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Quantum Leap:

The Ever-Changing Virtual Space of Quantum Computing [VMTN3079LV]

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The Art of Future State Architecture

Meet your Speakers



John Yani Arrasjid is a Field Principal at VMware, focused on solutions architecture for the financial industry.

He has held the roles of author, speaker, inventor, architect, and CTO for a diverse set of companies, with a majority of his career with VMware, DellEMC, and Virtustream.

Other companies that he was co-founder or joined early stage include Ottometric, 3Dfx, and WebNexus Communications (brought phone and internet to Treasure Island). He has also worked at AT&T, Roxio, and Chronologic Simulations. John holds 4 patents and is co-author on 8 books.

John's interests are in the convergence of technologies to advance what we do in work and in life. This has led to both his publications and patent work.

For additional background, see:

<https://www.linkedin.com/in/johnarrasjid/>



Tony Foster is a Senior Principal Technical Marketing Engineer at Dell Technologies focused on software defined technologies. He is commonly known as the WonderNerd on social platforms.

Tony has architected and deployed environments for small organizations up to fortune 100 companies. He also developed the concept of "VDI by day, compute by night," which is in production with various organizations.

He is also an adjunct professor at K-State Salina, where he teaches system administration and runs a small computer lab. Tony is also the lead volunteer for the Kansas 4-H STEM program and has helped thousands of Kansas youth discover an interest in STEM.

You will often find Tony dabbling in the futuristic areas of technology and pushing the limits of the possible.

Discover more at <https://wondernerd.net>

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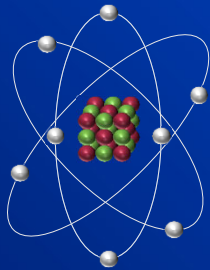
Agenda

- Why Quantum?
- What is Quantum Physics?
- What is Quantum Computing?
- Use Case – Financial
- Who is in this space?
- The leap to virtualization
- Post-Quantum discussion
- Conclusion & Takeaways

Note: All Q&A will be covered outside the theater area after the presentation finishes.



Why Quantum?



Mining – less environmental impact with higher precision tools



Navigation – more accurate clocks expand beyond where GPS signals reach



Secure Communications – stronger security for financial, personal, and other data



Agriculture – improved crop production in ever changing environments



Edge – faster wireless data rates as more edge devices generate more data



Quantum imaging – less invasive and more precise medical images



Logistics – optimized time, energy, and cost

“Quantum and precision technologies are the next stage in our species grand undertaking to harness the rules and laws of the universe so we can live better and lessen our impact on the natural world. We will do some things which are new and revolutionary, and those will change our lives in ways we can’t imagine yet. But we also can improve what we already do, making that much better by applying quantum and precision technologies to improve industries that are already important to us.”

– Dr. Michael Harvey, Translational Research Program Manager at the ARC Centre of Excellence for Engineered Quantum Systems (EQUS), August 11, 2021.

<https://ventures.uq.edu.au/blog/2021/08/what-are-quantum-technologies>

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What is Quantum Physics?

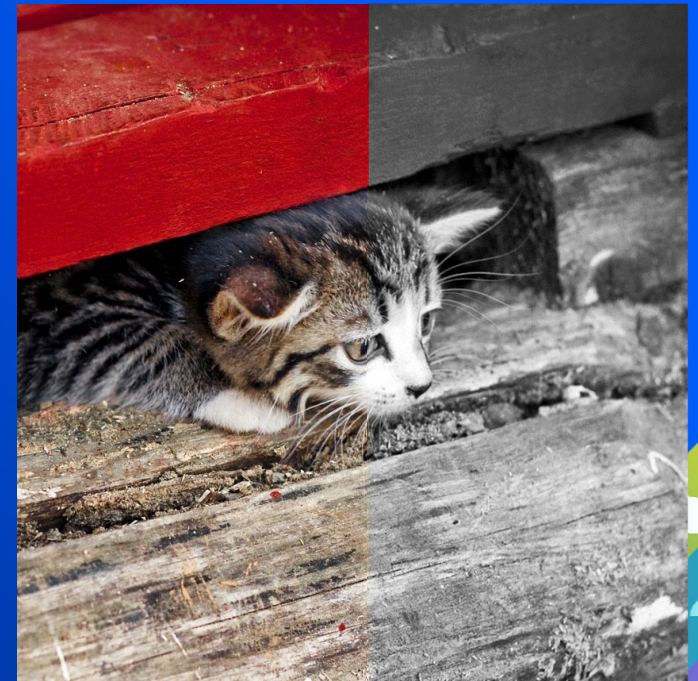
Schrodinger's Cat

Quantum = a share or portion

Quantum Physics = the branch of physics concerned with quantum theory.

Quantum Theory = a theory of matter and energy based on the concept of quanta, especially quantum mechanics

Quantum Mechanics = The branch of mechanics that deals with the mathematical description of the motion and interaction of subatomic particles, incorporating the concepts of quantization of energy, wave-particle duality, the uncertainty principle, and the correspondence principle.

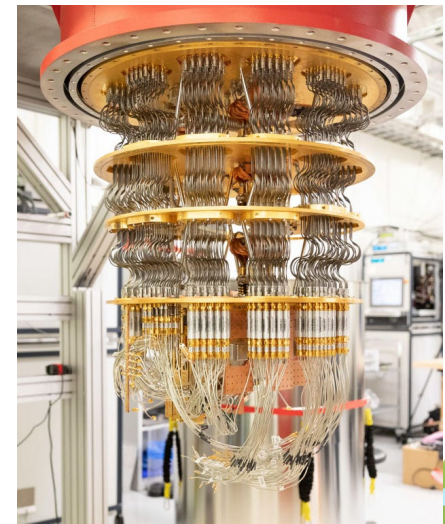
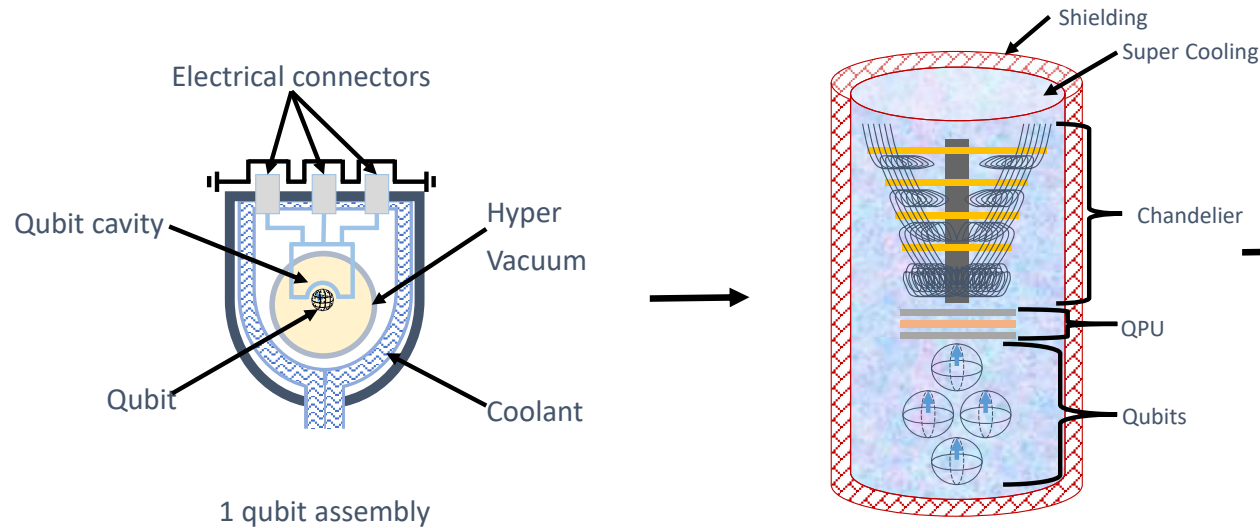


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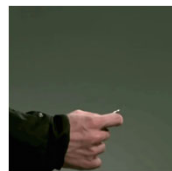
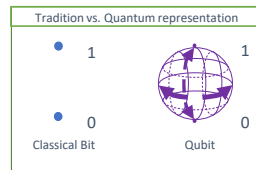
What is Quantum Computing?

Terms and concepts

A quantum computer is a computer that exploits quantum mechanical phenomena.



Qubits can represent numerous possible combinations of 0 and 1 simultaneously. This ability is called superposition.





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What is Quantum Computing?

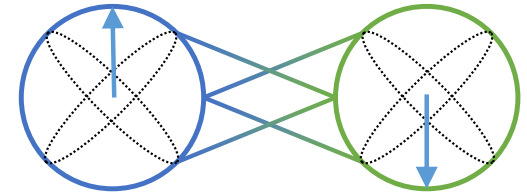
Terms and concepts

Superposition – when quantum particles are in a combination of all possible states.

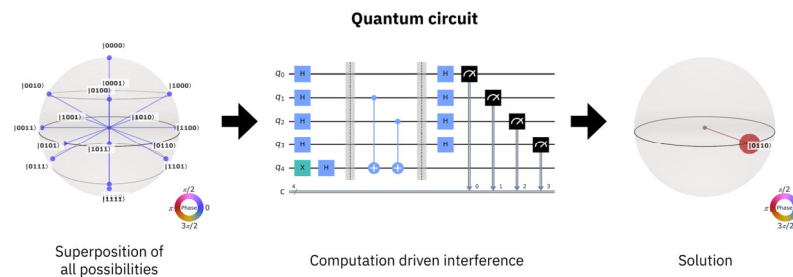
- *Quantum superposition is a fundamental principle of quantum mechanics. In classical mechanics, things like position or momentum are always well-defined. We may not know what they are at any given time, but that is an issue of our understanding and not the physical system. In quantum mechanics, a particle can be in a superposition of different states. – Wikipedia*

Entanglement – the ability of quantum particles to correlate their measurement results with each other.

- *Quantum entanglement is the phenomenon that occurs when a group of particles are generated, interact, or share spatial proximity in a way such that the quantum state of each particle of the group cannot be described independently of the state of the others, including when the particles are separated by a large distance. - Wikipedia*



Quantum interference - the intrinsic behavior of a qubit, due to superposition, to influence the probability of it collapsing one way or another.

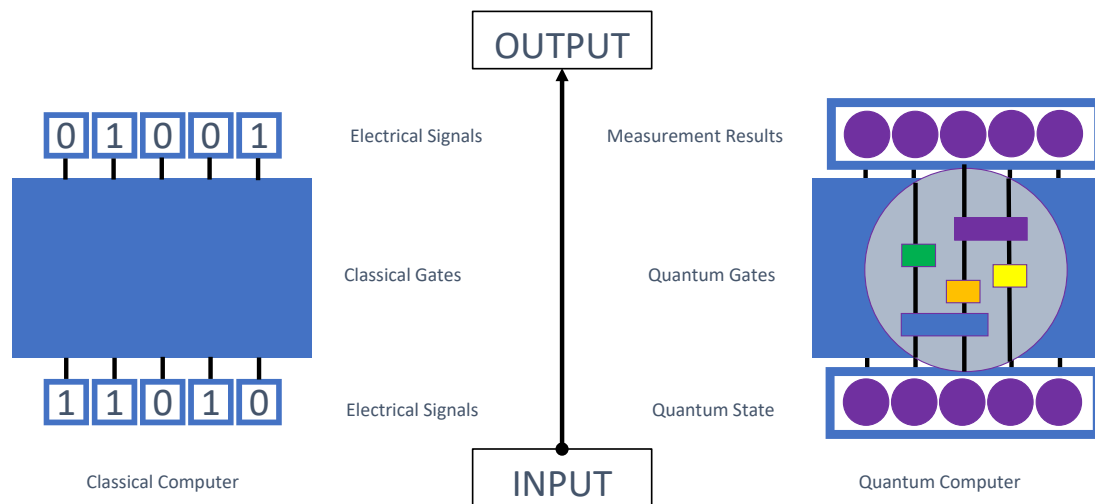


Quantum computation as an interference generation process. From https://qiskit.org/documentation/qc_intro.html

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What is Quantum Computing?

Process



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Use Case: Financial



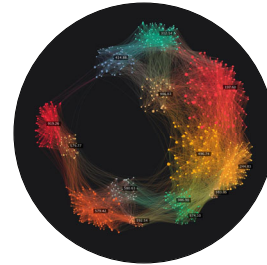
Risk Profiling

"Quantum computing promises the ability to process vast amounts of data and solve computational problems that are practically impossible for classical computers... Quantum machine learning could allow for the processing of larger datasets and more complex models, leading to more accurate risk assessments." — ChatGPT, OpenAI



Trading Optimization

"Trading optimization is a multifaceted endeavor, integrating advanced analytics, predictive modeling, and computational capabilities. With the rise of new technologies like quantum computing, there's the potential to revolutionize the speed and accuracy with which trading strategies are optimized. By analyzing vast datasets and processing multiple scenarios simultaneously, we can foresee a future where trade decisions are not only faster but also more attuned to the dynamic nature of financial markets." — ChatGPT, OpenAI



Targeting & Prediction

"Targeting and prediction stand at the crossroads of data science and strategic decision-making. Leveraging state-of-the-art algorithms and machine learning models, businesses can now pinpoint opportunities with unprecedented accuracy. As we dive deeper into the era of big data, the capability to forecast trends and make informed decisions isn't just an advantage—it's a necessity for staying relevant in a constantly evolving landscape." — ChatGPT, OpenAI



Security

"In the financial industry, where trust forms the bedrock of every transaction, security isn't merely a technical requirement—it's the very essence of customer confidence. Protecting the sensitive data of customers, ensuring the integrity of transactions with partners, and adhering to rigorous regulatory compliance standards is paramount. As the financial landscape grows more digitized and interconnected, so too does the need for robust and innovative security measures, ensuring that institutions remain a bulwark against the ever-evolving tide of cyber threats." —

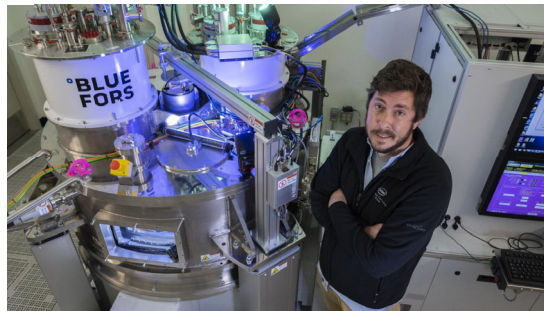
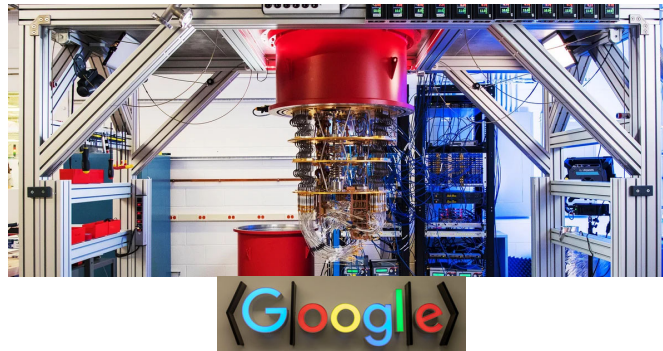
ChatGPT, OpenAI

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Who is in this space?



IBM Quantum



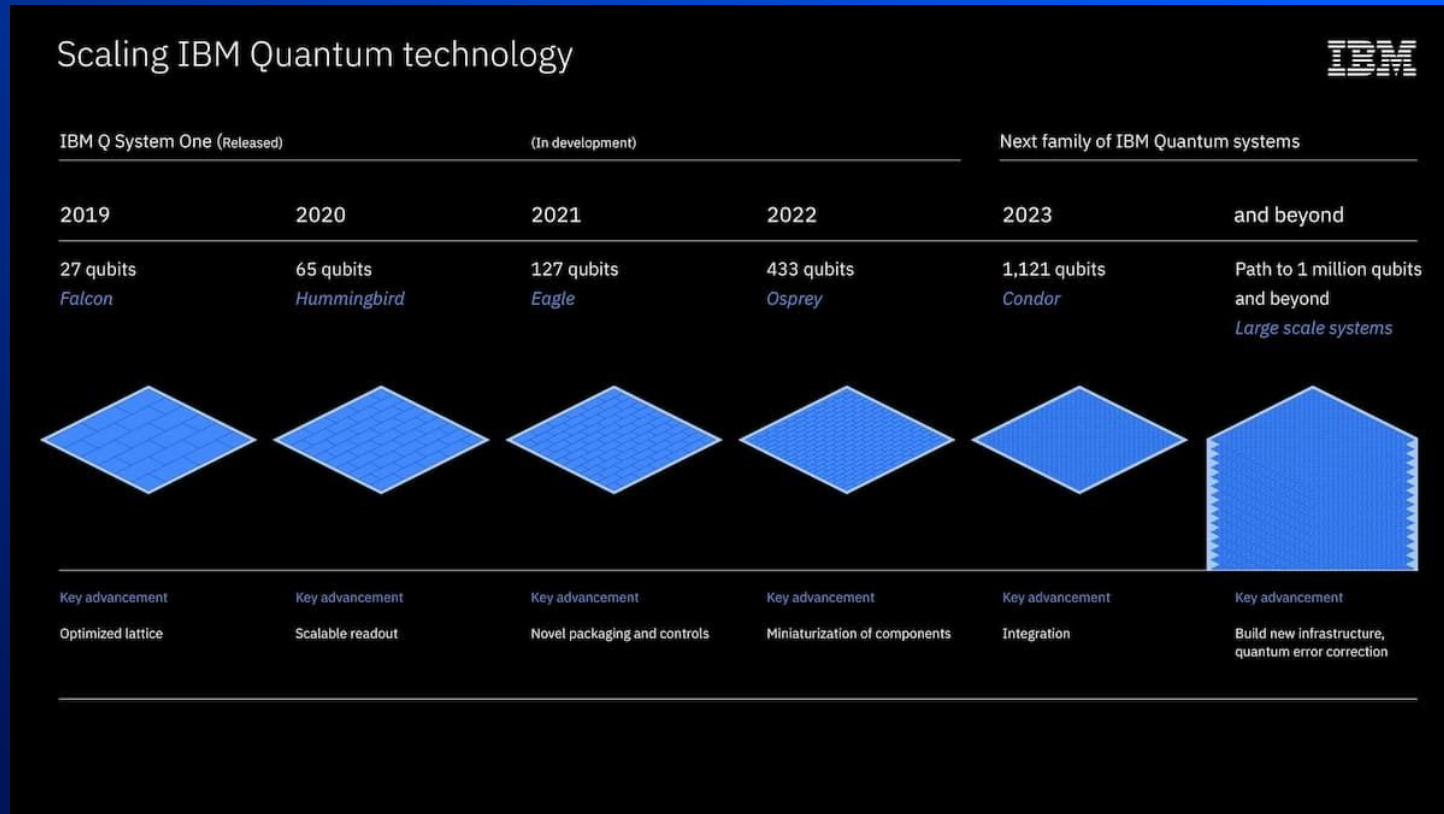
AMD





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Predictions from IBM on scaling Quantum technology

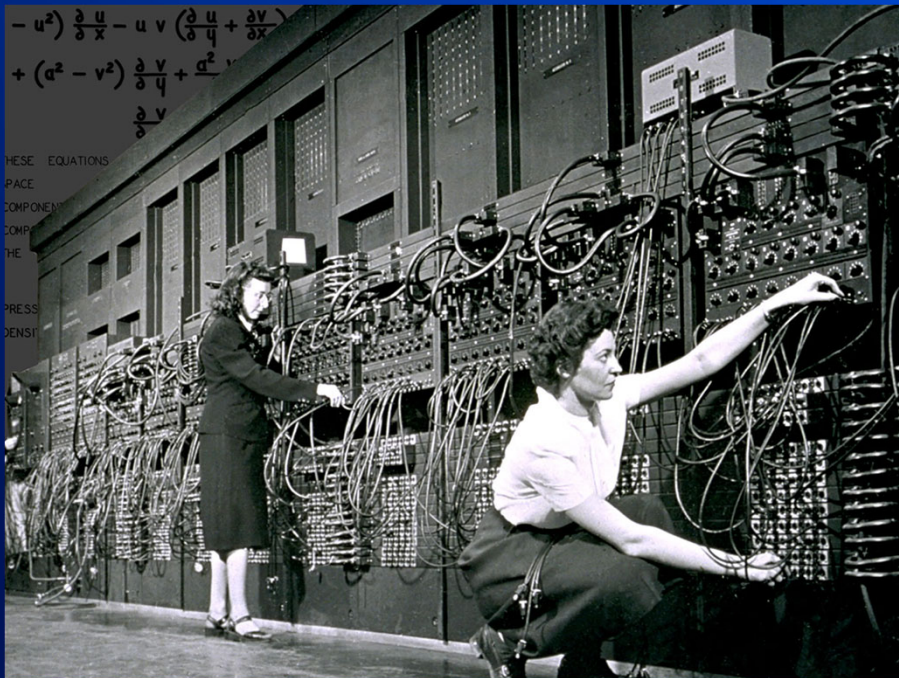


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From: <https://research.ibm.com/blog/ibm-quantum-roadmap>

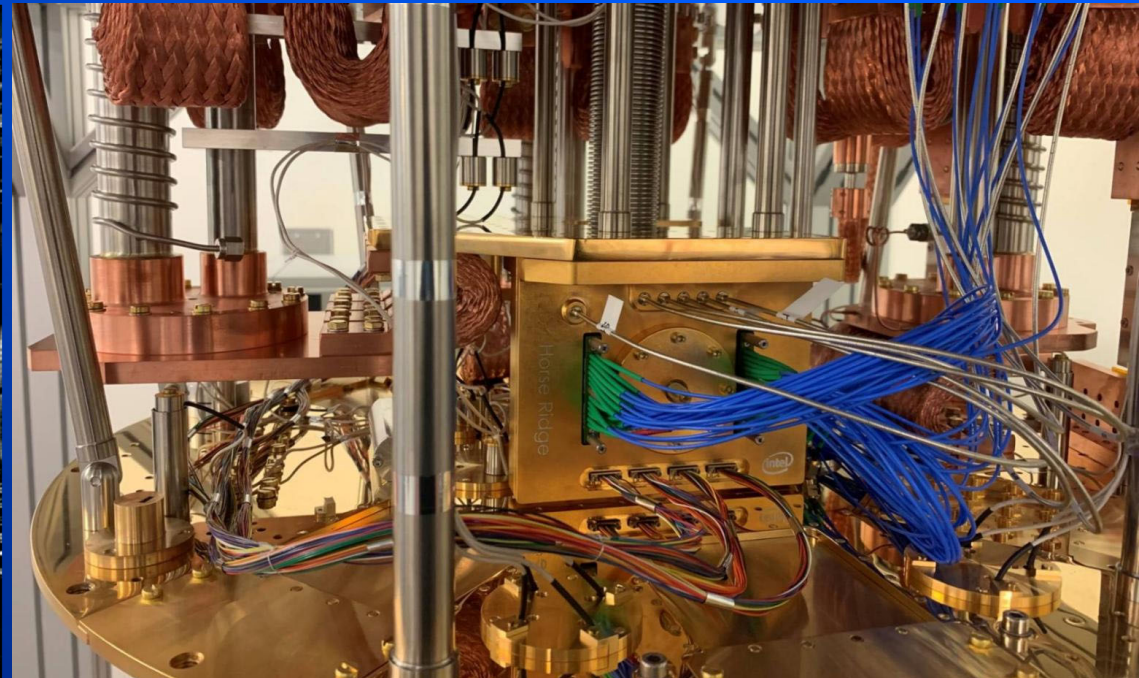
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Data Center QPUs



ENIAC – First Computer
<https://spectrum.ieee.org/untold-history-of-ai-invisible-woman-programmed-americas-first-electronic-computer>

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Horse Ridge II, Intel's second-generation cryogenic control chip
<https://www.intel.com/content/www/us/en/newsroom/news/2nd-gen-horse-ridge-cryogenic-quantum-control-chip.html#gs.3wfs5w>

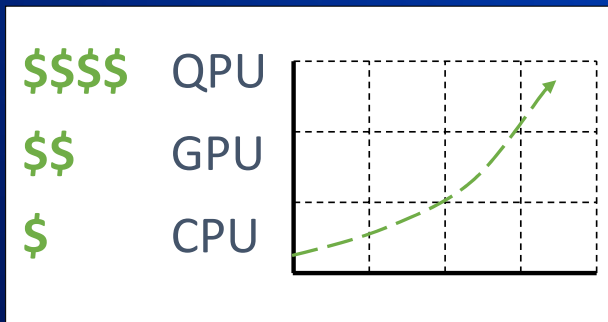


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The Leap to Virtualization...

It will change*

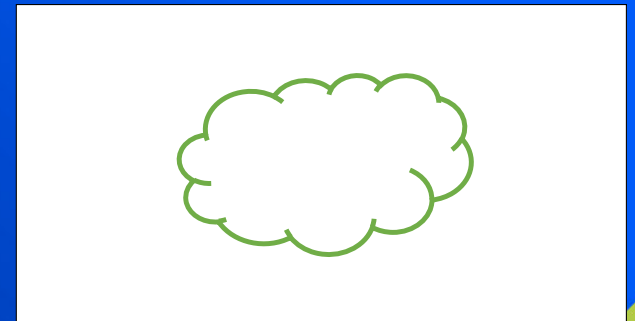
Consumed on Price



Workloads: Speed or Security



Cloud Consumption Model



**The content presented here are forward looking observations and may be subject to change*

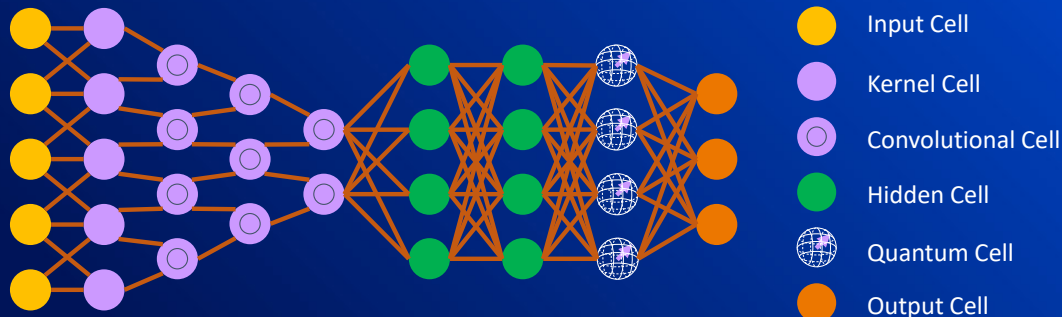
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Post Quantum Discussion

What can we do with Large Language Models (LLMs)?

- “300 qubits would represent more states than there are atoms in the universe.” – Jim Clarke, Intel
- Imagine a LLM with a large qubit layer... each state represented at the same time...





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Conclusion and Takeaways

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References

- **Quantum computing in a nutshell**, https://qiskit.org/documentation/qc_intro.html
- **Quantum Computing** – Dell, <https://www.dell.com/en-us/dt/solutions/quantum-computing/>
- **NVIDIA cuQuantum**, <https://developer.nvidia.com/cuquantum-sdk>
- **How Does a Quantum Computer Work** – Scientific America, <https://www.scientificamerican.com/video/how-does-a-quantum-computer-work/>
- **Discover Quantum Computing** – Intel, <https://www.intel.com/content/www/us/en/research/quantum-computing.html>

Thank you!

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