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AI and Quantum shaping decisions in financial services

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Why this conversation matters

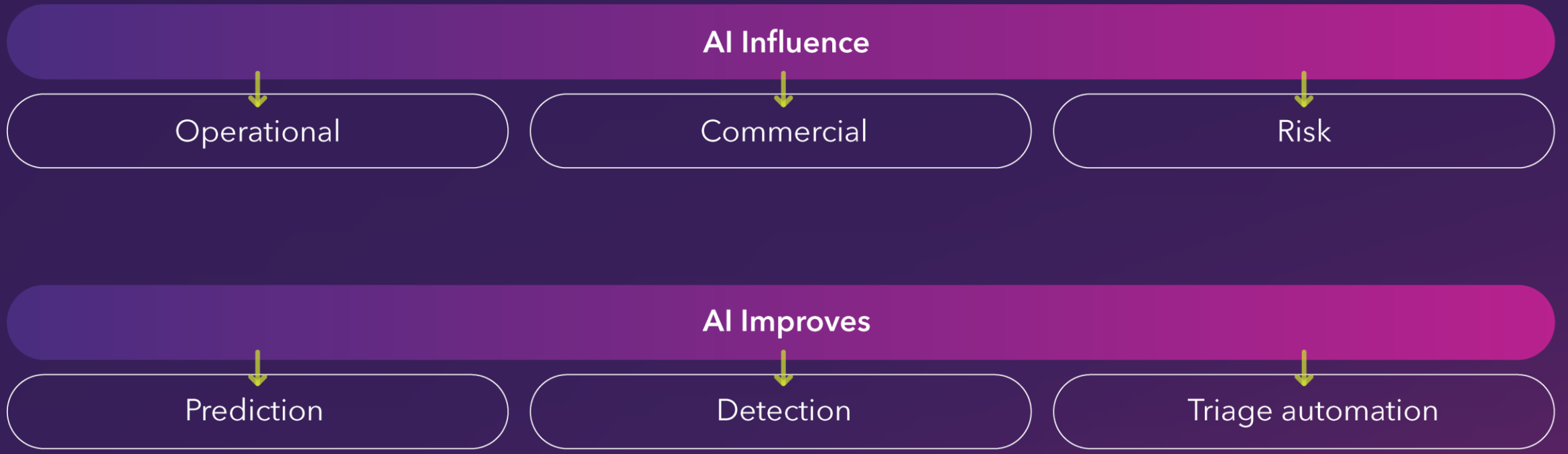
1. FS is fundamentally a decision business
2. AI is already embedded in those decision loops
3. Quantum matters because complexity is rising faster than classical compute can keep up

Financial services is a decision engine

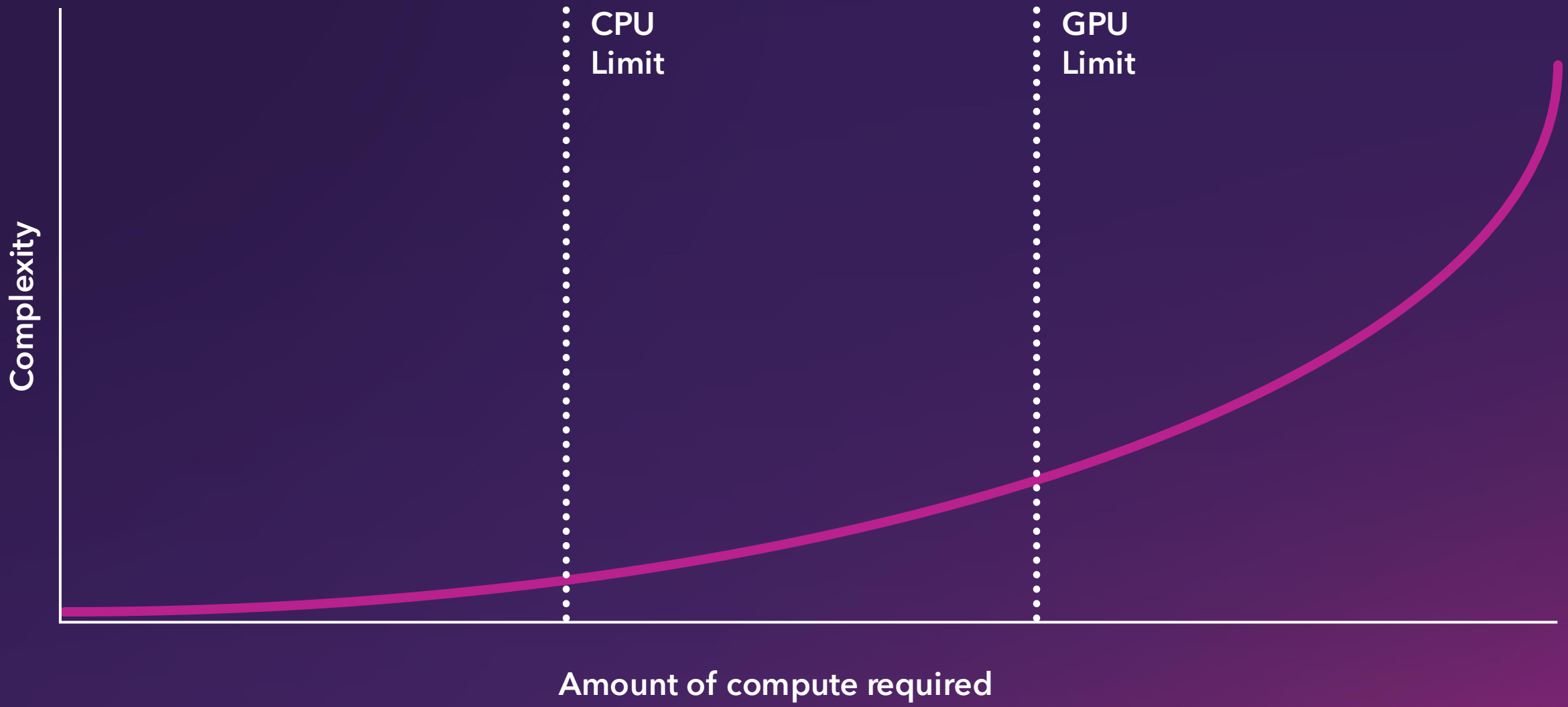
Pressure = Speed + Accuracy + Auditability

AI is already changing decisions

AI is already changing decisions



Where classical compute starts to struggle



Where Quantum fits (conceptually)

Setting expectations

This is not a talk about buying Quantum

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Understanding the technology

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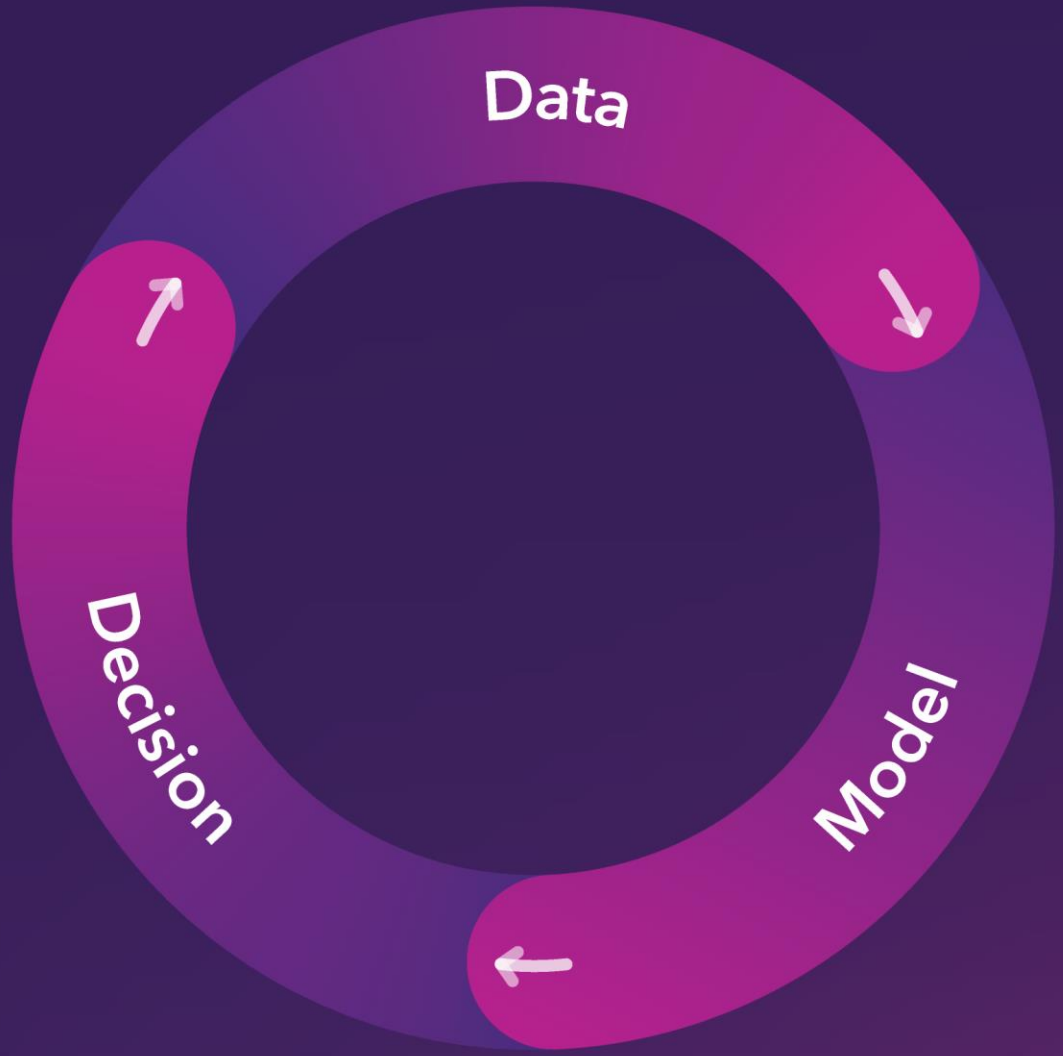
How decisions are made today



What AI is exceptionally good at

Pattern recognition at scale

Prediction and classification

Natural language interfaces and summarisation (where appropriate)

Where AI and classical compute hit limits

1. Optimisation under constraints
2. Scenario explosions in stress testing
3. Complex dependency graphs
4. At scale, approximation replaces optimality

Quantum computing – plain English

What it is	Different computational paradigm
What it isn’t	Replacement for traditional compute
What it’s good for	Exploring complex probability spaces (simulation, complex problem spaces)

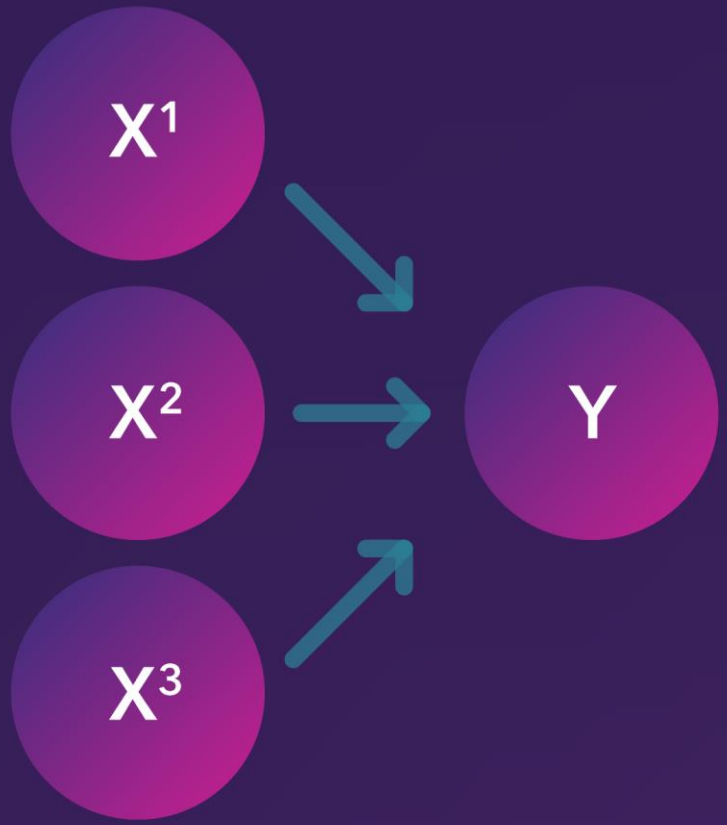
A useful mental model

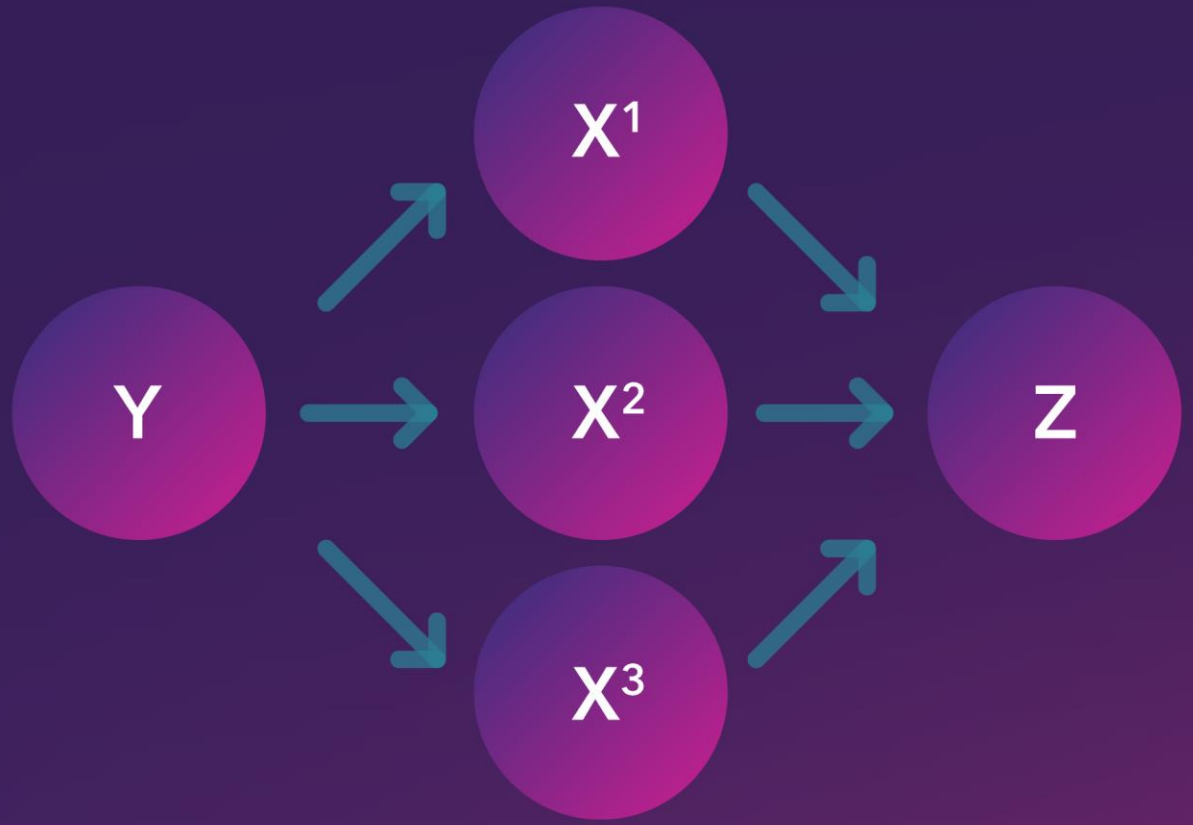
Classical compute

Quantum

A useful mental model

AI and Quantum together





Key Takeaway: Expanding What's Solvable

The strategic question is: which decisions are bottlenecked by complexity?

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State of technology

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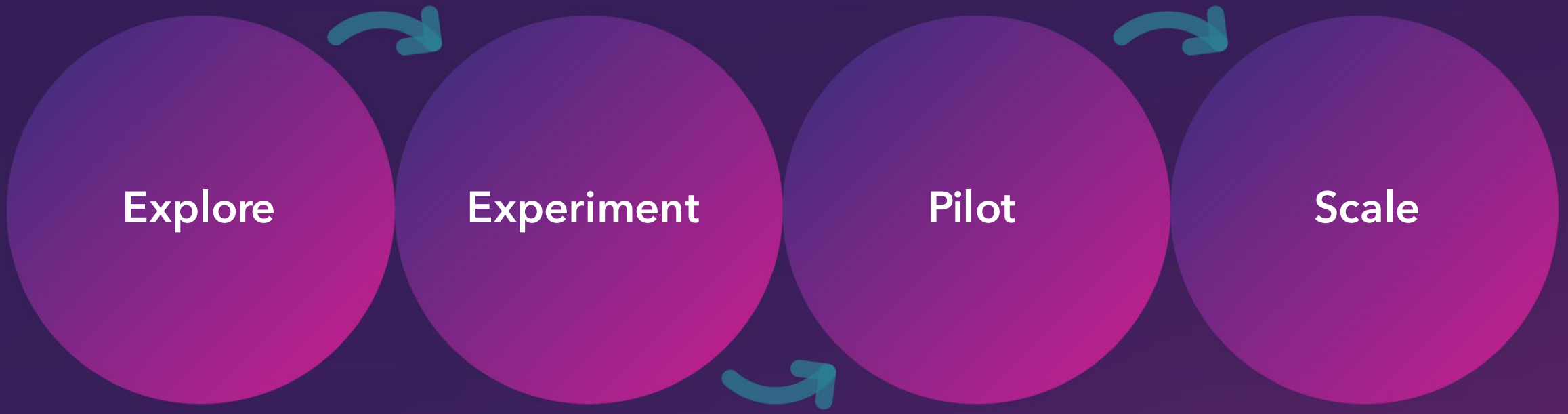
Where we actually are today



What Quantum is *not* (yet)

Why financial services is engaging early

Horizon

Regulation

Security

A familiar technology pattern

Cloud

AI

Quantum

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Where it's being used today

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IBM Quantum for enterprise

Quantum computing applications for financial services

Dr. Ian A. Robotham
Financial Services CTO & Quantum Ambassador
IBM Quantum

Quantum computing is rapidly maturing, with opportunities to capture value as it advances

2023

Establish quantum utility

2026

Demonstrate quantum advantage

2029

Deliver the first large-scale, fault-tolerant quantum computer

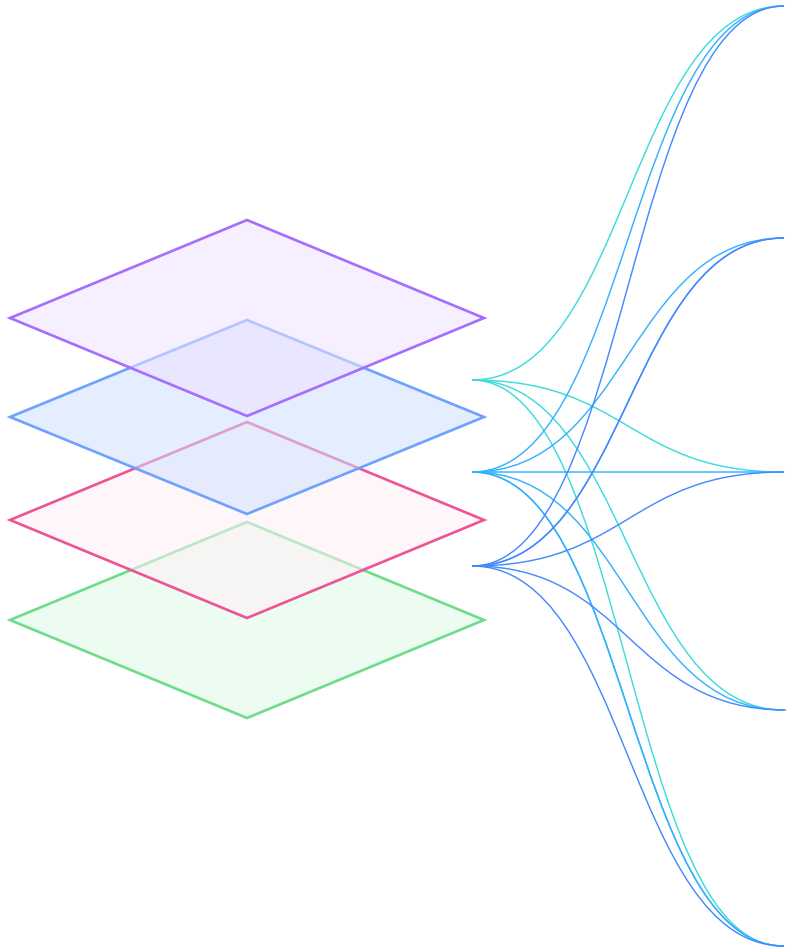
Quantum computing is expected to have impact across industries

Hamiltonian simulation

Optimization

Machine Learning

Partial differential equations (PDEs)



Aerospace	• High strength-to-weight materials development • Wing ply-composite design optimization • Aircraft computational fluid dynamics
Automotive	• Advanced batteries • Multi-objective vehicle routing optimization • Auto design and simulation
Chemicals	• Lower energy fertilizer manufacturing • Efficient Catalysts • Accelerated product development
Electronics & semiconductors	• Placement and routing optimization • Deposition/etch process modeling • Multi-domain simulation
Energy	• Grid management • Grid optimization with EV's • Carbon Sequestration
Financial Services	• Portfolio optimization • Derivatives/options pricing • Anti-Money laundering
Health Care & Life Sciences	• Drug discovery and drug design optimization • mRNA & protein structure predictions • Disease target & biomarker discovery

Quantum applications

Financial services industry

We are exploring quantum computing applications in:

- Quantitative/algorithmic trading strategies
- Portfolio optimization
- Risk exposure estimation
- Market forecasting times series
- Anti-money laundering
- Underwriting optimization
- Credit line optimization

Modeling financial time series and sequences

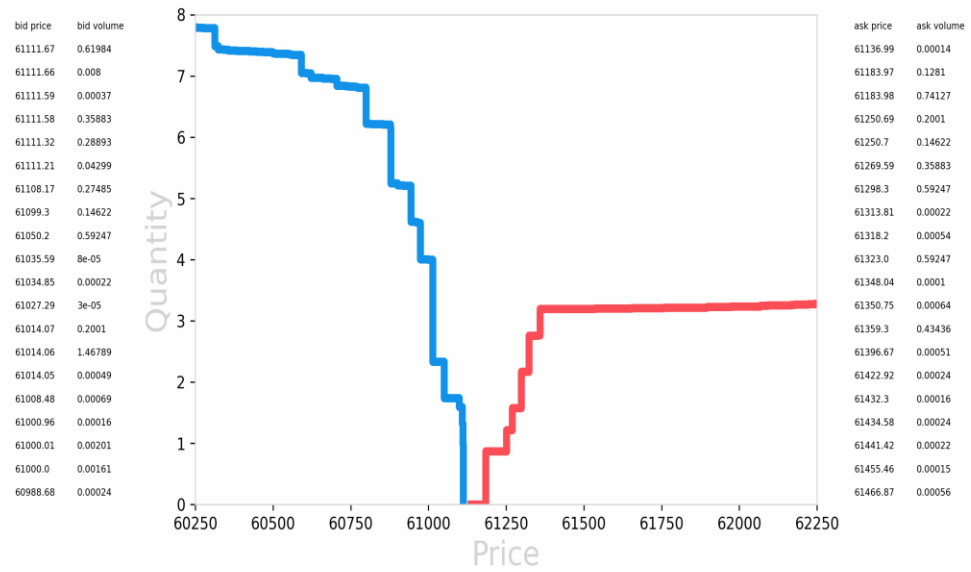
QML

Wells Fargo partnered with IBM to conduct research on time series using quantum models, such as for limit order book mid-prices prediction to reduce uncertainty in the execution price and determine the optimal quoting strategy for spread capture.

The team developed experiments up to 72 qubits for sequence predictions. The models have proven to be parsimonious in resources compared to classical methods and efficiently learnable and analytically tractable.

"Not engaging is not an option... We saw a line of sight for solving mathematical problems which would be a big amplification of productivity."

Chintan Mehta
CIO of Digital Technology and Innovation, Wells Fargo



The figure above depicts a distribution of limit orders within a limit order book, where the horizontal axis shows the price and the vertical axis shows the number of orders. The blue curve represents cumulative "buy" orders, while the red line shows cumulative "sell" orders. The point at which these lines intersect shows where the queue of limit orders is executed. Averaging the top bid and lowest ask ("mid-price") characterizes the distribution and the "current" price of the security.

Read the papers: arXiv:2212.03796, https://dl.acm.org/doi/10.1145/3677052.3698679

Vanguard

Portfolio optimization for fixed income assets

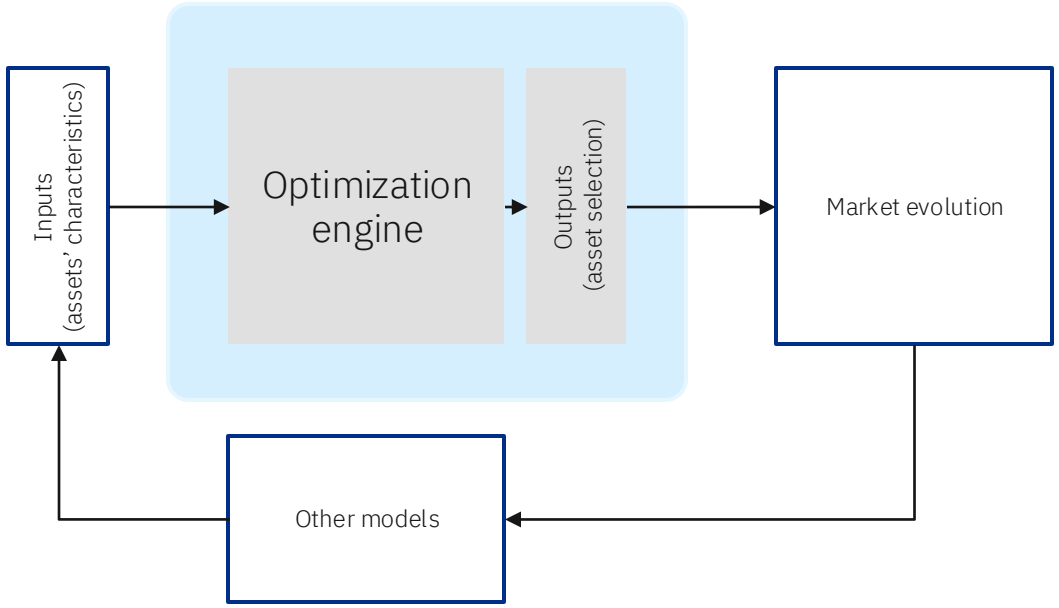
Optimization

IBM partnered with Vanguard to conduct research on hybrid quantum algorithms for optimal portfolio construction in the context of fixed income assets, with the goal of improving the replication quality of selected financial indexes using smaller, less complex portfolios that are cheaper to manage.

The team developed a scalable sampling-based approach, tested up to 109 bonds on utility-scale hardware using up to 4,200 gates, producing solutions within 0.5% of the optimal.

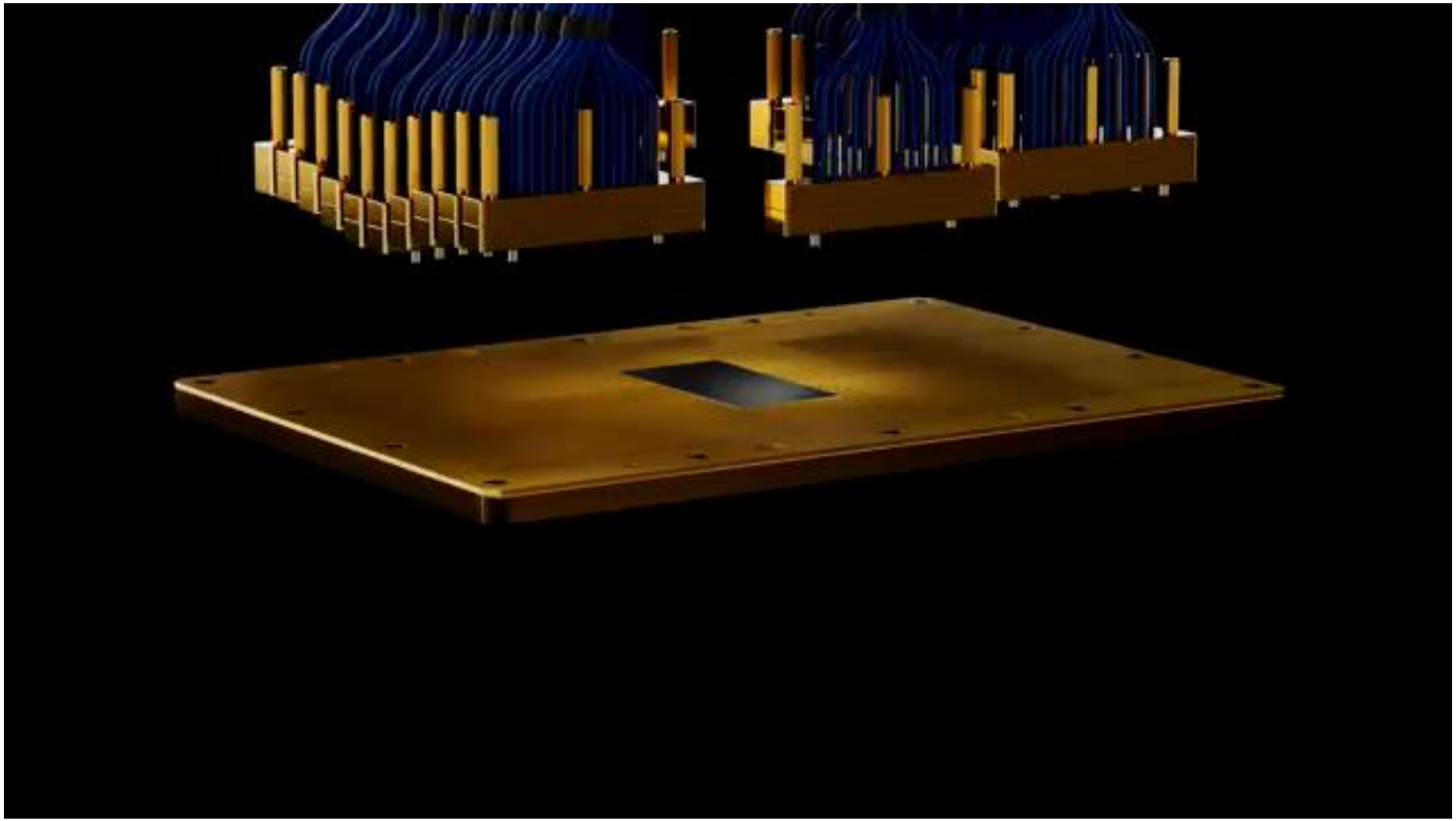
"The study found that the quantum-classical workflow consistently outperformed a purely classical local search approach, especially as the problem size increased."

"IBM and Vanguard explore quantum optimization for portfolio construction"



- The figure above shows the workflow implemented for this solution.
  The generic portfolio creation problem can be defined as selecting the optimal subset of assets (in the asset universe) that better corresponds to a target set of properties.
  The asset characteristics (returns, risks, etc.) that are input to the optimization engine are considered as given deterministic inputs, coming from other models.

Read the paper → arXiv:2508.13557



HSBC

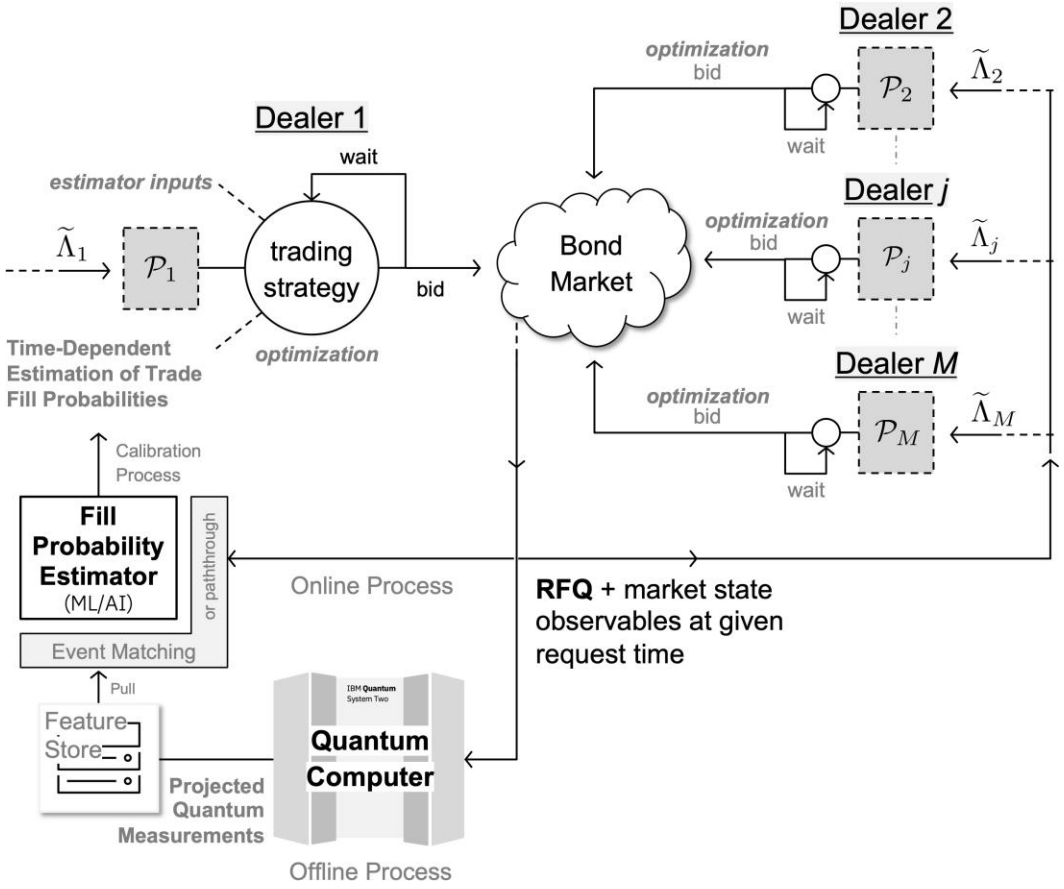
Trade execution optimization in corporate bond markets

QML

IBM and the algorithmic trading division of HSBC partnered to explore the potential for hybrid quantum algorithms to optimize trade execution strategies for corporate bonds.

Using real production-scale data, they investigated whether a form of quantum-enhanced likelihood estimation could obtain better estimates of trade fill probabilities in credit orders, testing their approach on IBM Quantum Heron processors.

The researchers observed a relative gain of up to ~34% in the models with access to quantum-hardware-transformed data, demonstrating that quantum is a useful and relevant discovery tool in modeling complex financial markets.



The figure above shows the bigger picture considered when developing this solution, where the focus in this project has been first on building better optimization inputs with lower errors in fill probability estimates that feed subsequent trading strategies.

Read the paper → arXiv:2509.17715

Read the press release → https://ibm.biz/hsbc-pr

The response: make the world quantum safe

The problem with quantum computers

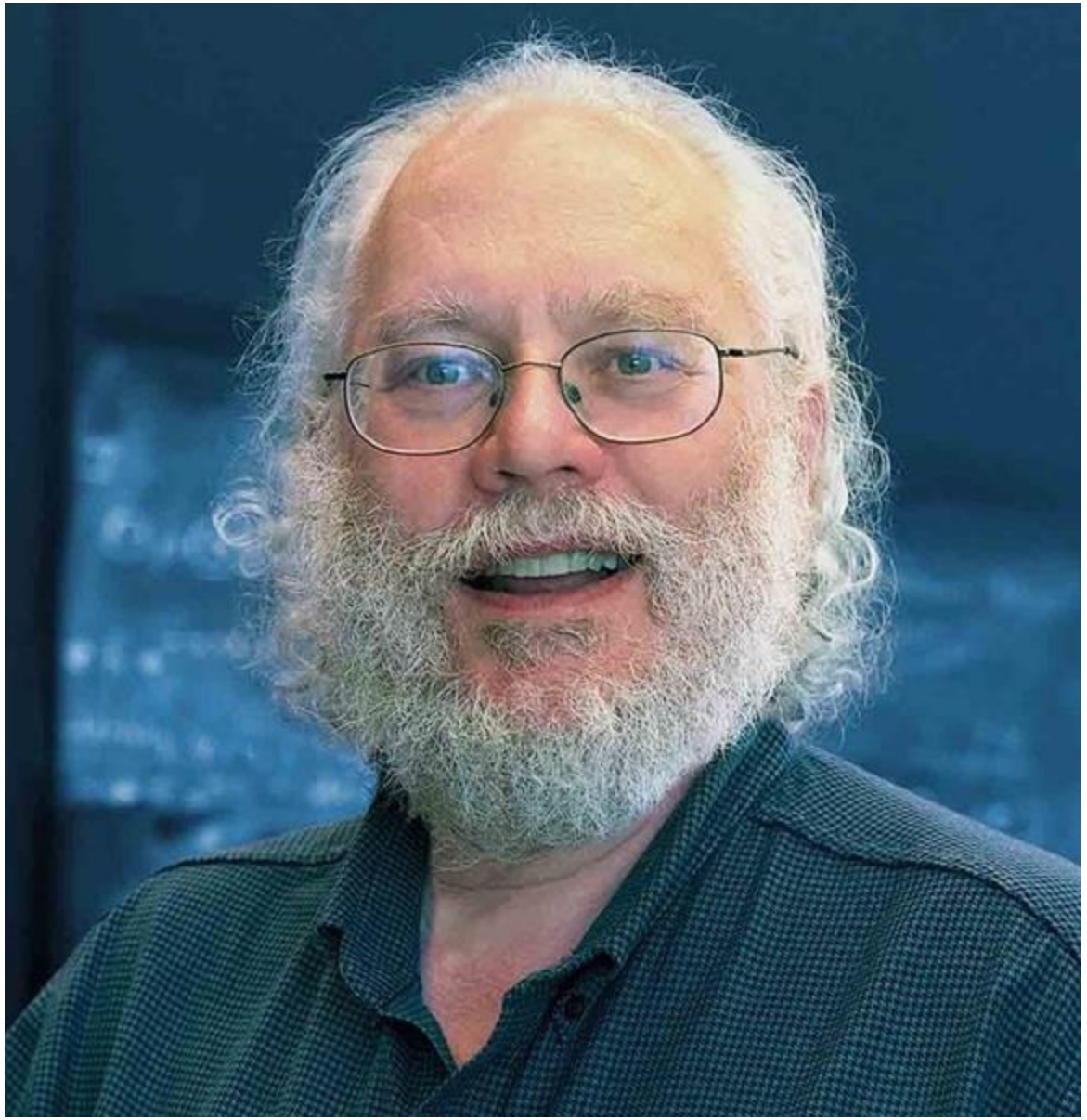
Shor's algorithm (1994) shows a quantum computer can factor large numbers—at least 2048 bits long (that's 617 decimal digits).

On a classical computer, this would take millions of years.

On a *cryptographically relevant quantum computer,* this would take a few hours.

Shor's algorithm breaks RSA and other public-key cryptosystems, where security is based on the difficulty of mathematical **trapdoor** functions (factoring large numbers or taking discrete logarithms).[1]

Grover's algorithm (1996) theoretically affects AES. Current guidance is to continue using AES, which is believed to be quantum-safe.[2]



Peter Shor of Bell Labs and MIT delivered the 2017 Viterbi Lecture, "Capacities for Quantum Communication Channels"
Photo: Ming Hsieh, Department of Electrical and Computer Engineering at the University of Southern California.

1. "Polynomial-Time Algorithms for Prime Factorization and Discrete Logarithms on a Quantum Computer," 25 January 1996.

2. "A fast quantum mechanical algorithm for database search" 29 May 1996

The Solution: Rebuild the cryptographic foundations of our digital world for the quantum era

Quantum-safe cryptography/Post-quantum cryptography (PQC)

New lattice-based cryptography

Resistant to classical and quantum attacks

Runs on classical computers!

NIST process

Standardization of PQC for key encapsulation and digital signature started in 2016

Standards (FIPS 203, FIPS 204, FIPS 205) published Aug 2024

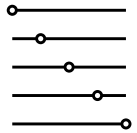
On-going cryptography standardization program

(IBM Research Zurich)

Cryptographic protocols

Major cryptographic protocols, such as TLS and IPSec need to be adapted in order to use quantum-safe algorithms

Related activities to update or create new RFCs are ongoing at the IETF

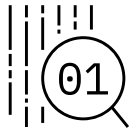


Migration

The migration to Quantum-safe affects the entire IT estate:

- Software development
- Vendor products
- Software as a service
- Infrastructure, network, devices, etc.

and needs new capabilities such as cryptographic discovery & cryptographic agility



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Customer value & what to do next

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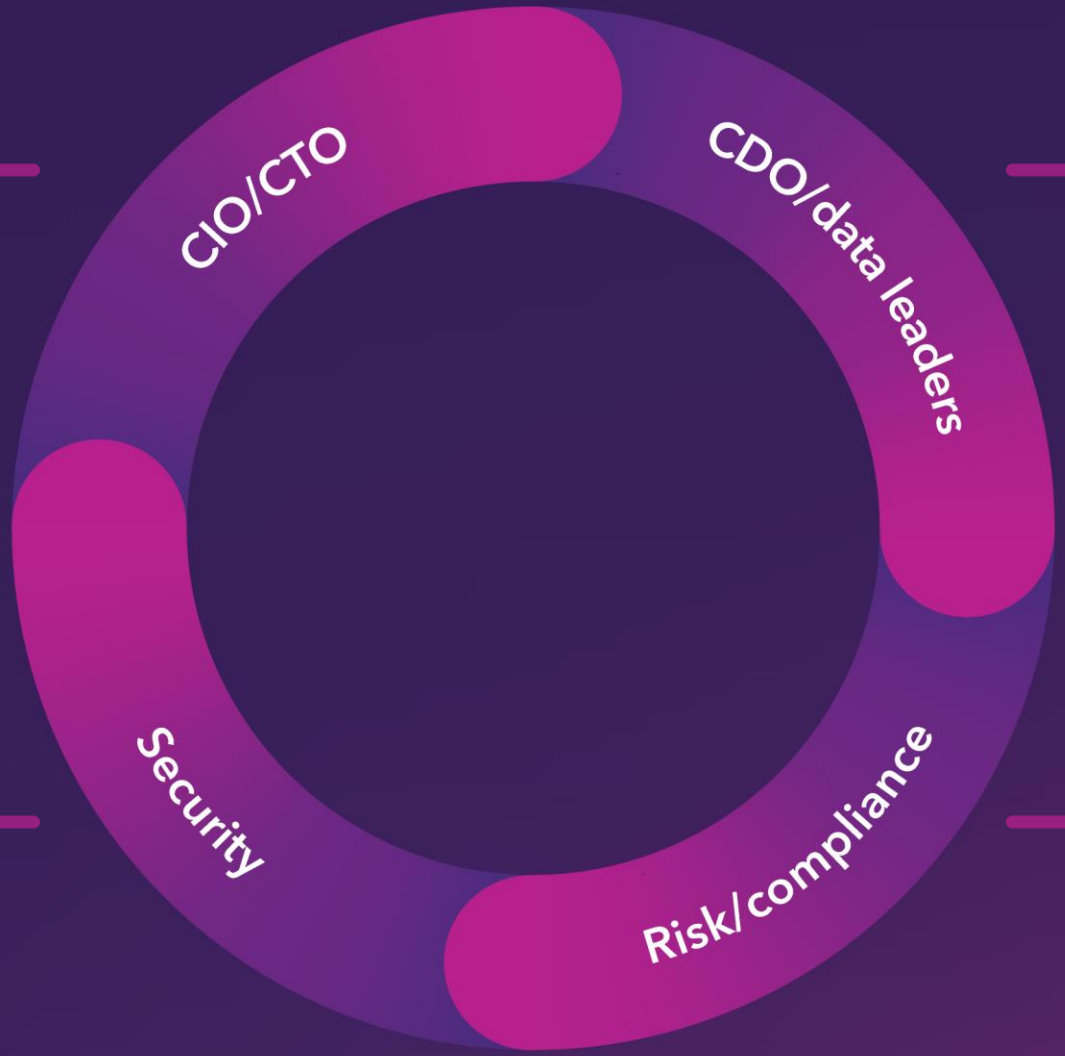
Who should care now

Architecture and capability planning

Data foundations, modelling pipeline

Crypto readiness and long-term posture

Governance + audit + scenario depth



What leaders should do now

1. Identify decisions bottlenecked by complexity
2. Build AI-ready foundations (data, platforms, governance)
3. Create a quantum-ready roadmap (skills, partners, crypto plan)

Softcat's roles

The big idea

The big idea

AI shapes decisions today

Quantum expands which decisions are possible tomorrow

Your job now: prepare foundations so you can move when it matters

Which decisions feel impossible today?

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Thank you