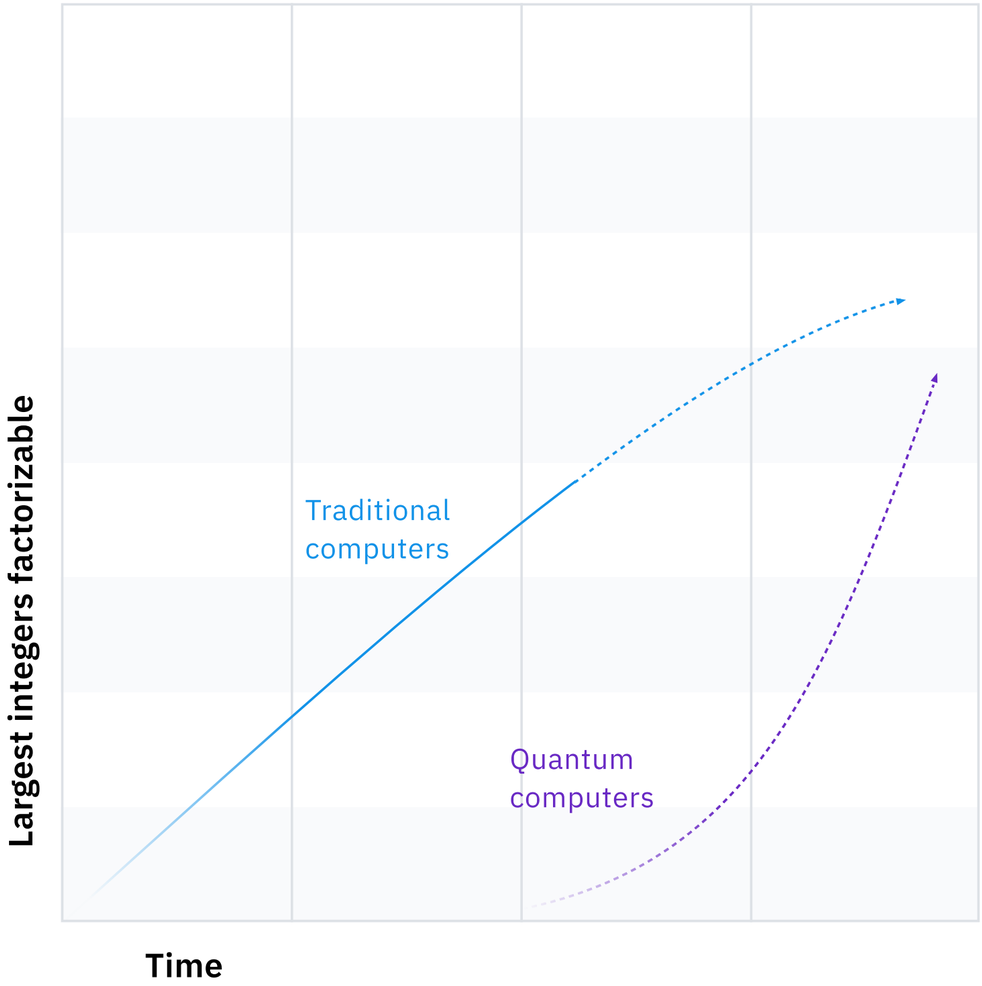


Image Source: Qiskit Textbook

Physicists created quantum physics to explain behaviour they'd never seen before, and computer scientists found they could (in theory) exploit this newly discovered behaviour to create more efficient algorithms.

Classical computers struggle with the growing complexities of today's problems. Quantum computing, with its ability to navigate intricate challenges in a blink, offers a time and space efficiency that's simply beyond the reach of traditional methods. It's not just evolution; it's a quantum leap into a faster, more efficient era.

Underlying Quantum Physics

Qubits
A qubit is a unit of quantum information that can be in multiple states simultaneously.

Superposition
Superposition is the ability of qubit to exist in linear combination of multiple states at the same time.

Interference
We use interference to manipulate the state of qubits to increase the probability of getting desired result on its measurement.

Entanglement
Entanglement allows two or more qubits to share a single quantum state, such that measuring one qubit reveals information about the others, regardless of their distance.

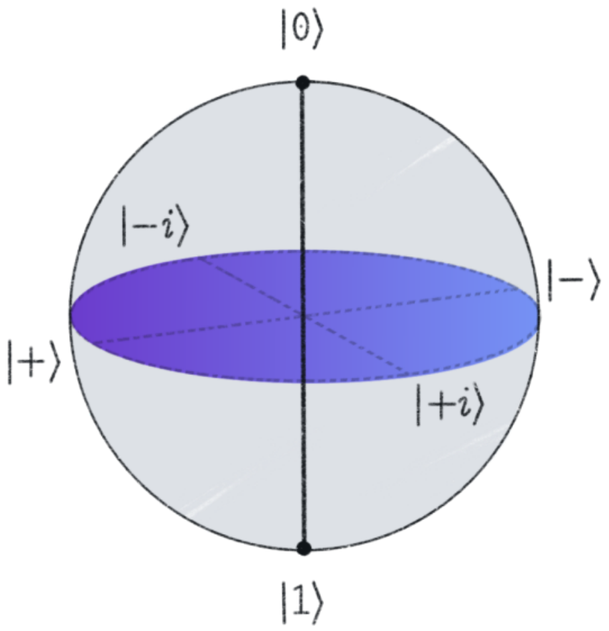


Image Source: Qiskit Textbook

How we implement these?

Quantum Gates

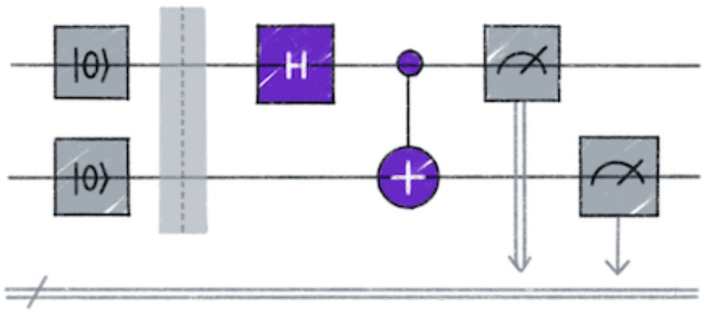
We use Quantum Gates to manipulate states of qubits. They are used to realize interference in qubits.

Quantum Measurement

We use quantum measurement to obtain information about the state of a qubit by interacting with it in a way that destroys its quantum coherence.

Quantum Circuits

Quantum circuits are computational models that use qubits and quantum gates to perform operations, representing a sequence of quantum transformations on the input data which can increase the probability of getting our desired state on measurement.

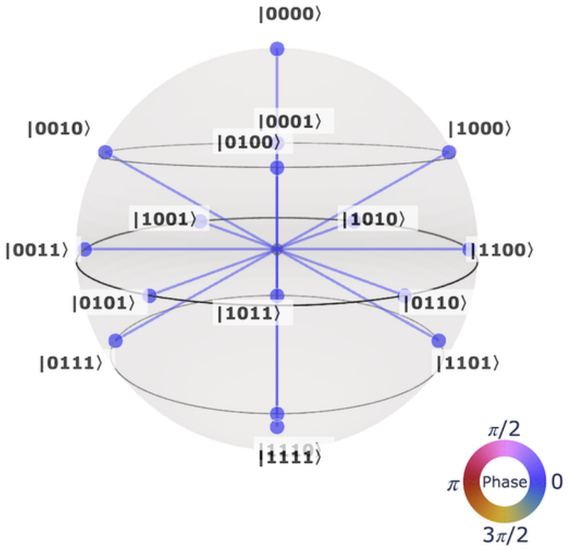


Quantum Coherence

Quantum coherence is the ability of a quantum system to maintain a superposition of two or more states and interfere with itself in a predictable way.

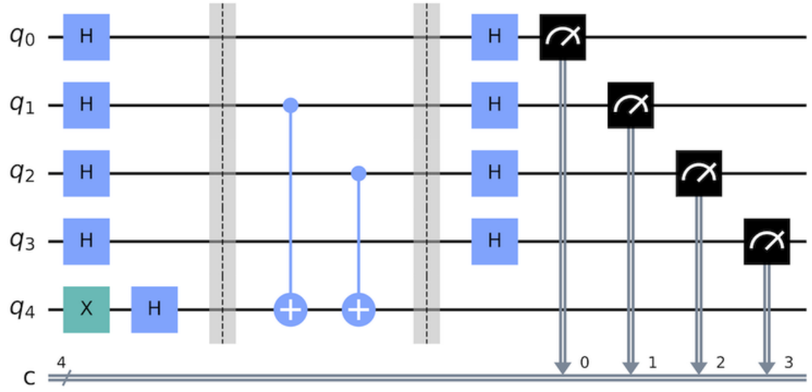
Image Source: Qiskit Textbook

How Quantum Computing works?

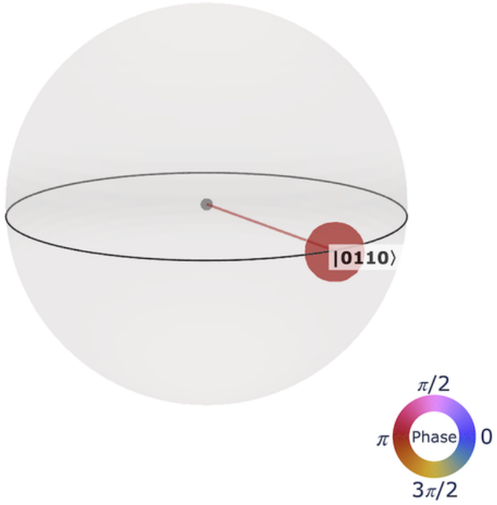


Superposition of all possibilities

Quantum circuit



Computation driven interference



Solution

Image Source: Qiskit Textbook

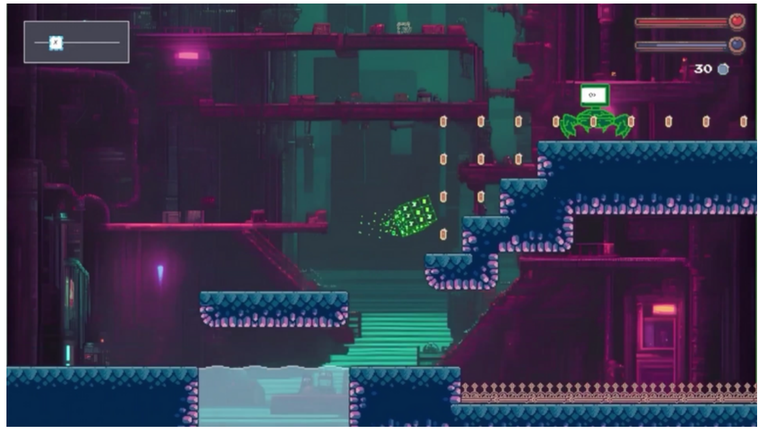
Quantum Games

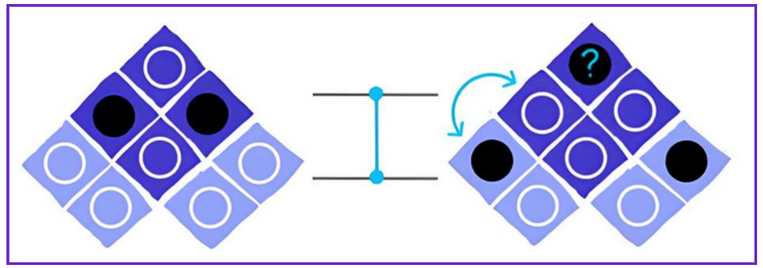
Image Source: Qiskit Textbook

Why we need Quantum Games?

Quantum games serve as a gateway, welcoming beginners with no physics background. They break down complex concepts into interactive and engaging experiences, making quantum computing accessible to all.

- Accessible Quantum Learning
- Playful Mastery of Quantum Concepts
- Visualizing Quantum Ideas in Action
- Fun Foundations for Quantum Intuition



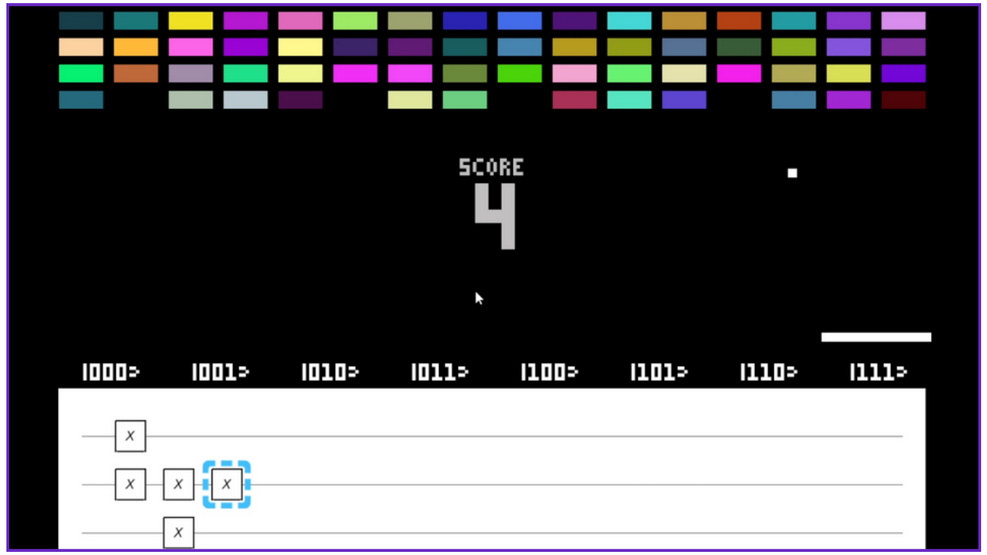


Quantum Breakout Game

A game for understanding Qubit Manipulation by Quantum Gates

The Quantum Breakout Game is a quantum version of the Classic Breakout Game where players have to construct a three-qubit circuit to control the paddle. The goal is to maximize the probability of the paddle being above the state vector where the ball is heading.

Paddle opacity reflects the probability, with 100% indicating certainty. Upon the ball's approach, a measurement collapses the paddle's position from a superposition state to a definite one.



Download From Itch.io: https://jaisarita.itch.io/quantum-breakout

GitHub Repository: https://github.com/devilkiller-ag/quantum-breakout

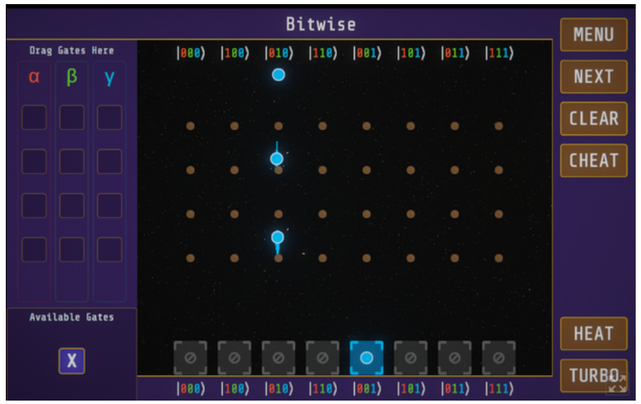
Demo: Quantum Breakout Game

A game for understanding Qubit Manipulation by Quantum Gates

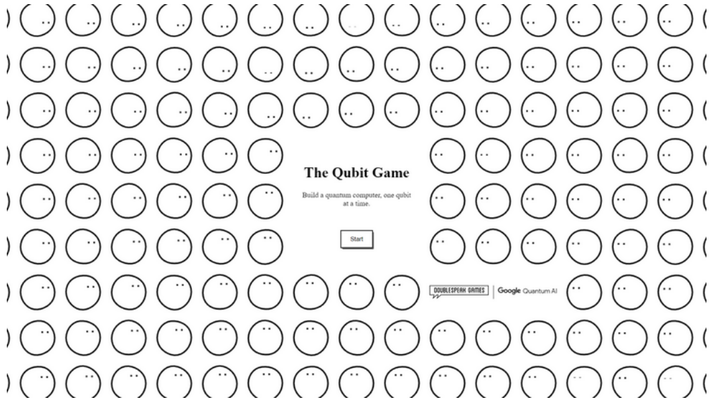
Watch on YouTube: https://youtu.be/LehUEIPl2iU?si=9NSOEGvwqIujmtda

Other Quantum Games

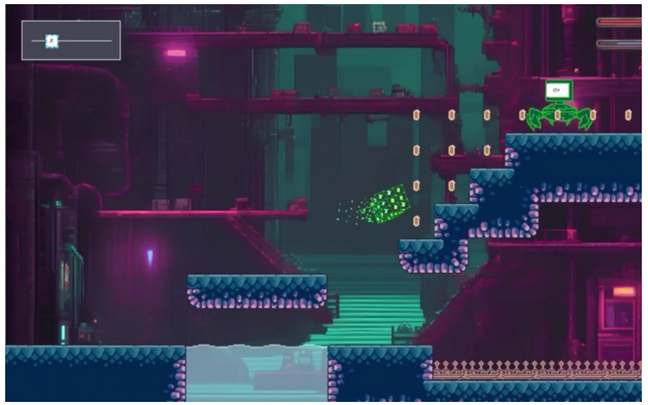
Make Quantum Learning fun



Superposition Arcade

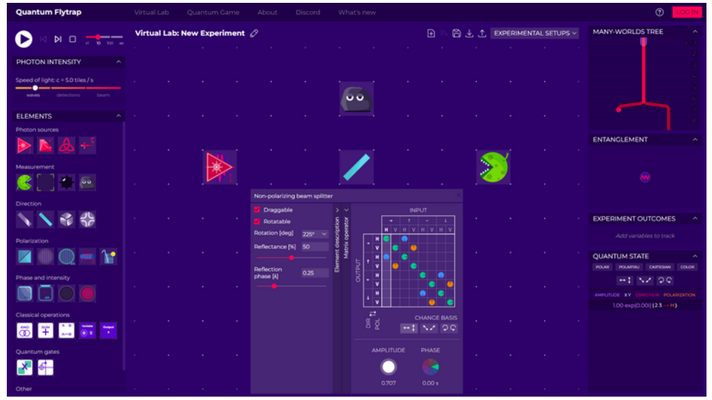


The Qubit Game

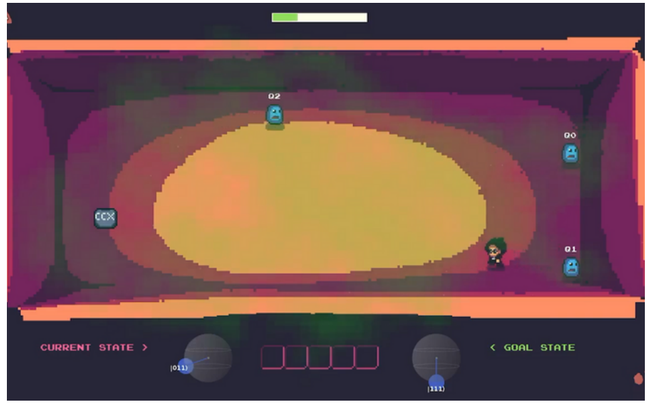


QuantaVania

Quantum Odyssey



Quantum Flytrap



Out of the Box

Some Awesome Resources

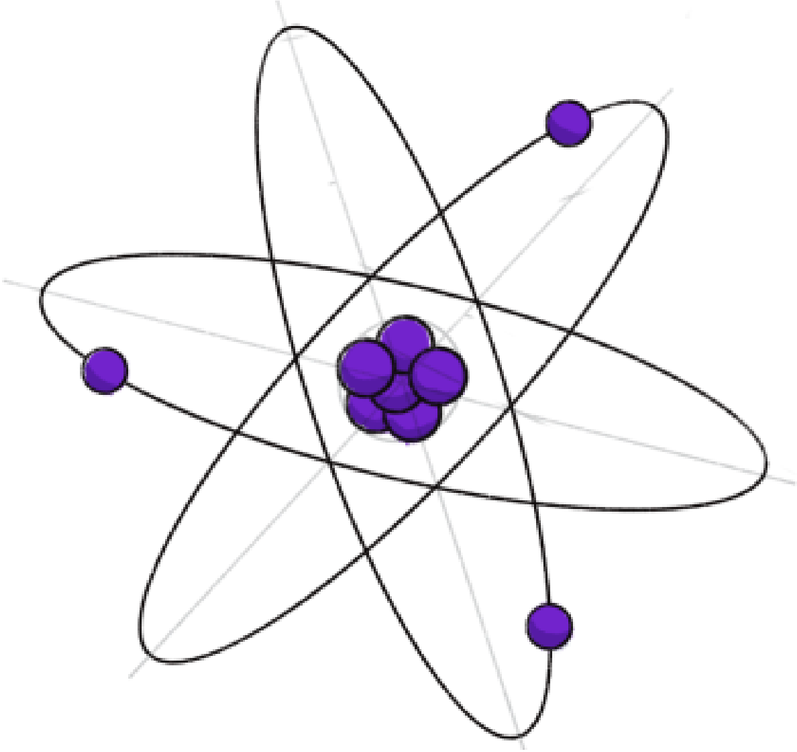
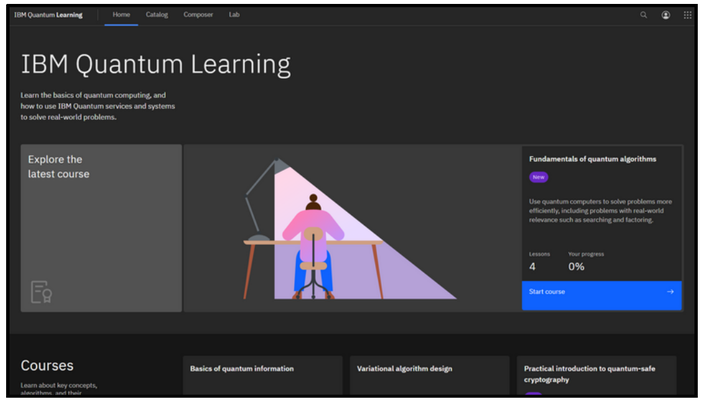
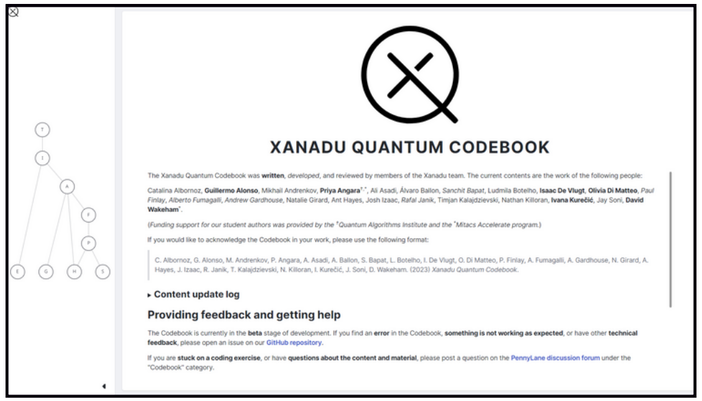


Image Source: Qiskit Textbook

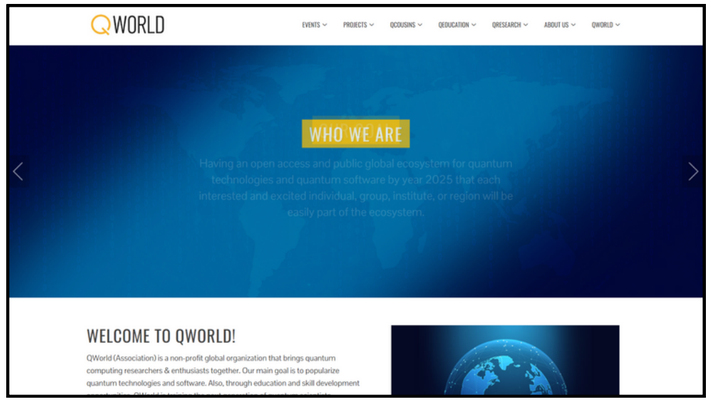
Learning Resources for Beginners



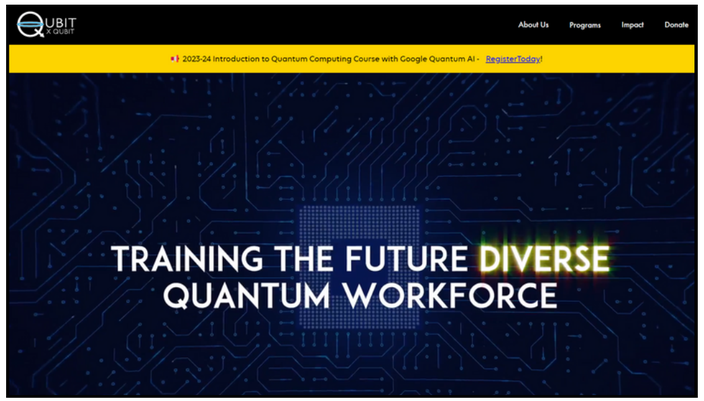
IBM Quantum Learning



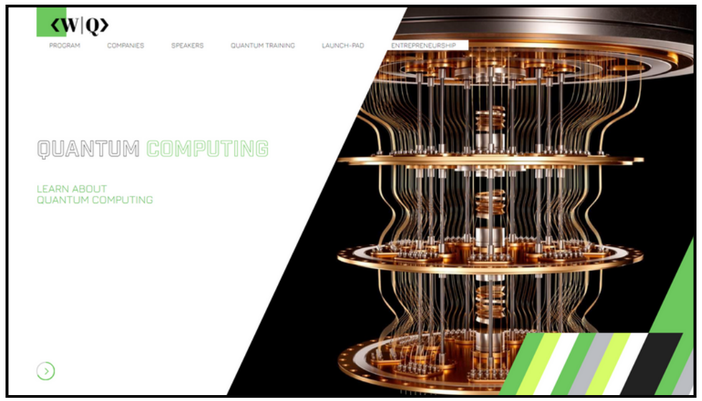
Xanadu Quantum Codebook



Courses by QWorld & QCousins



Courses by Qubit x Qubit



Womanium Quantum Program

And many more listed here🚀

Surprise for Quantum Game Developers:

Quantum Circuit Game Engine (QCGE) for Pygame based Quantum Games

Features:

- You can use it simply by creating an object of the **QuantumCircuitGrid** class stored in the **quantum_circuit.py** file.
- Easy to change size of Quantum Circuit by passing optional parameters: tile_size, and gate_dimensions.
- Easily change UI by passing optional parameters: background_color, wire_color and gate_phase_angle_color.
- Developers can create Quantum Circuit for any number of qubit/wires and circuit width (max. number of gates which can be applied in a wire) of their choice.

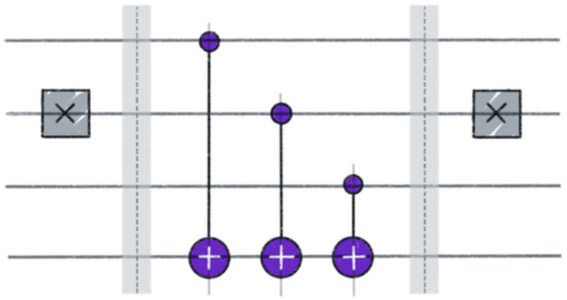


Image Source: Qiskit Textbook

Install: **pip install qcge**

GitHub Repository: **https://github.com/devilkiller-ag/Quantum-Circuit-Engine-for-Pygame-based-Quantum-Games** (Do not forget to give it a Star⭐)

Search projects

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qcge 1.0.0

```
pip install qcge
```

Latest version

Released: 2 minutes ago

A package that allows game developers to integrate quantum circuit in their pygame-based quantum games.

Navigation

- Project description
- Release history
- Download files

Project links

- Homepage

Statistics

GitHub statistics:

- Stars: 0
- Forks: 0
- Open issues: 0
- Open PRs: 0

View statistics for this project via Libraries.io, or by using our public dataset on Google BigQuery

Meta

Project description

Quantum Circuit Game Engine for Pygame-based Quantum Games

This is a Quantum Circuit Game Engine for integrating Quantum Circuits into your Pygame-based quantum game. You can use it simply by creating an object of the `QuantumCircuitGrid` class stored in the `quantum_circuit.py` file.

This Quantum Circuit was originaly created for the **QPong Game** developed by Junye Huang in the 12 Days of Qiskit

Visit: **https://pypi.org/project/qcge/**

OCEŃ PRELEKCJĘ

Quantum Breakout Game: Revolutionizing Quantum Learning Through Gamification

Ashmit Gupta

http://dssconf.pl/user.html#!/lecture/DSS23-967c/rate

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