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2026

Sydney | March 16 - 18

AU Db2 TECH CONFERENCE

Quantum Computing and Its Impact on DB2 Specialists

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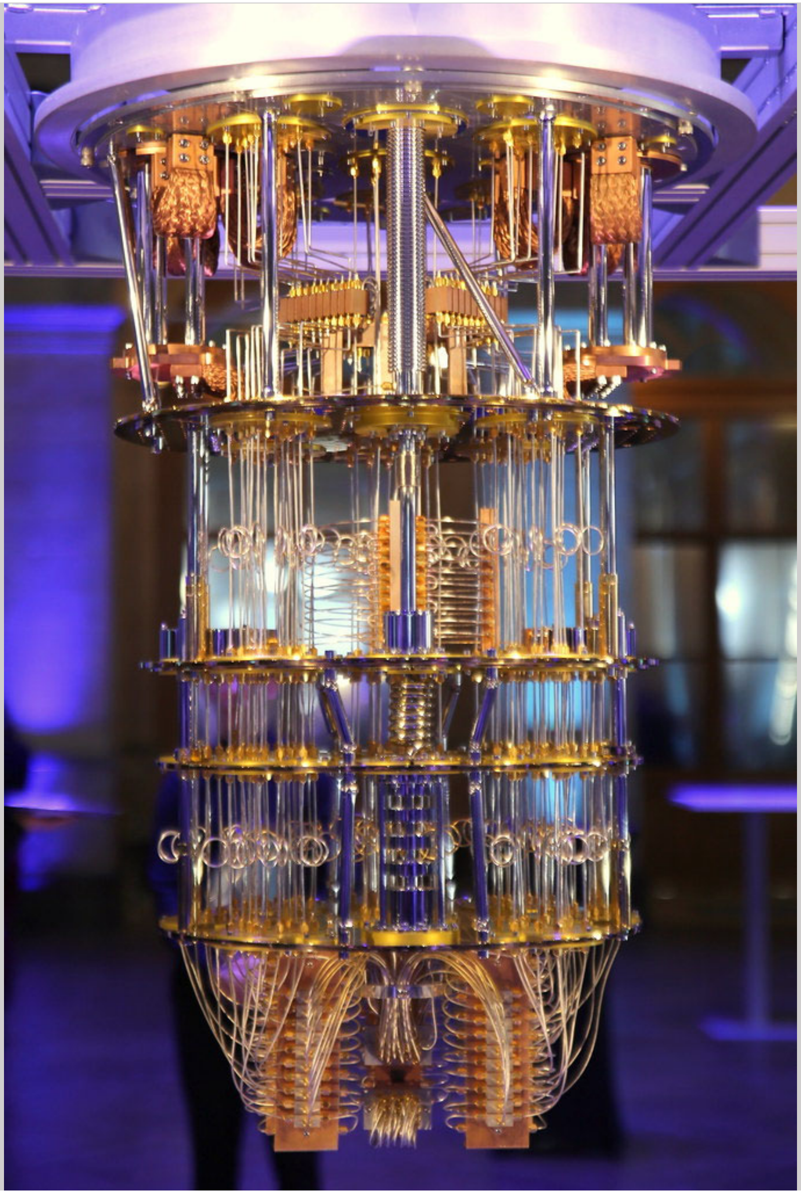
Session Code: B10

Quantum Computing and Its Impact on DB2 Specialists

Exploring future changes for database professionals



Why Quantum Computing Matters for DB2 Specialists

Quantum Impact on Optimization

Quantum computing introduces new methods for solving complex optimization problems like join ordering in large database queries.

Challenges to Cryptography

Quantum technology poses significant threats to current cryptographic standards securing database systems. (RSA, AES-128, 3DES, and SHA have been weaken or made obsolete)

DB2 and Classical Architectures

DB2 will continue running on classical architectures, with quantum computing complementing rather than replacing SQL engines and transactional systems.

Preparing for Future Changes

DB2 specialists must anticipate shifts in optimization strategies and security protocols driven by quantum advancements without hype.

Agenda and Presentation Goals

Quantum Computing Fundamentals

Introduction to core concepts and principles of quantum computing relevant to enterprise environments.

DB2 Architecture Overview

Exploration of DB2 architecture and its optimization limits within modern database systems.

Hybrid Quantum-Classical Models

Discussion of hybrid models combining quantum and classical computing for query optimization.

Security and Cryptography

Analysis of security implications and the transition to post-quantum cryptographic methods.

Career Outlook for DB2 Specialists

Insights into skill development and future career opportunities in the evolving tech landscape.

Quantum Computing Fundamentals

What is Quantum Computing?

Quantum Principles

Quantum computing uses superposition and entanglement to process information beyond classical binary states.

Qubits vs Classical Bits

Qubits represent multiple states simultaneously, enabling efficient exploration of large solution spaces.

Application Scope

Quantum computing excels in optimization and search but is limited for general-purpose tasks like databases.

Complementary Technology

Quantum computing complements rather than replaces relational databases in modern IT environments.

What Quantum Computing Is Not

Not a Faster CPU

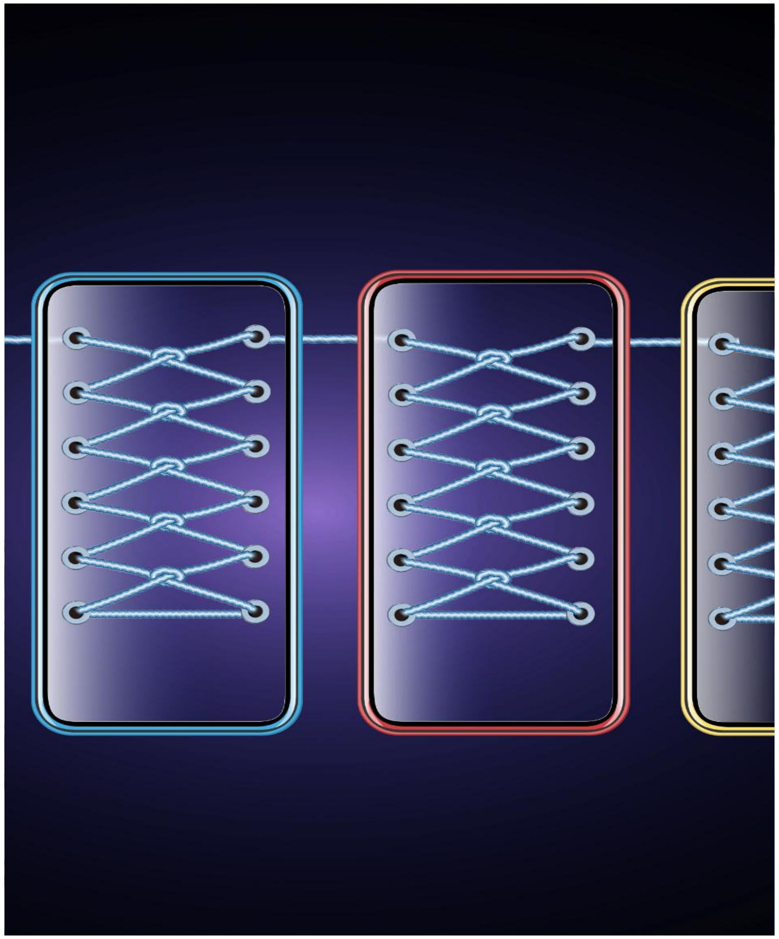
Quantum computing is not a direct replacement for classical CPUs and does not speed up standard computations like SQL queries.

No Transaction Management

Quantum systems do not manage database locks, execute transactions, or enforce ACID properties essential in database engines.

Focus on Specific Problems

Quantum computing targets complex problems like NP-hard optimization and cryptographic challenges, not general workloads.



Classic versus Quantum Computing

Classical Computing

0 | 1

Bits: Binary (0 or 1)

Processing: Sequential

Speed: Linear scaling

Quantum Computing

0+1 | Both

Qubits: Superposition (0, 1, both)

Processing: Parallel universes

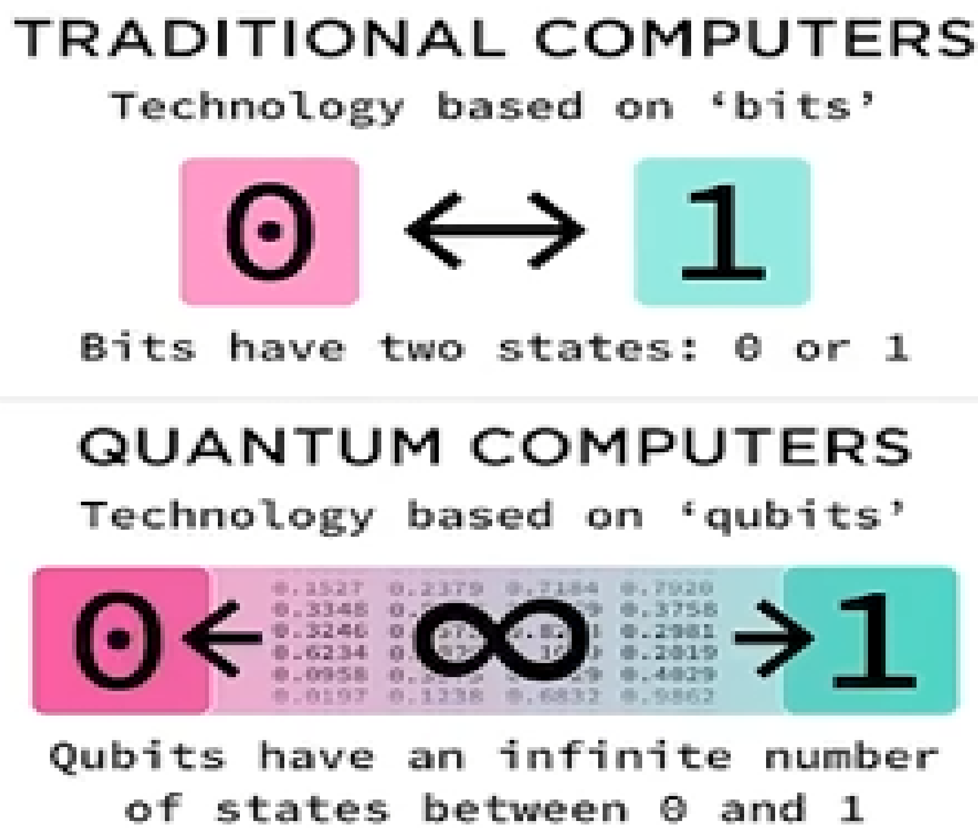
Speed: Exponential scaling

Key Insight: A 300-qubit quantum computer could process more states simultaneously than there are atoms in the observable universe

Bits versus Qubits

Qubit

A Qubit is a physical **subatomic particle** such as **electron** or **proton** – usually a mix of **aluminum** and **niobium**



Three Core Quantum Principles

Superposition

Qubits exist in multiple states simultaneously until measured

Database Impact:
Explore all query paths at once

Entanglement

Qubits become correlated, sharing state information instantly

Database Impact:
Instant correlation detection across datasets

Interference

Amplify correct answers, cancel out wrong ones

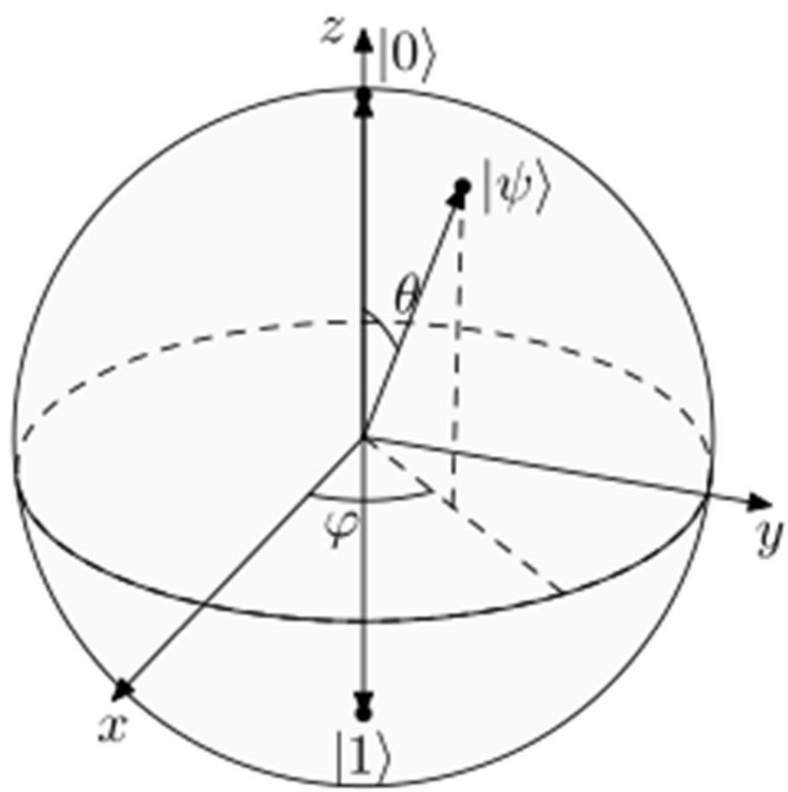
Database Impact:
Eliminate inefficient query plans

Principal 1: Superposition

A Single Qubit is best visualized with a **Bloch Sphere**
The **Bloch sphere** is a geometrical representation of the pure state space of a qubit

The arrow pointing straight down represents 1
The arrow pointing straight up corresponds to 0

In any other position it represents a **superposition** of 0 and 1



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Principal 1: Superposition

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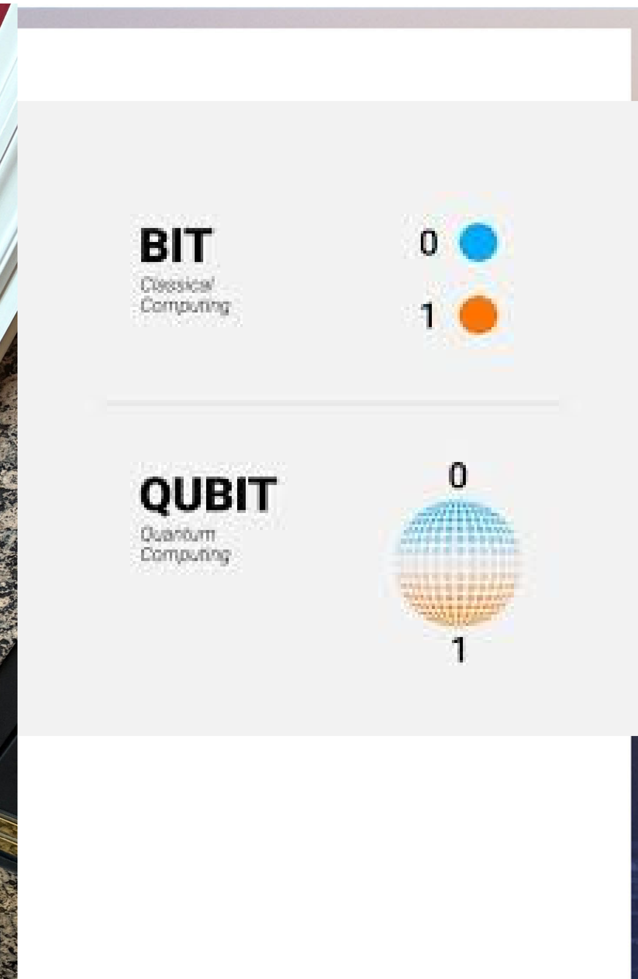


Principal 1: Superposition

A Qubit in its superposition state can have any of an infinite number fo values between 0 and 1

It's measured value always resolves to 0 or 1

The measurement "collapses" the Qubit's quantum state

We can never predict a specific outcome

We can only calculate the probability of a specific outcome

Principal 1: Superposition

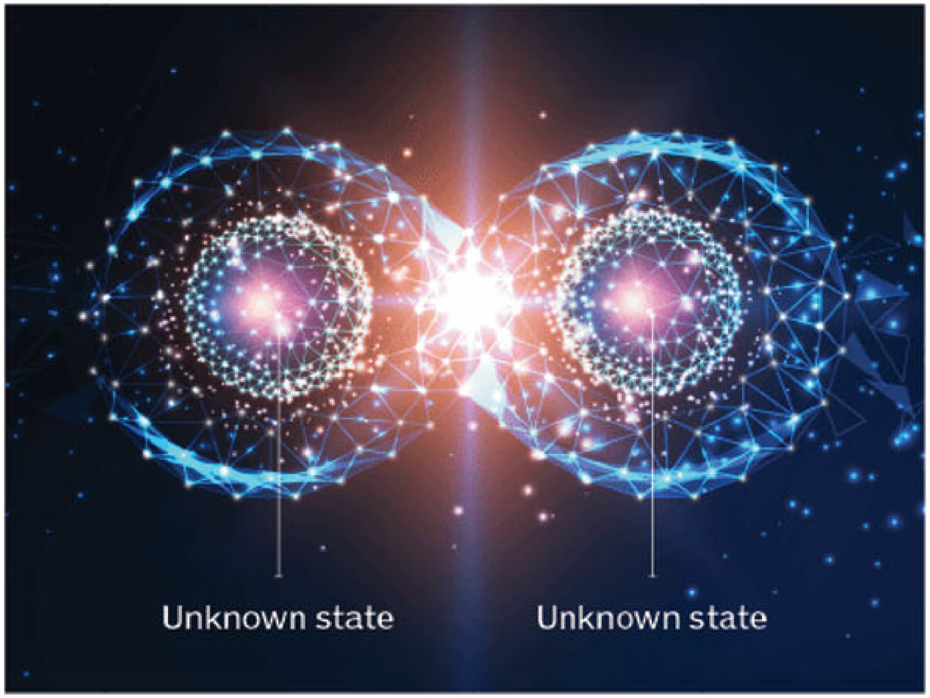
Superposition states are unobservable – there's no actual value

A measured state – we can observe – a state of Spin Up or Spin down is defined

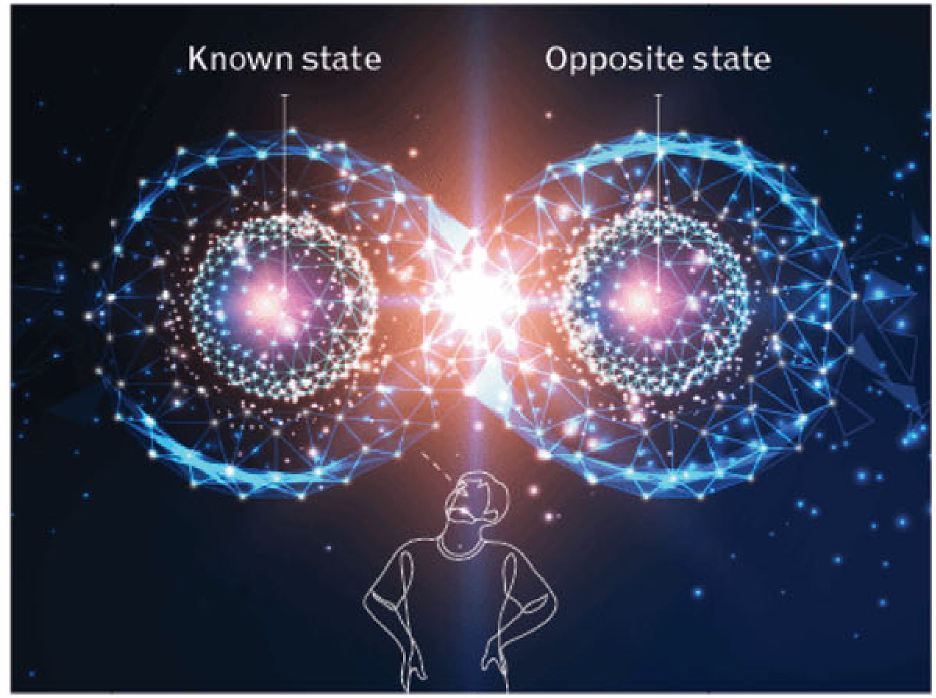
Spin Down = 0 – no energy applied to the electron or proton

Spin Up = 1 – energy applied to the electron or proton

Principal 2: Entanglement



Two or more quantum particles can become entangled, and each has the opposite state of the other regardless of the distance between them.



Their states are unknown until someone observes or measures one particle, thereby revealing the state of the other particle.

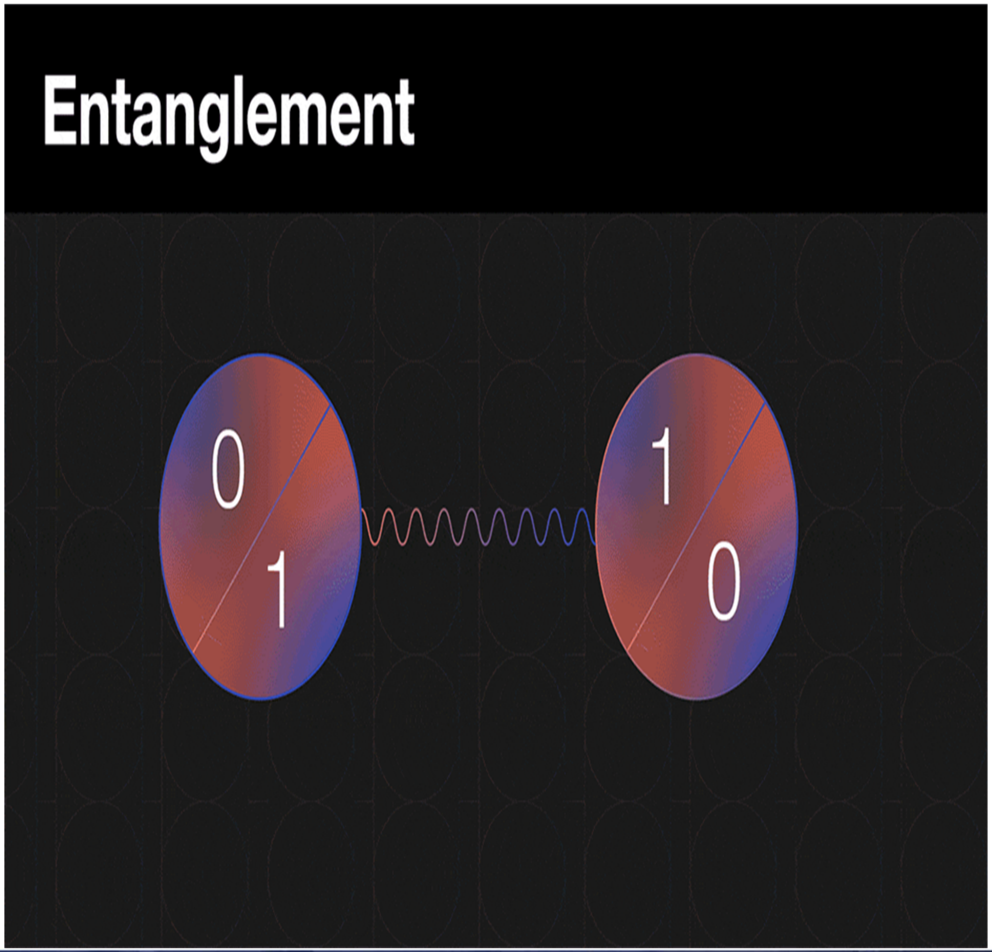
Principal 2: Entanglement

Two or more Qubits are entangled to create a Single Quantum State

Changing the state of one Qubit instantaneously changes the state of the other entangled Qubits

Entanged Qubits can be leveraged to provide “quantum speed-up” in quantum computing

What is entanglement



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Principal 2: Entanglement

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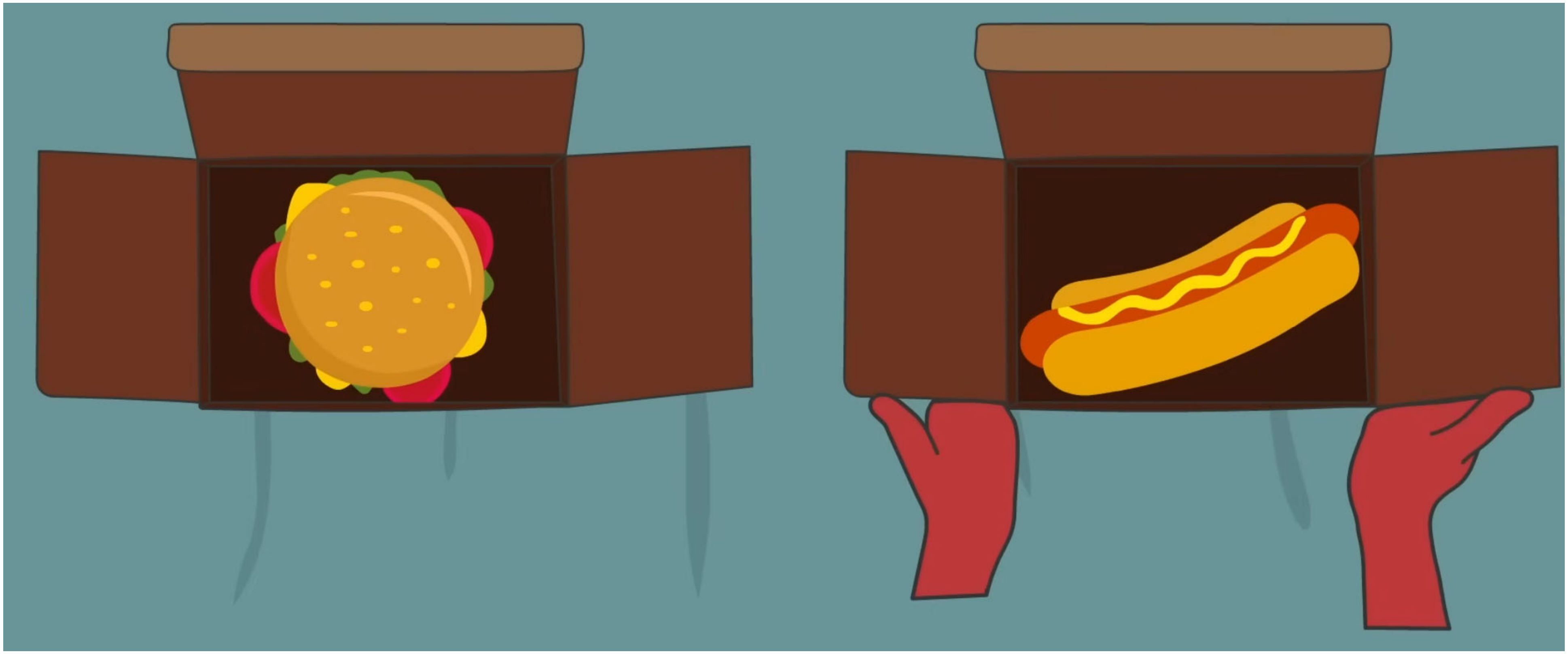
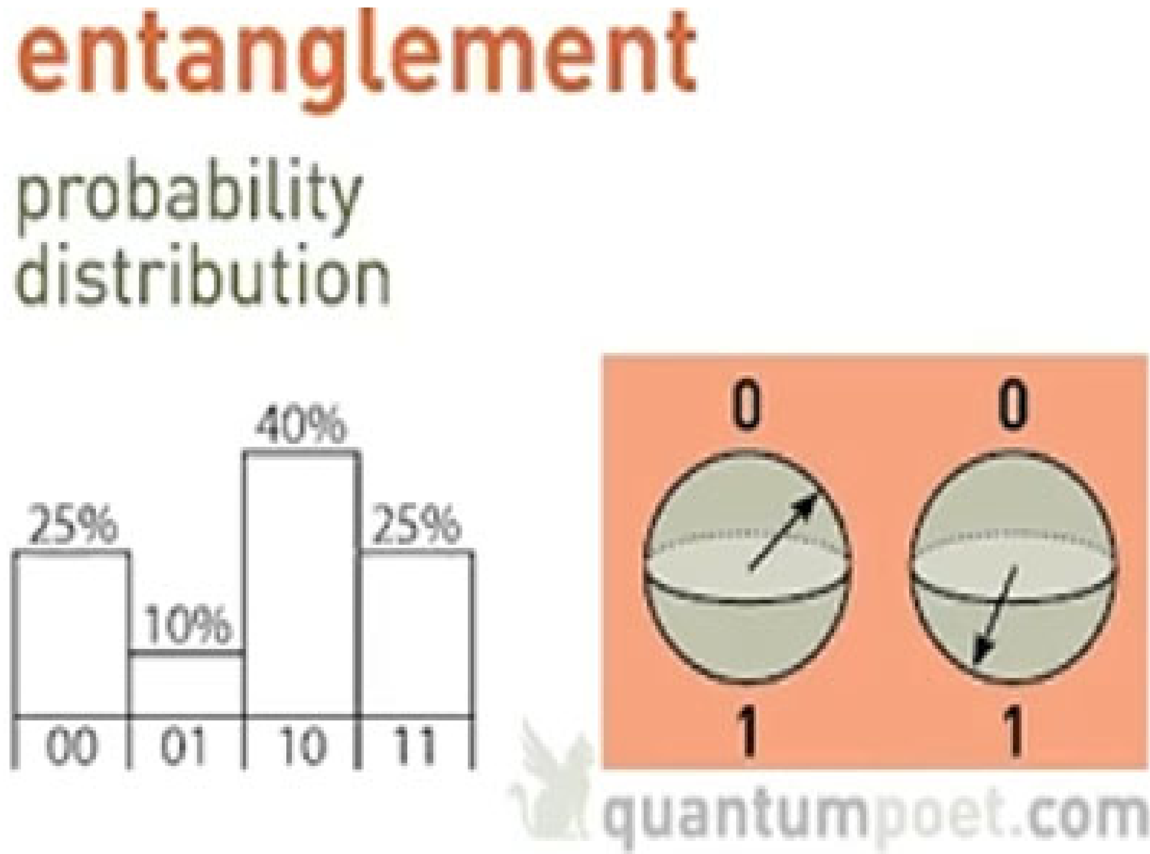


Principal 2: Entanglement

Entangling Qubits can provide an exponential speed-up in quantum computing

Entangling Qubits can only be measured (remember “collapsing”) based on a probability distribution across the Qubits based on wave function amplitudes

We still do not fully understand entanglement



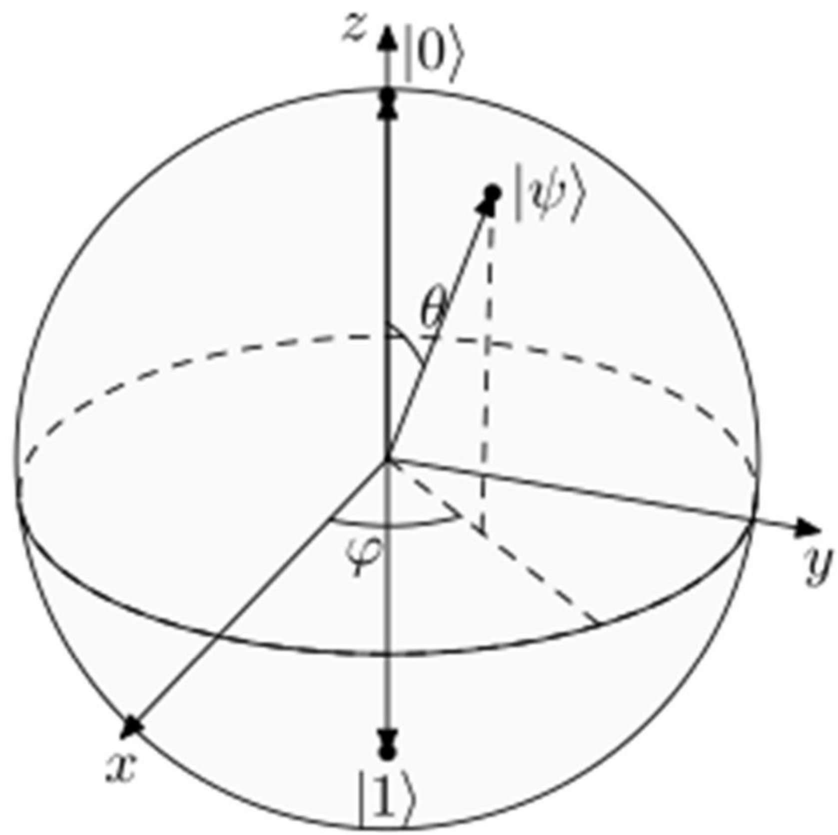
Principal 2: Entanglement

For one qubit we have a probability distribution over two states

For two qubits, the probability distribution is over four states

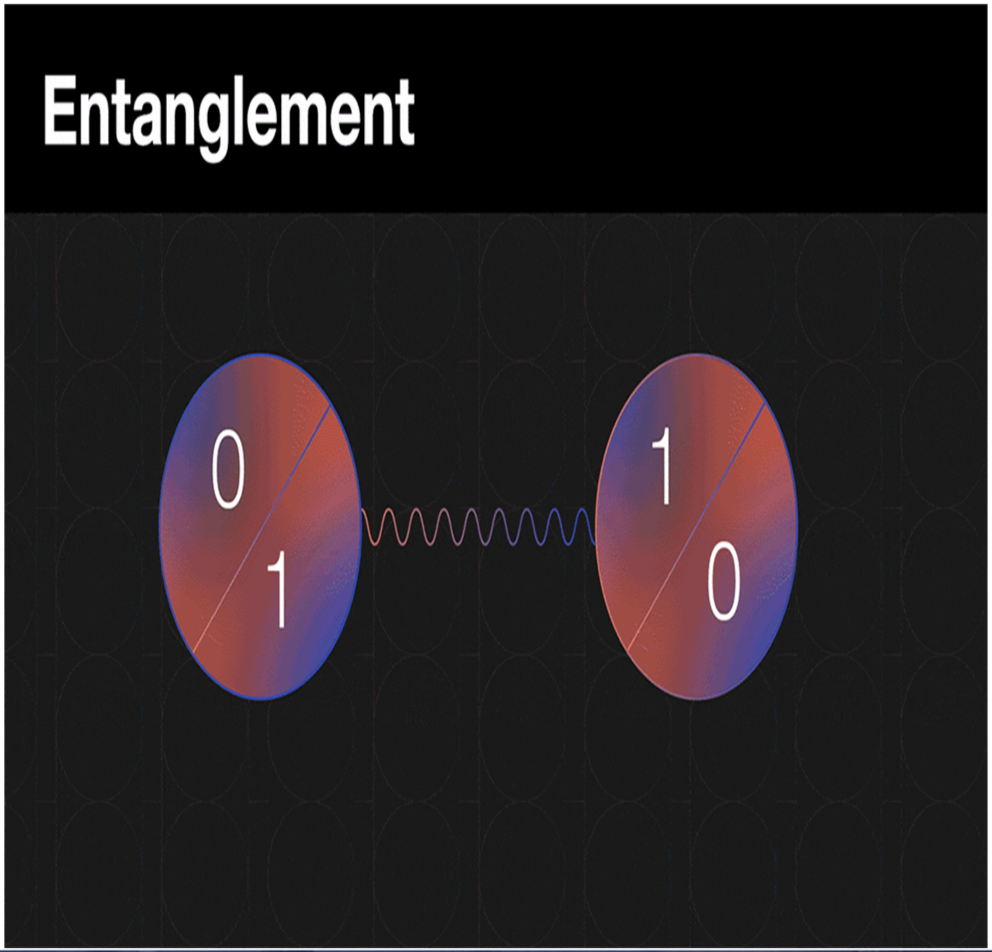
For three qubits, it is eight states

In general, for N Qubits, the probably distribution of over 2^n states.



Principal 2: Entanglement

Engineers create entanglement using quantum logic gates, the building blocks of quantum circuits. The most common recipe uses two steps: first, put one qubit into superposition (an equal mix of 0 and 1), then apply a controlled-NOT gate (CNOT) between that qubit and a second one.

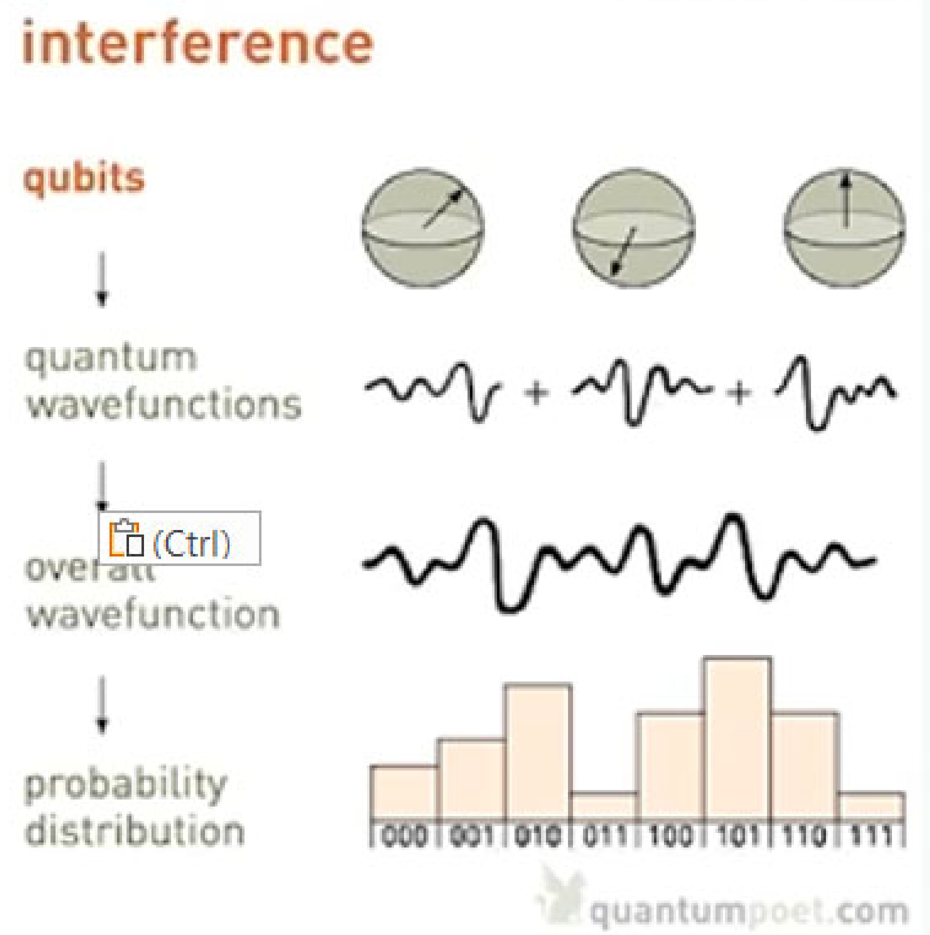


Principal 3: Interference

A wave function is the basic mathematical description of everything in quantum physics

To measure the entangled qubits, we add the individual wave functions of each qubit, producing a single wave function of a single quantum state.

The adding together of the individual wave functions gives us the interference pattern.



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Principal 3: Interference

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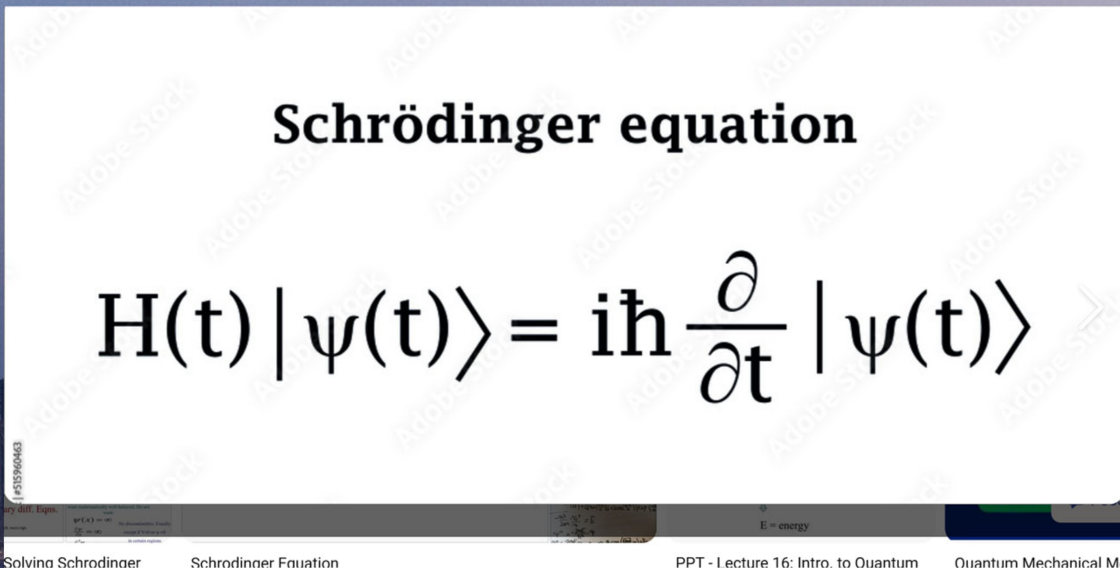
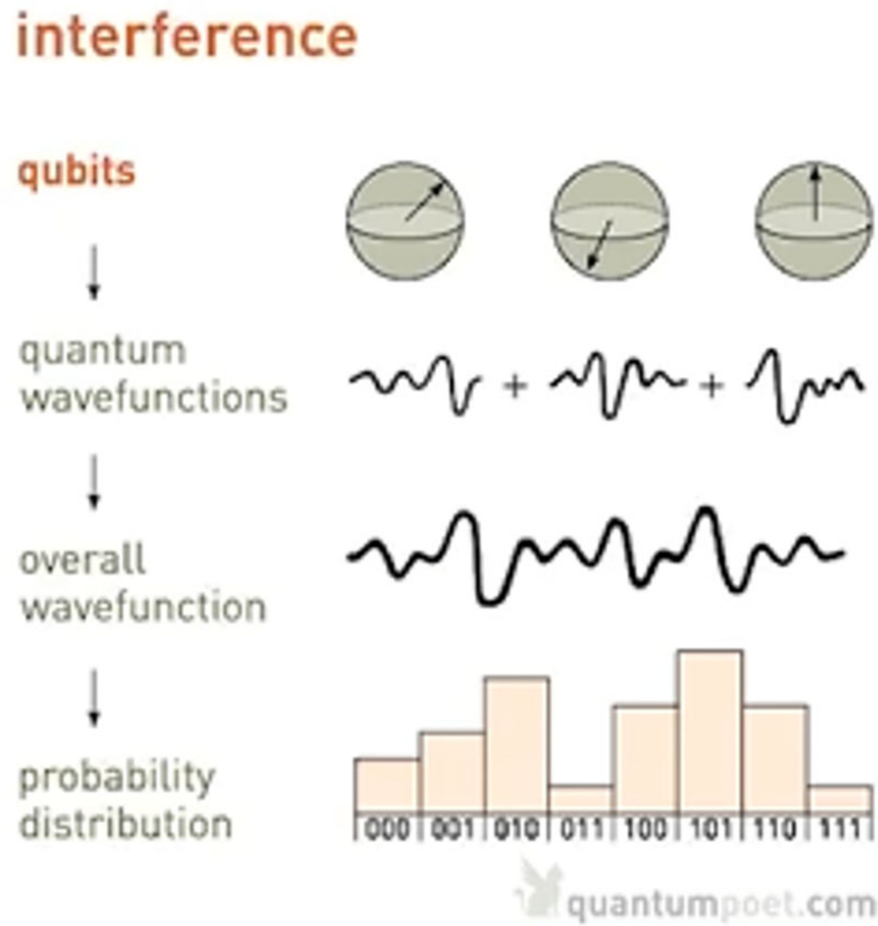


It provides a mathematical framework for understanding the behavior of particles at the quantum level, where classical physics no longer applies. The equation describes the wave function, which encapsulates all the information about a quantum system.

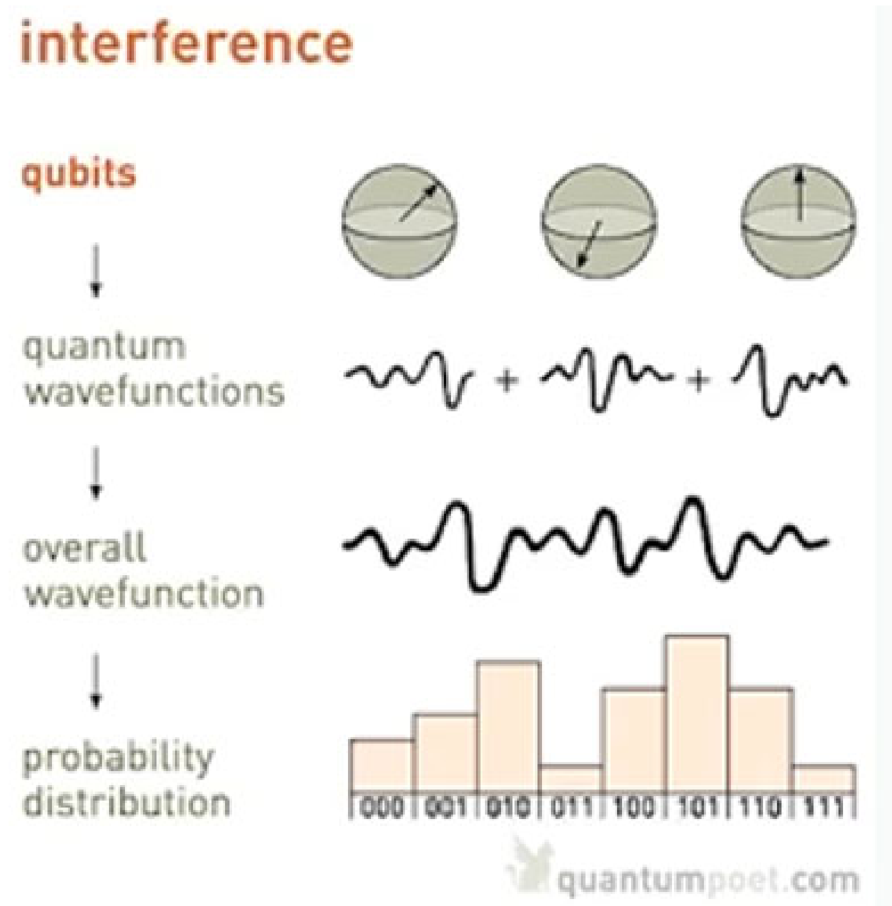


Principal 3: Interference

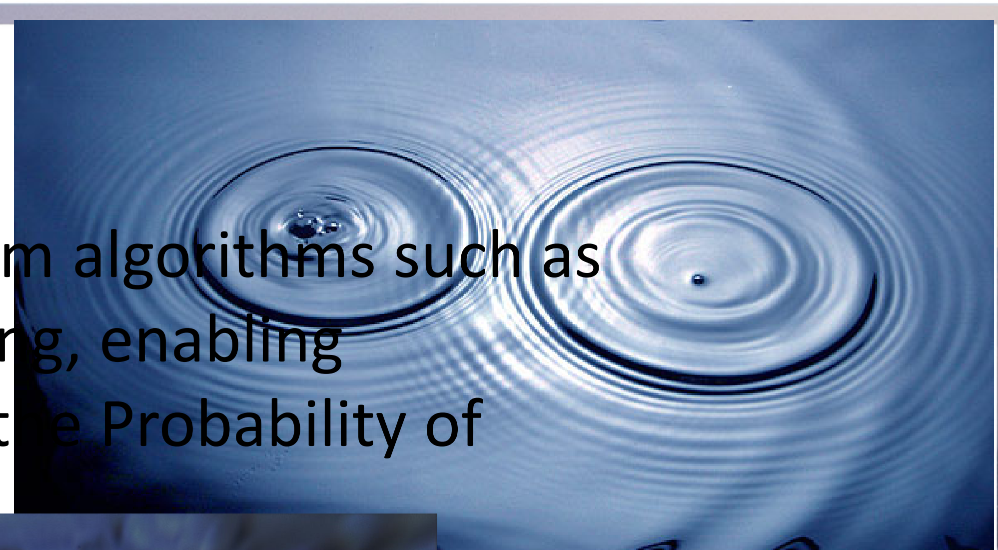
To increase the probability of the correct answer, leverage a constructive interference (where two wave crests add up, producing a larger wave).

To decrease the probability of an incorrect answer, leverage destructive interference (where two waves cancel each other out)

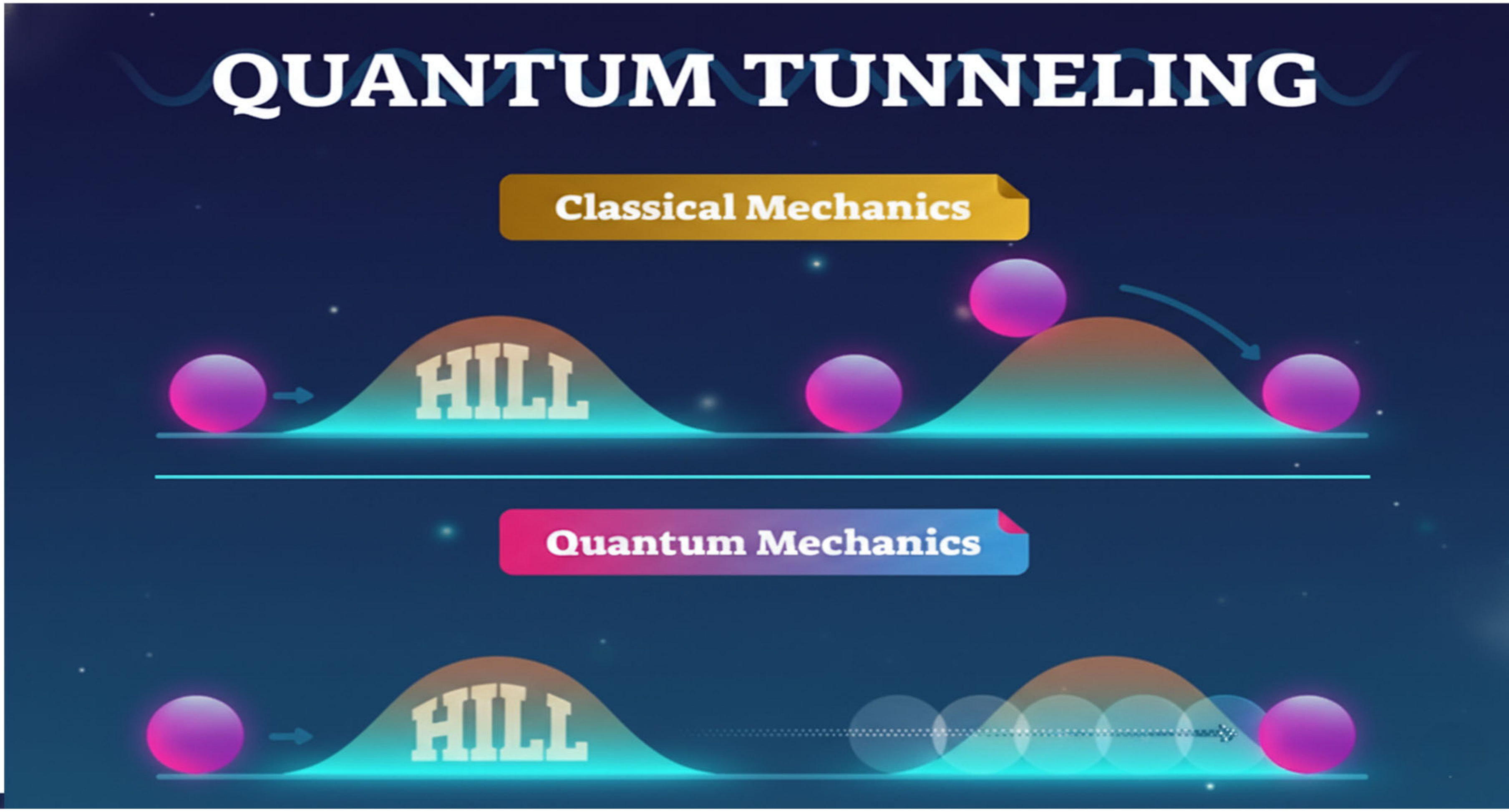
Quantum algorithms are designed so that correct solutions path amplify each other increasing their probability and incorrect solution path cancel each other out.



Principal 3: Interference



Interference is integral for quantum algorithms such as Grover's search and Shor's factoring, enabling expotential speedup by reducing the Probability of incorrect solutions


QUANTUM TUNNELING
Classical Mechanics
HILL
Quantum Mechanics
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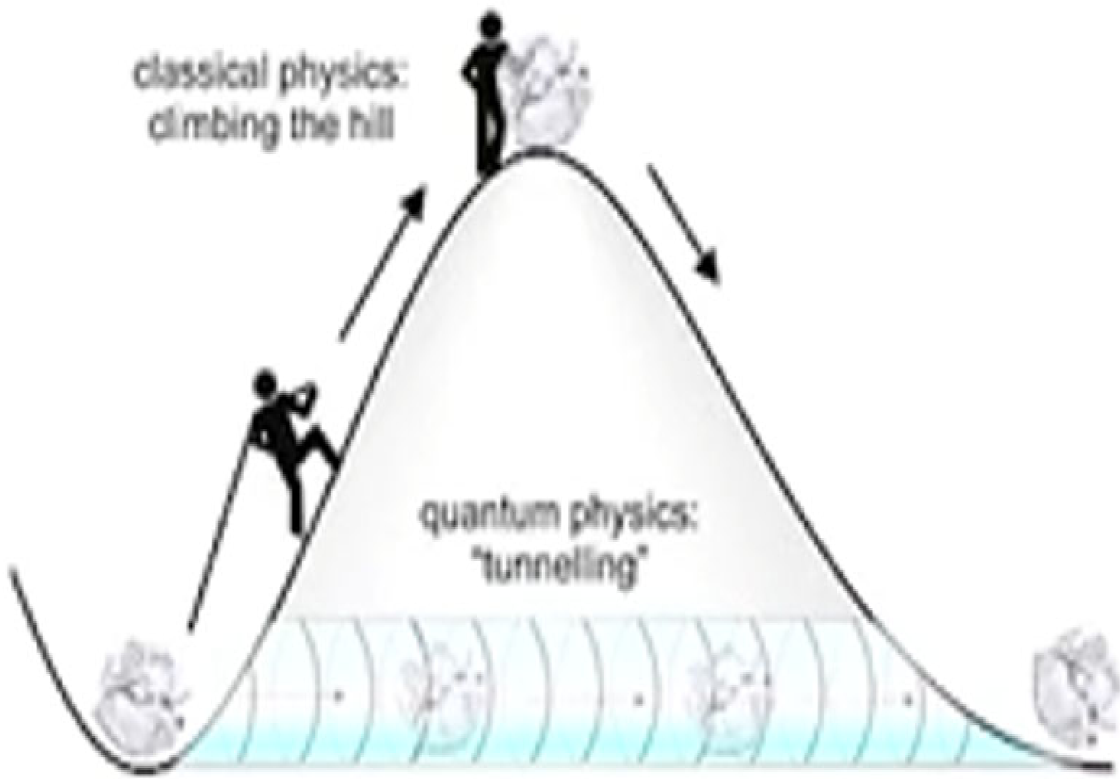
Concept: Tunneling

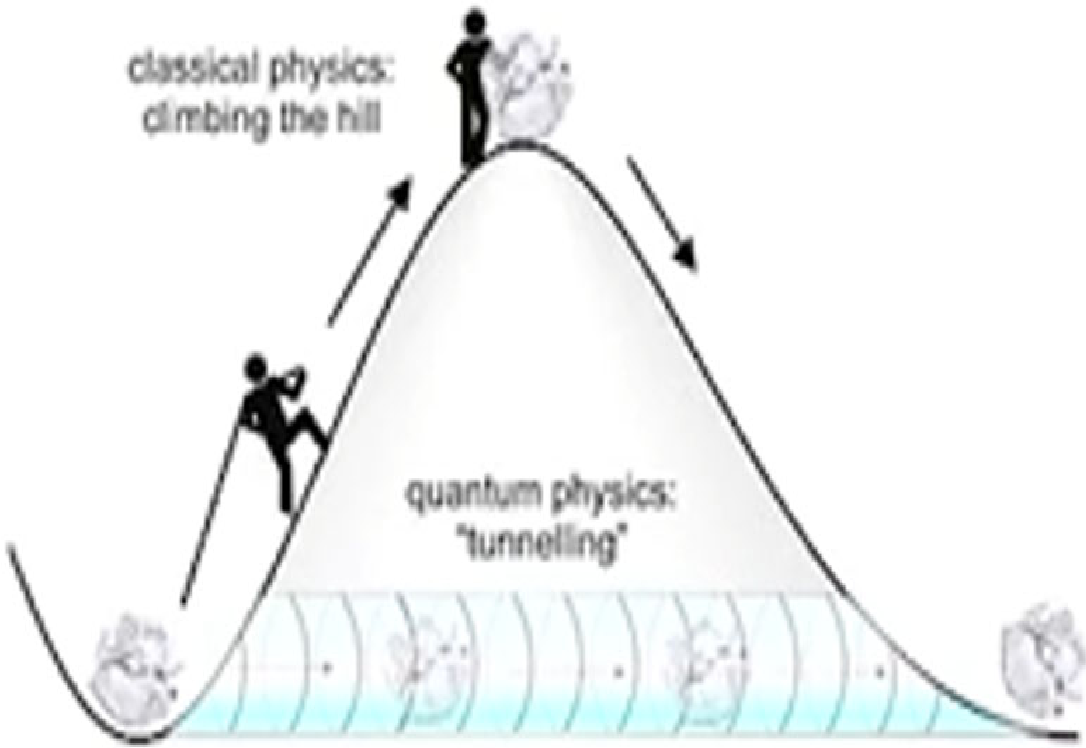
Phenomenon in which an object such as an electron passes through an energy barrier that, according to classic mechanics, should not be passable due to the object not having sufficient energy to pass or surmount the barrier

Qubits need to be kept at near 0 Kelvin in order for this to be accomplished which drastically reduces friction and movement



Concept: Tunneling

Heisenberg's indeterminacy principle, is a fundamental concept in quantum mechanics.
It states that there is a limit to the precision with which certain pairs of physical properties, such as position and momentum, can be simultaneously known. In other words, **the more accurately one property is measured, the less accurately the other property can be known**
We can use wave function to compute the probability of the other property

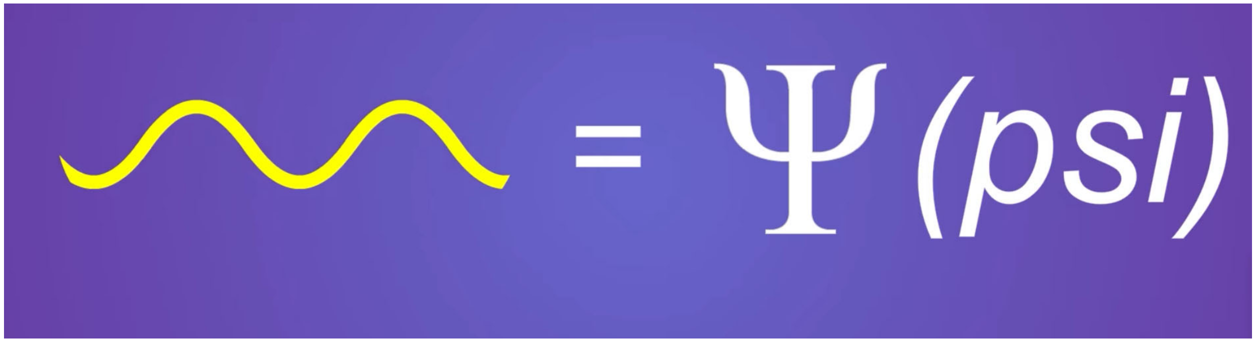


Concept: Tunneling

A particle can behave as a particle and as a wave.

The wave can be represented mathematically

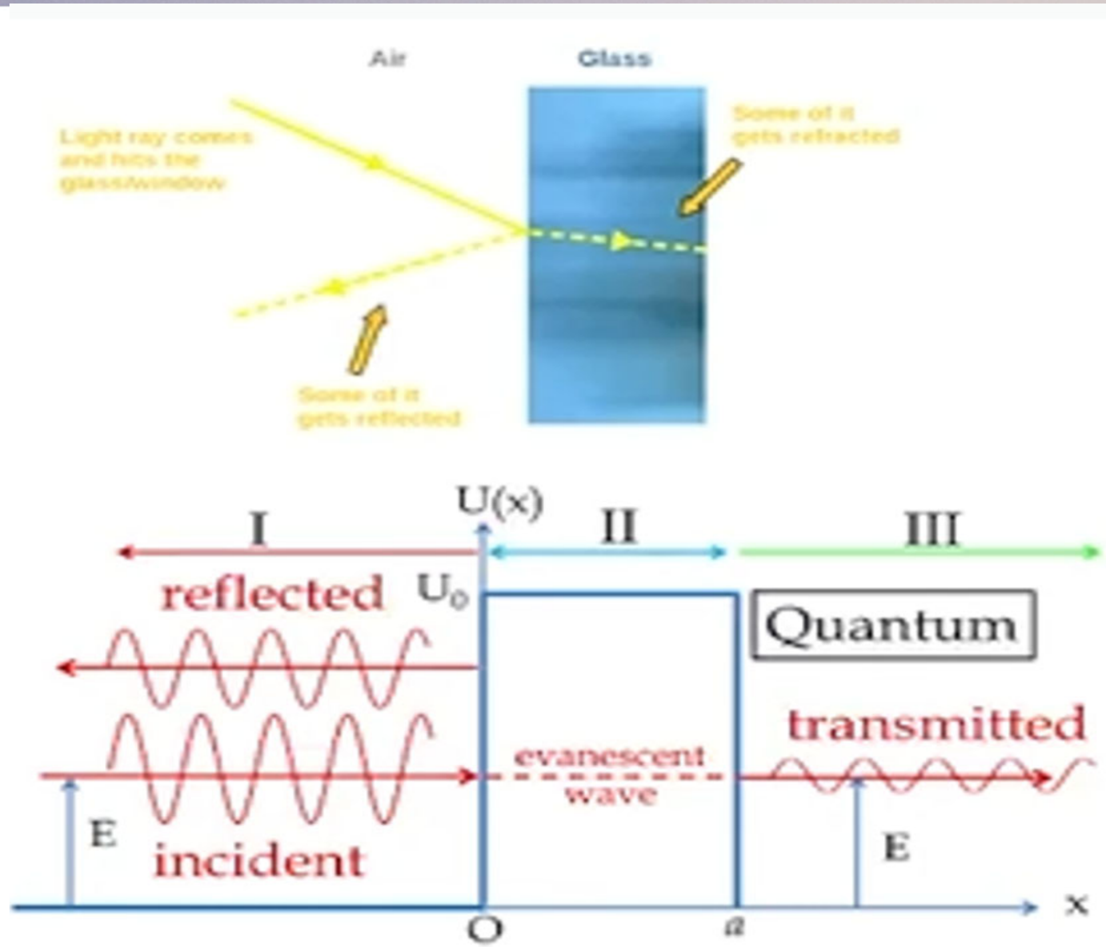
This defies the classical laws of physics.



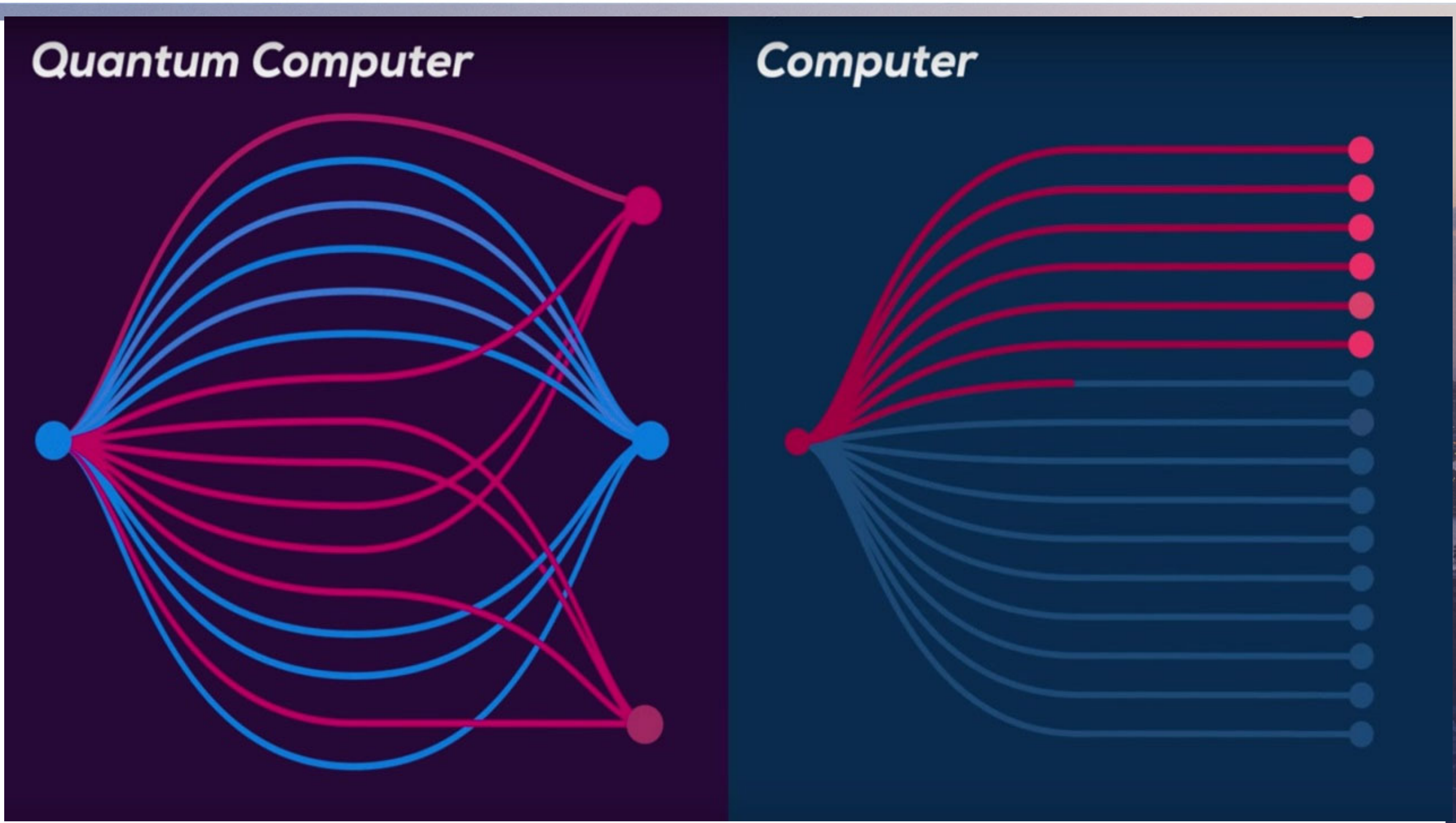
Concept: Tunneling

The Benefit:
A lot of the power comes from this phenomenon
This drastically reduced the energy required to accomplish computing tasks.

The Challenge:
Keeping electrons at near 0 Kelvin – which is needed to maximize the number of electrons which will tunnel – drives up the size and cost of quantum computers



Concept: Quantum Parallelism



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Pulling This Together

N Qubits

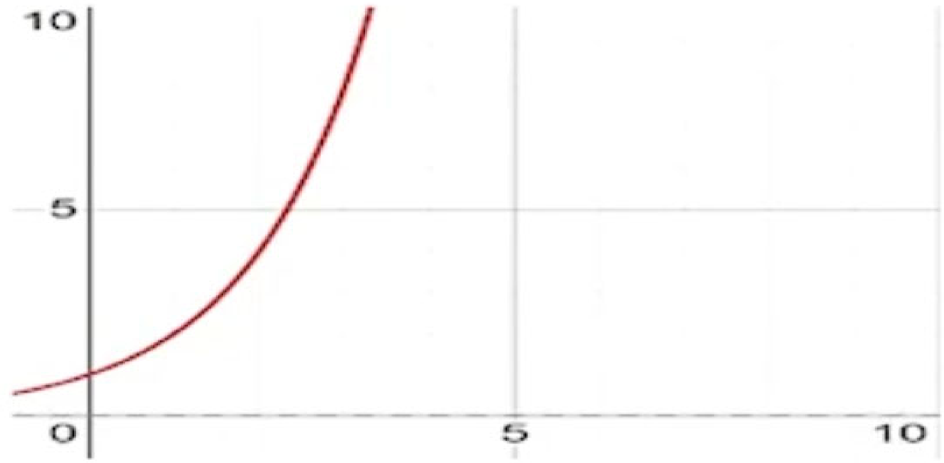
2^n Compressed Numbers

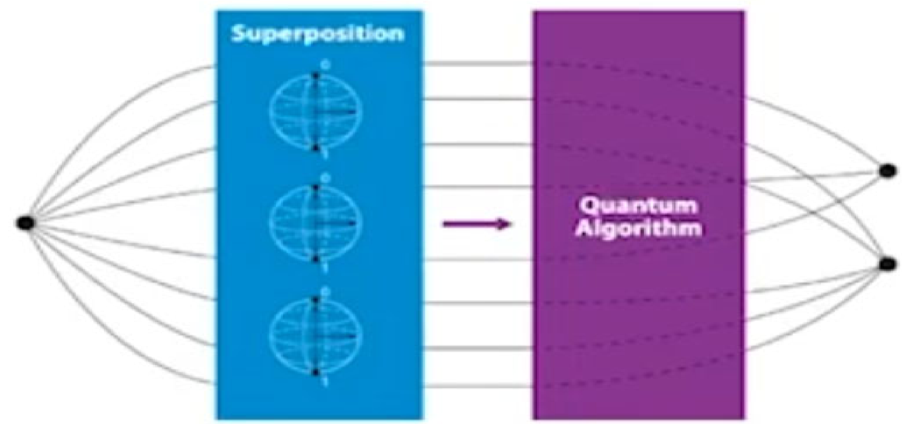
Think of a reasonable number of Qubits like N = 300

$2^{300} = \sim 10^{90}$

Leverage Linear Quantum Mechanics

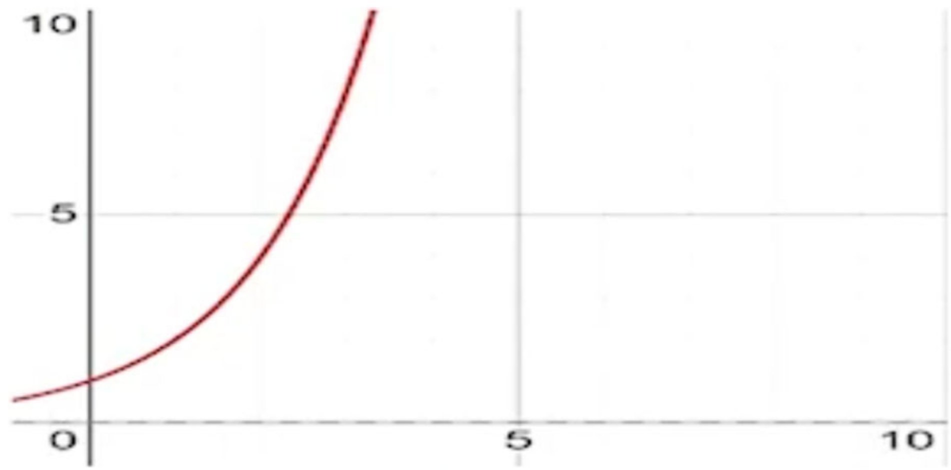
Apply algorithms to Superposition

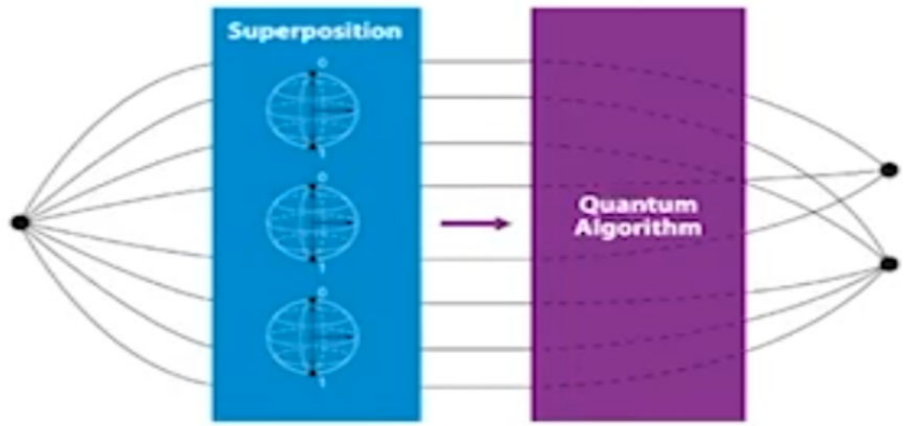




Pulling to all together

- Based on qubits
- Exponential scaleup 2^npower
- Leveraging Linear Quantum Mechanics
- Applying algorithms to Superposition
- Exploit interference to identity the most likely solutions.





Other concepts if you are interested

- Tunneling – how particle can pass through barriers
- Spontaneous Synchronization
- Quantum Algorithms – Shor’s and Grover’s

Current state of Quantum Computing

The most usable qubits in a quantum computer is 1,180,
achieved by Atom Computing (USA).
The company's latest experimental prototype – which builds on technology developed for their 100-qubit *Phoenix* computer – was announced on 24 October 2023.

2027-2030	Error-Corrected Quantum: Logical qubits, early commercial applications
2030+	Fault-Tolerant Quantum: Widespread enterprise adoption

1000+
Qubits (IBM, Google)

$15B+
Market by 2030

60%
Fortune 500 exploring QC

Why do I care about Quantum computing

Why should a Db2 DBA Care about Quantum?

There are several key areas of Impact that we need to be aware of:

- Encryption – The Most Urgent Thread
- Query Optimization and Performance
- AI-Augmented Analysis
- Autonomous Database Management – Already in progress

How Should I Prepare?

Immediately

- Audit your encryption posture
- Follow IBM Quantum Safe
  - https://www.ibm.com/quantum/quantum-safe
- Engage with NIST post-quantum standards

Medium Term

- Learn quantum-adjacent skills (quantum safe cryptology concepts)
- Embrace AI tooling (Db2 Genuis Hub)
- Advocate for a transition roadmap (prepare for the future)

Bottom Line

Quantum computing is fast approaching practical applications that exhibit quantum advantage. Leaders who do not adapt could be years behind.

For Db2 DBAs specifically, the encryption threat is real and actionable *today*, while the performance and analytics benefits are on a longer horizon.

The role isn't going away — it's evolving, and the DBAs who stay curious and proactive will be the most valuable ones in the room.

DB2 Architecture and Optimization Challenges

Join Order Search Space Explosion

NP-hard Join Ordering

Join ordering is NP-hard, causing factorial growth in possible join sequences as table count increases.

Heuristics and Pruning

DB2 uses heuristics and pruning to reduce complexity but may produce suboptimal plans for large queries.

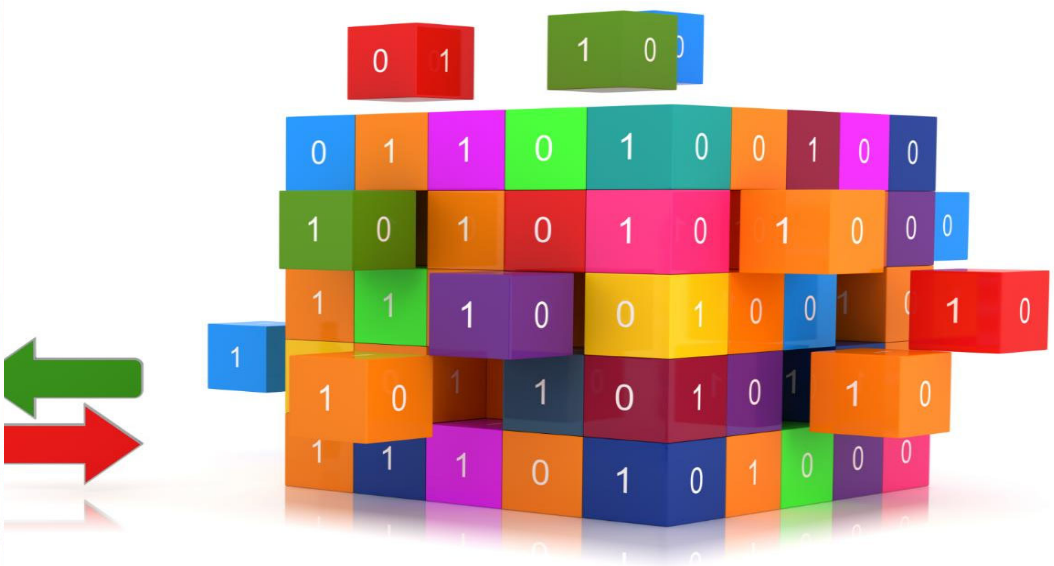
Quantum Annealing Potential

Quantum annealing provides a theoretical method to efficiently explore large optimization spaces in join ordering.

Practical Integration Challenges

Despite its potential, quantum approaches face long-term practical integration challenges in database systems.

Hybrid DB2 + Quantum Optimizer Architecture



Hybrid Quantum Advisory Model

Quantum computing acts as an advisory service for DB2's optimizer, enhancing complex query optimization.

Selective Quantum Offloading

DB2 offloads complex optimization tasks like join ordering to quantum services based on cost and policy.

Enterprise Safety and Control

Final query plans are validated and executed by DB2, ensuring ACID compliance and operational integrity.

Security and Cryptography Implications

Impact of Quantum on Cryptography

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Quantum Threat to Cryptography

Quantum algorithms like Shor's threaten current public-key systems such as RSA and ECC, critical for secure communications.

DB2 Cryptographic Dependencies

DB2 relies on operating system and JVM cryptographic stacks that must migrate to post-quantum cryptographic standards.

Post-Quantum Cryptography Standardization

NIST is standardizing post-quantum cryptography, requiring DB2 specialists to monitor and ensure compliance and security readiness.

Urgency of Cryptographic Migration

Cryptographic migration to post-quantum standards is an immediate concern with a shorter timeline than quantum optimization efforts.

Career Outlook and Skills Roadmap

Skills That Remain Critical

Essential Core DB2 Skills

Data modeling, workload management, and performance tuning are vital for maintaining efficient databases.

Foundation for Reliability

These skills ensure database reliability and efficiency regardless of new technology advancements.

Continuous Learning

Experts should deepen skills and stay updated with emerging technologies to remain effective.

New Adjacent Skills to Develop

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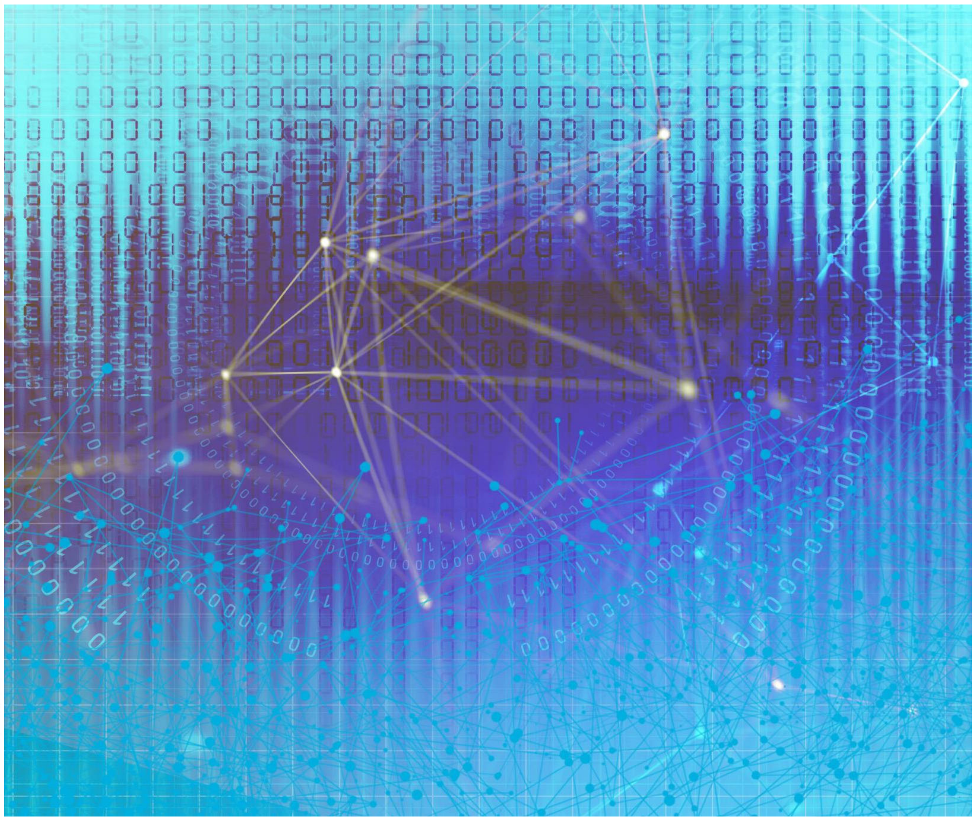


Optimization Theory

Learning optimization theory helps professionals improve efficiency and solve complex problems effectively in DB2 environments.

Probabilistic Modeling

Probabilistic modeling equips specialists to manage uncertainty and make data-driven decisions within database systems.

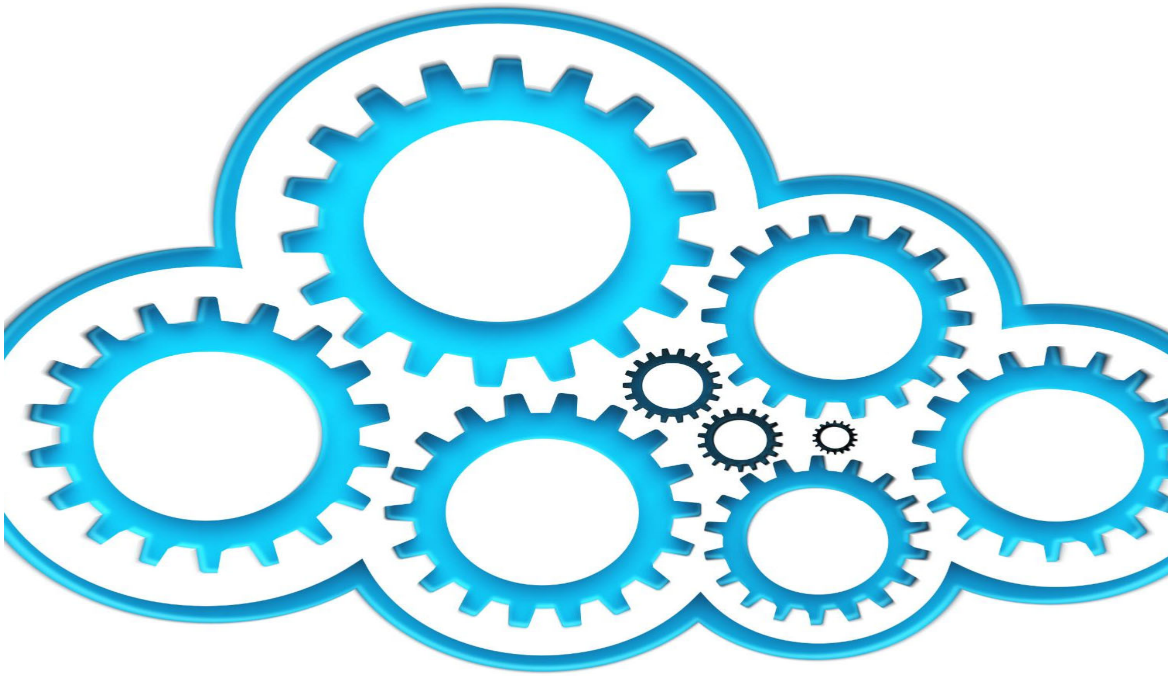
Machine Learning-Assisted Tuning

Machine learning techniques assist in automating tuning for better performance and resource management.

Quantum Algorithm Concepts

Understanding quantum algorithms conceptually aids strategic planning and fosters innovation in hybrid optimization.

Enterprise Timeline and Key Takeaways



Short-term Focus (0-5 years)

The initial phase involves migrating cryptographic systems to post-quantum standards ensuring future security.

Medium-term Developments (5-10 years)

Experimental advisory systems for optimization may emerge in niche database scenarios during this period.

Long-term Outlook (Beyond 10 years)

Hybrid quantum-classical computing models could become practical, but full quantum SQL execution remains unlikely.

Key Takeaways for DB2 Specialists

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Quantum Computing as a Tool

Quantum computing complements but does not replace relational databases such as DB2 in handling transactional workloads.

Enduring DB2 Principles

DB2's core principles like SQL semantics, ACID properties, and buffer pool management remain essential and unchanged.

Strategic Specialist Preparation

DB2 specialists should focus on fundamentals, cryptographic developments, and optimization theory to stay prepared.

Stay Calm and Prepare

The key message for specialists is to prepare thoughtfully and avoid panic amid technological changes.

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