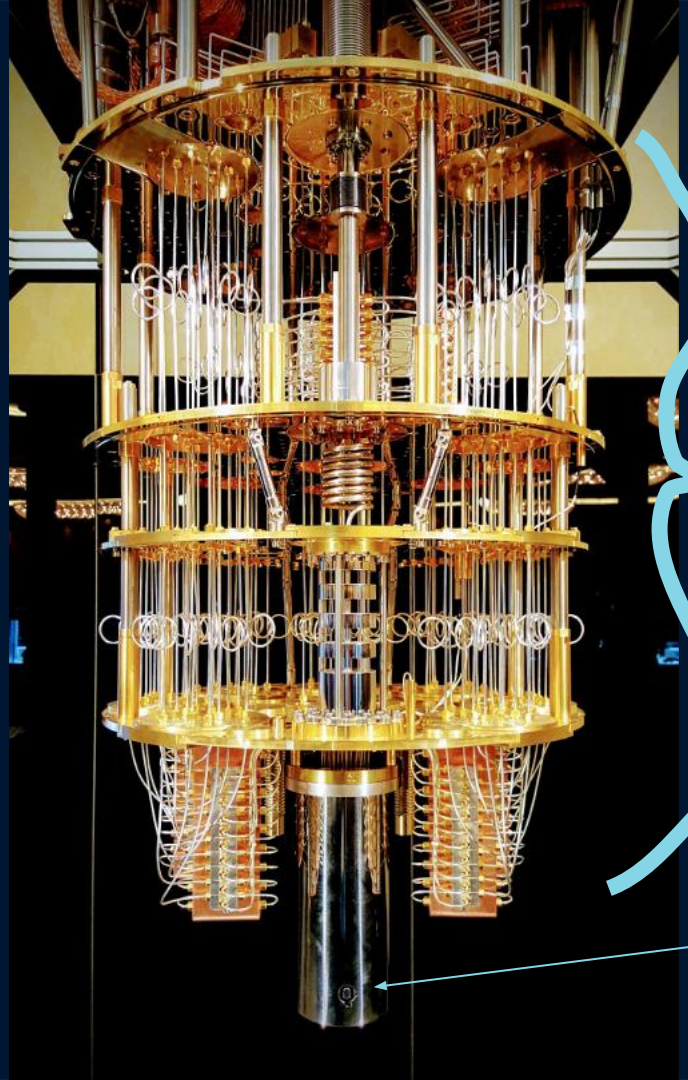
Quantum Computing

How does it work, how will it affect us and when?

John Fletcher, Staff Engineer
Lorenzo Petricone, IT-Consultant

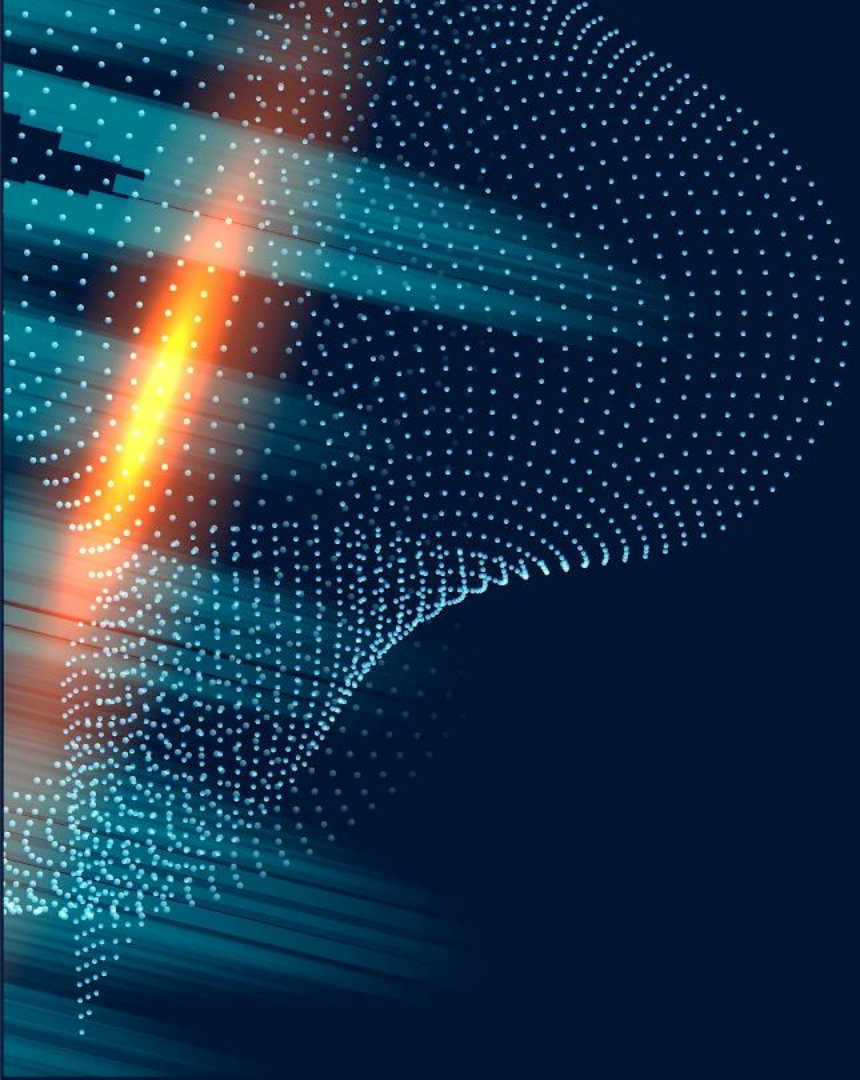
codecentric

2025 was the International Year of Quantum Science and Technology



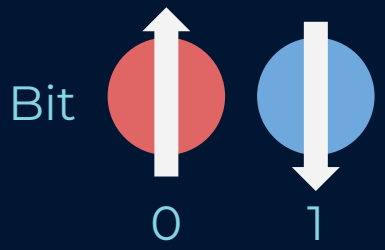
Cooling

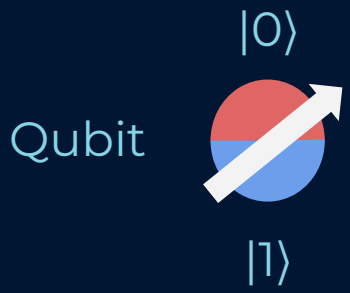
QPU



Wie?

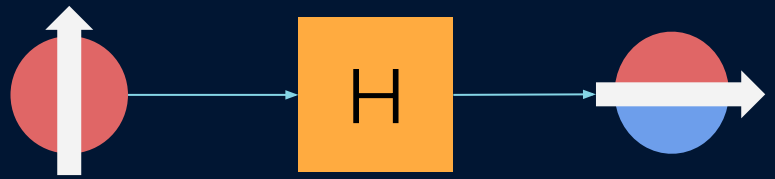
Quantum 101 - Superposition





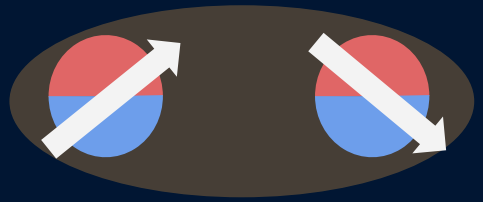
$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$

Quantum 101 - Gates



Quantum 101 - Verschränkung

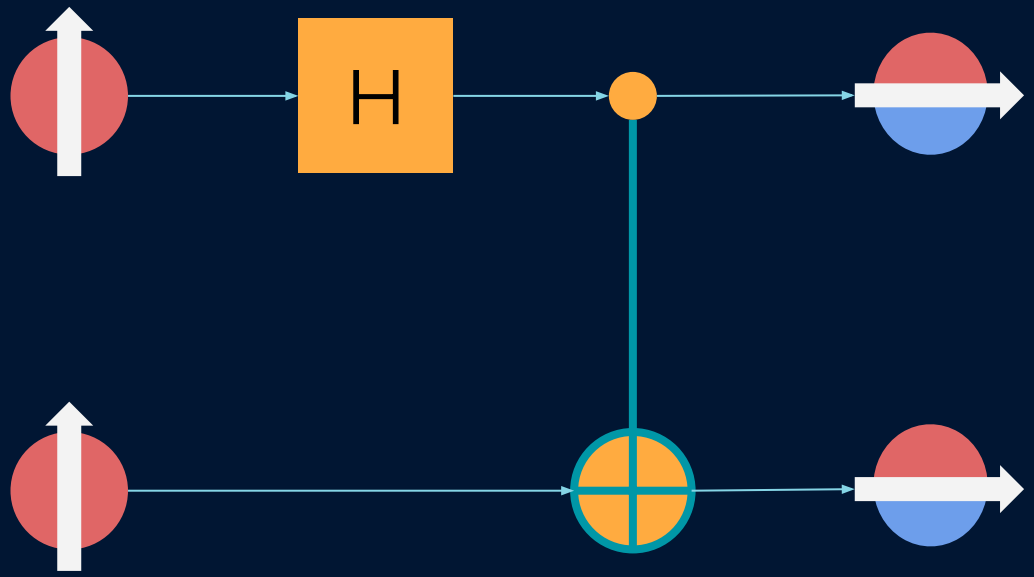
Qubit



$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$

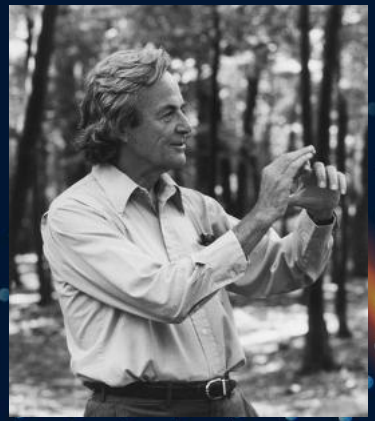
$$|\psi\rangle = \alpha_{00}|00\rangle + \alpha_{01}|01\rangle + \alpha_{10}|10\rangle + \alpha_{11}|11\rangle$$

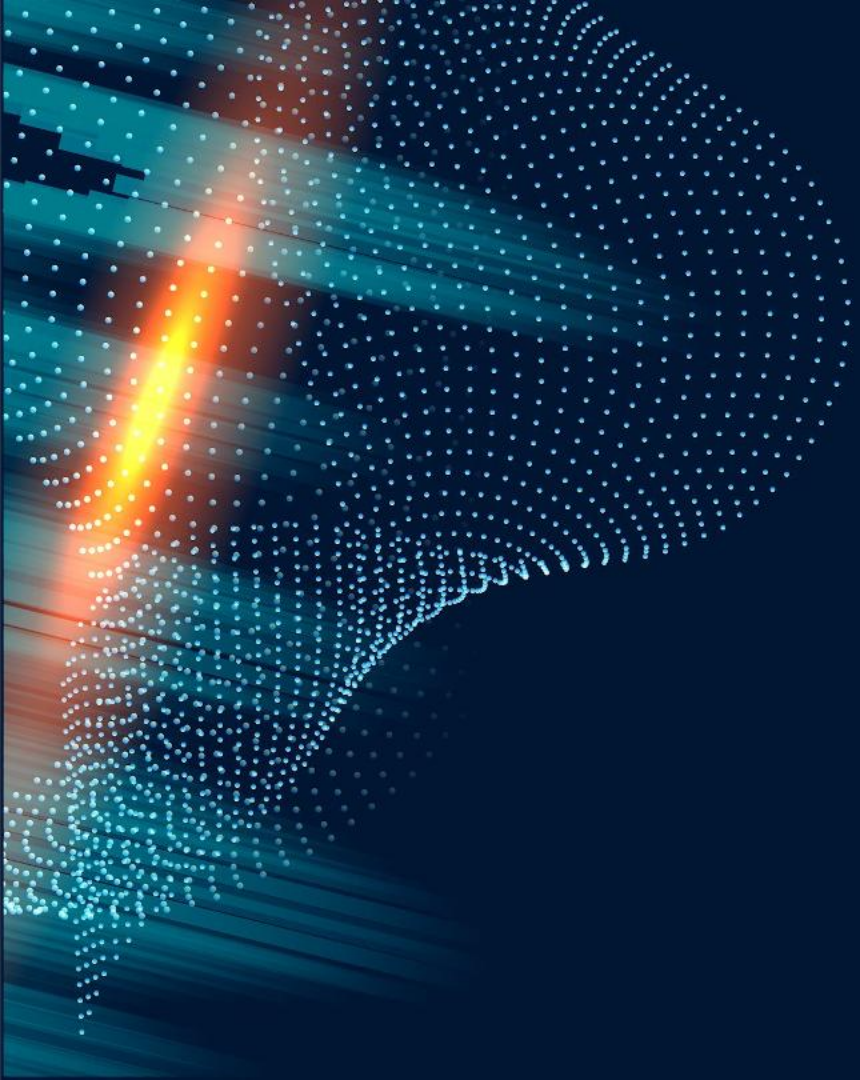
Quantum 101 - Circuit



“I think I can safely say that nobody understands quantum mechanics.

Richard Feynman

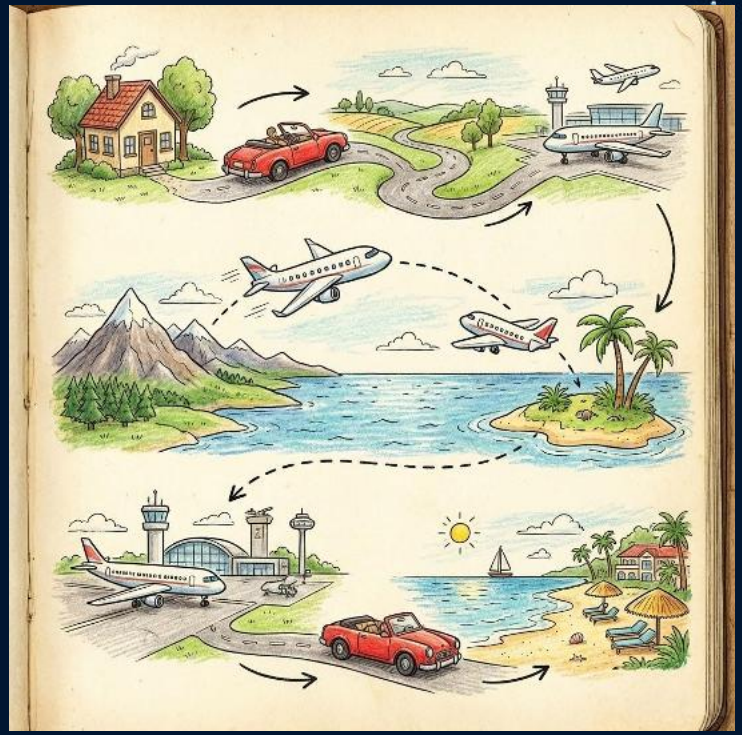




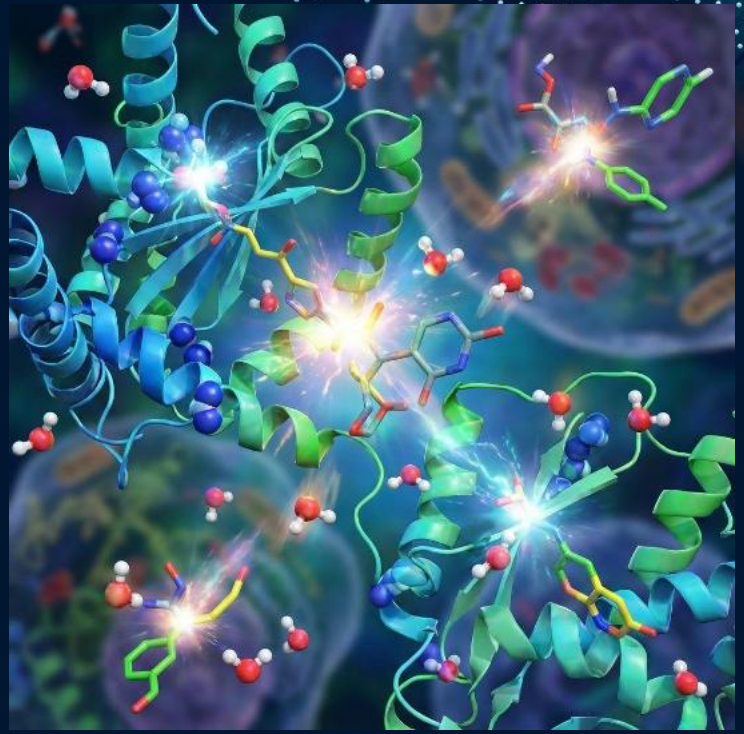
Wofür?

Wofür nicht?

Nur noch Quantencomputer?



Optimierung und Simulation



Riedbahn Sanierung

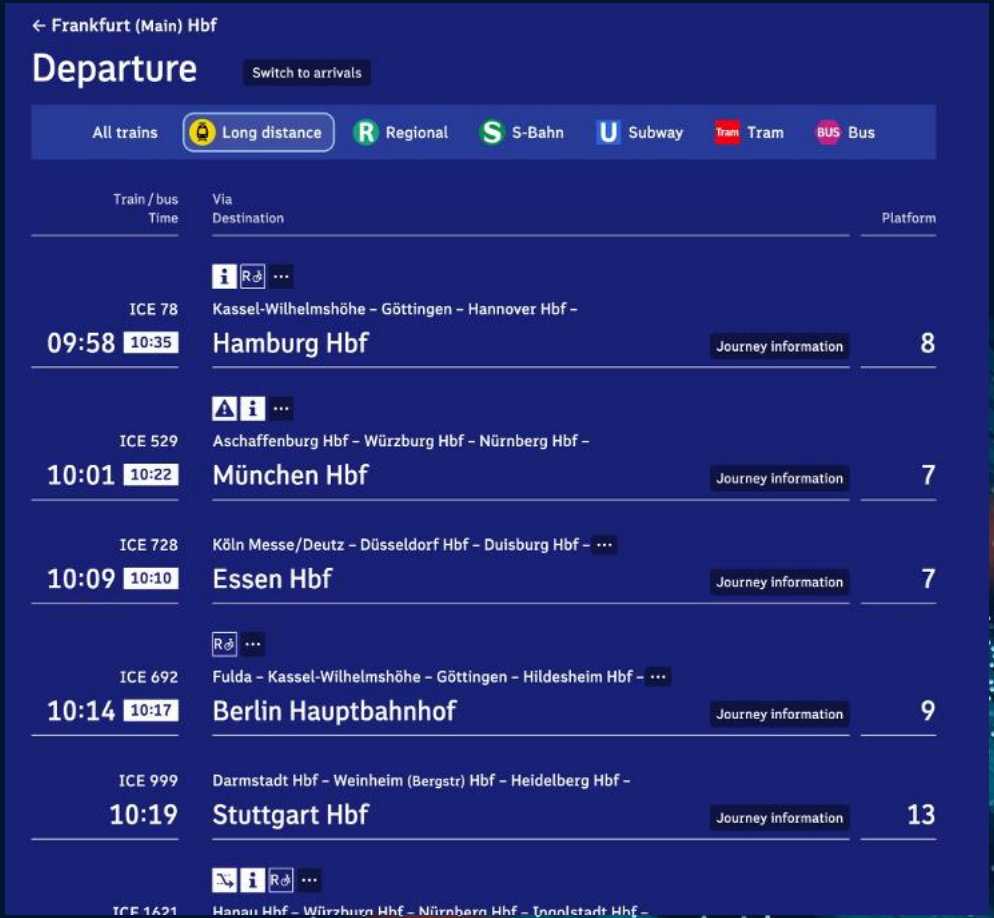
“Es gibt einige hochbelastete und störungsanfällige Korridore. Dort entstehen Verspätungen, die sich auf das gesamte Netz auswirken.”

- Deutsche Bahn

Zugscheduling

“Verspätung eines vorausfahrenden Zuges”

https://www.bahnhof.de/en/frankfurt-main-hbf/departure?transport=long-distance



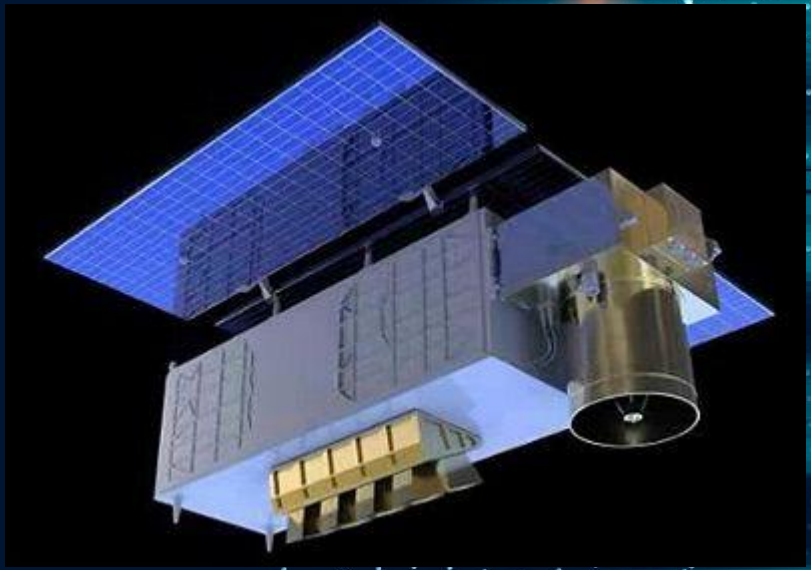
Kommunikation - Cyber Security

Quantum in Space

19 March 2025, *Nature*

Chinese Researchers have broken a distance record in quantum communication by sending a secret encryption key nearly 13,000 km from China to South Africa, using a cheap, lightweight ‘microsatellite’.

Li, Y. et al., Nature https://doi.org/10.1038/s41586-025-08739-z, 2025



Krebs, Gunter D., “Jinan 1 (Diguidao Lianzi Miyao Fenfao)”, Gunter’s Space Page, 2025

Globales Interesse

QuEra

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Opinion

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Quantum Computing and National Security: The Pentagon's Race Against Time

June 06, 2025

U.S. Commission On China Calls For 'Quantum First' National Goal By 2030, Recommends Significant Funding

National, Quantum Business, Research Matt Swayne • November 18, 2025

ASP

American Security Project

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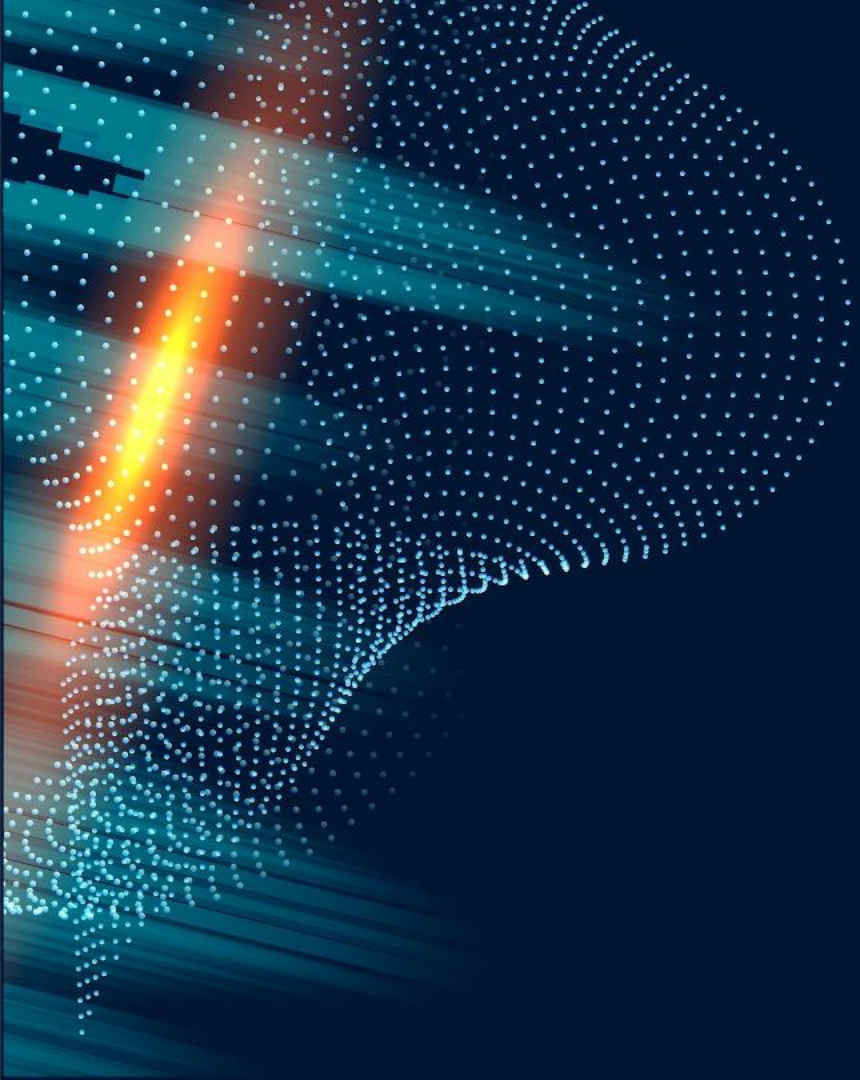
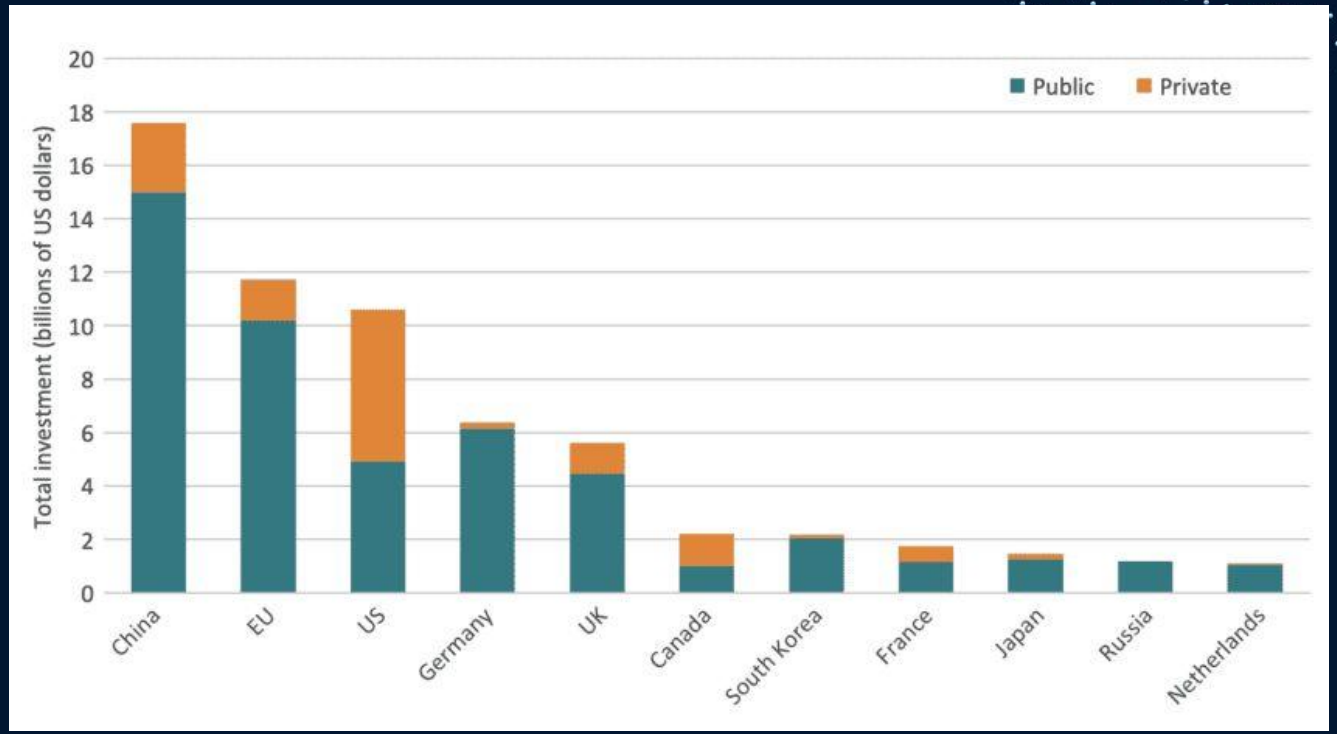
Posted By Morgan Nguyen on Oct 10, 2025



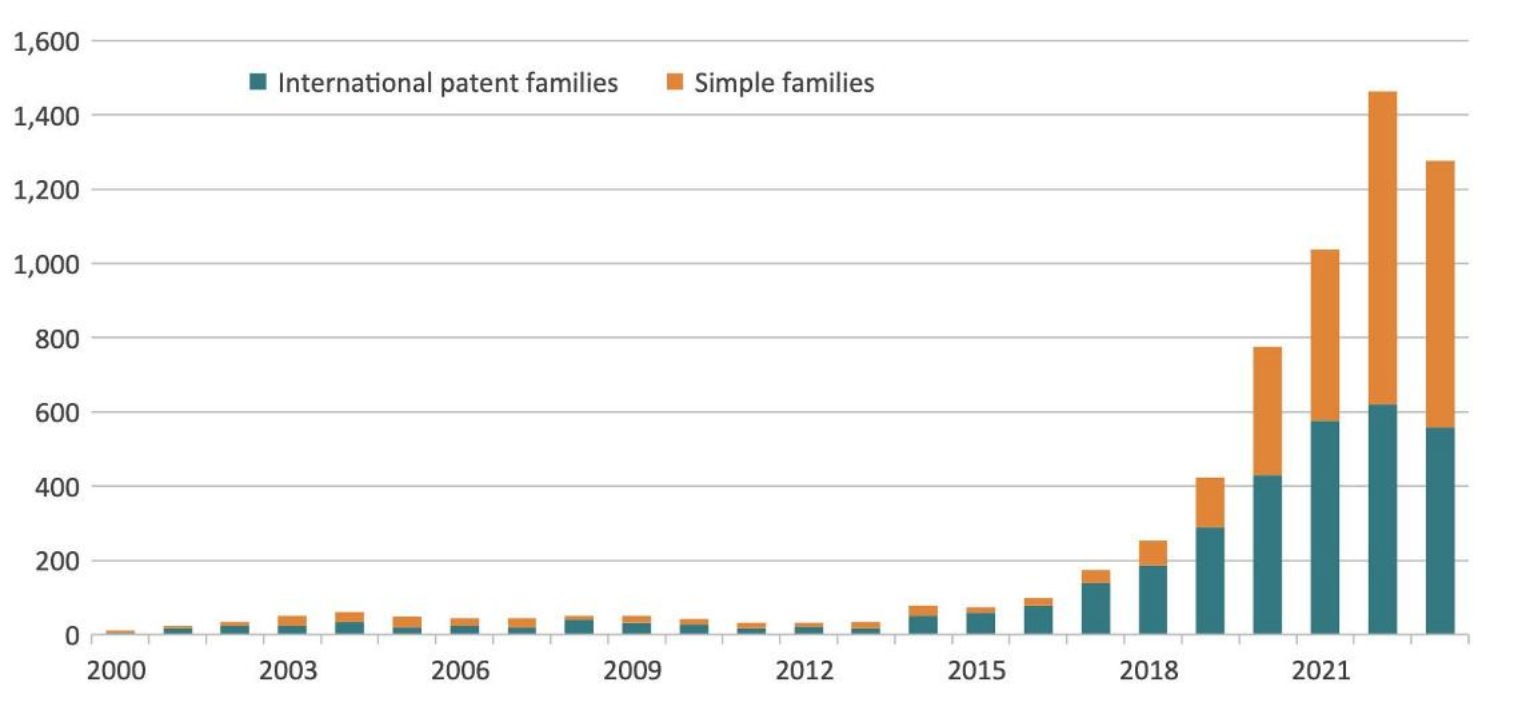
Wann?

Investitionen



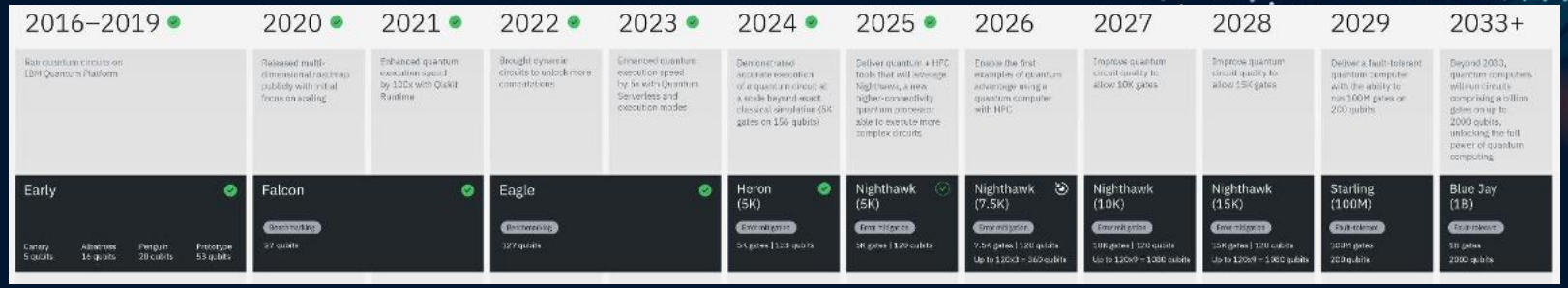
Erixon et al., “Benchmarking Quantum Technology Performance”, ECIPE, 2025

Patente



Erixon et al., “Benchmarking Quantum Technology Performance”, ECIPE, 2025

Wann und warum noch nicht?



Mandelbaum, “Scaling for quantum advantage and beyond”, IBM, 2025

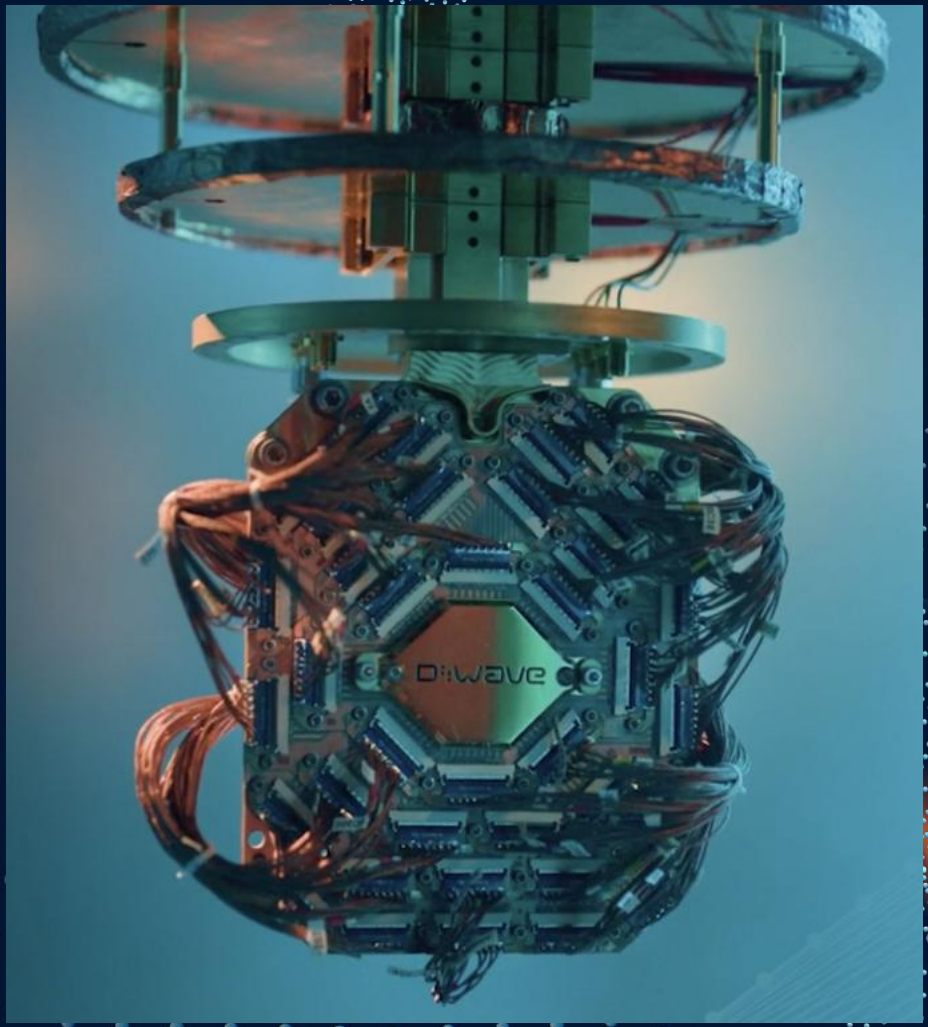
2024	2025	2026	2027	2028	2029	2030
					Commercial Quantum Computers	Commercial Quantum Computers
36+ Physical Qubits	**64-100+** Physical Qubits	**100-256+** Physical Qubits	**10,000** Physical Qubits	**20,000** Physical Qubits	**200,000** Physical Qubits	**2,000,000** Physical Qubits
99.96% Physical Qubit Fidelity	**99.99%** Physical Qubit Fidelity	**99.99%** Physical Qubit Fidelity	**99.99%** Physical Qubit Fidelity	**99.99%** Physical Qubit Fidelity	**99.99%** Physical Qubit Fidelity	**99.99%** Physical Qubit Fidelity
		12 Logical Qubits	**800** Logical Qubits	**1,600** Logical Qubits	**8,000** Logical Qubits	**80,000** Logical Qubits

“IonQ's Accelerated Roadmap: Turning Quantum Ambition into Reality”,IonQ, 2025

2030

Quantum
Computing-Ansätze lösen
eine begrenzte Menge an
Problemen eindeutig besser

Quantum Computing wird heute verkauft



Cloud Quantum

1 free hour of simulation time per month with AWS Fr

Amazon Braket

Accelerate quantum computing research

IBM Quantum Platfo

Get access to IBM quantum computers, Qiskit documentation, and learning resources all in one place.

Azure Quantum

Experience the powerful synergy between Azure's high-performance computing, AI capabilities, and the transformative potential of quantum technologies, all designed to push the boundaries of innovation.

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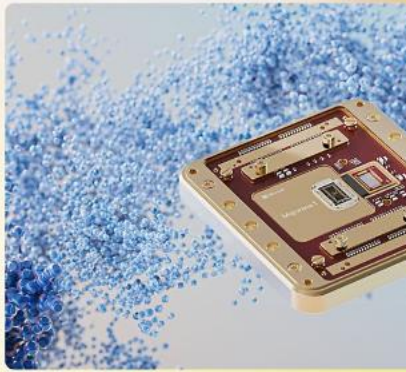
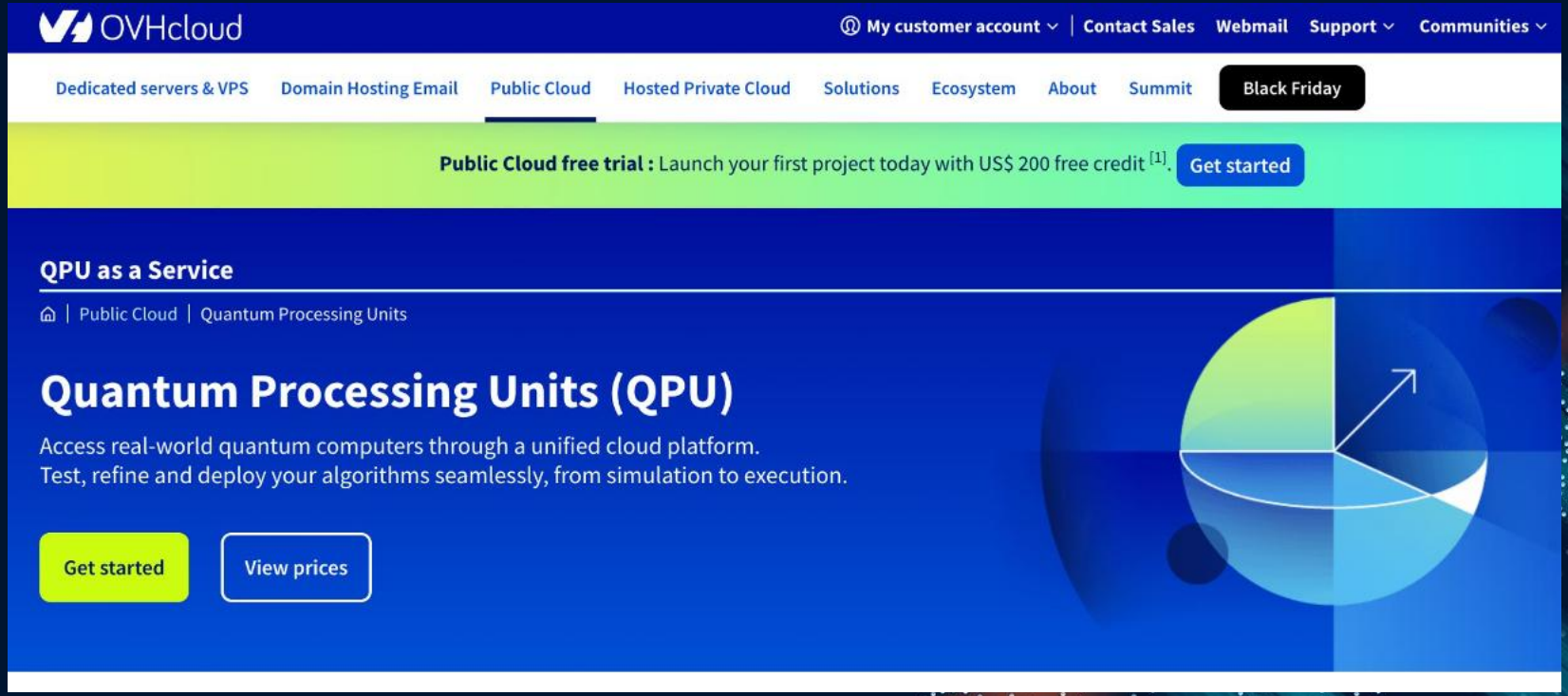
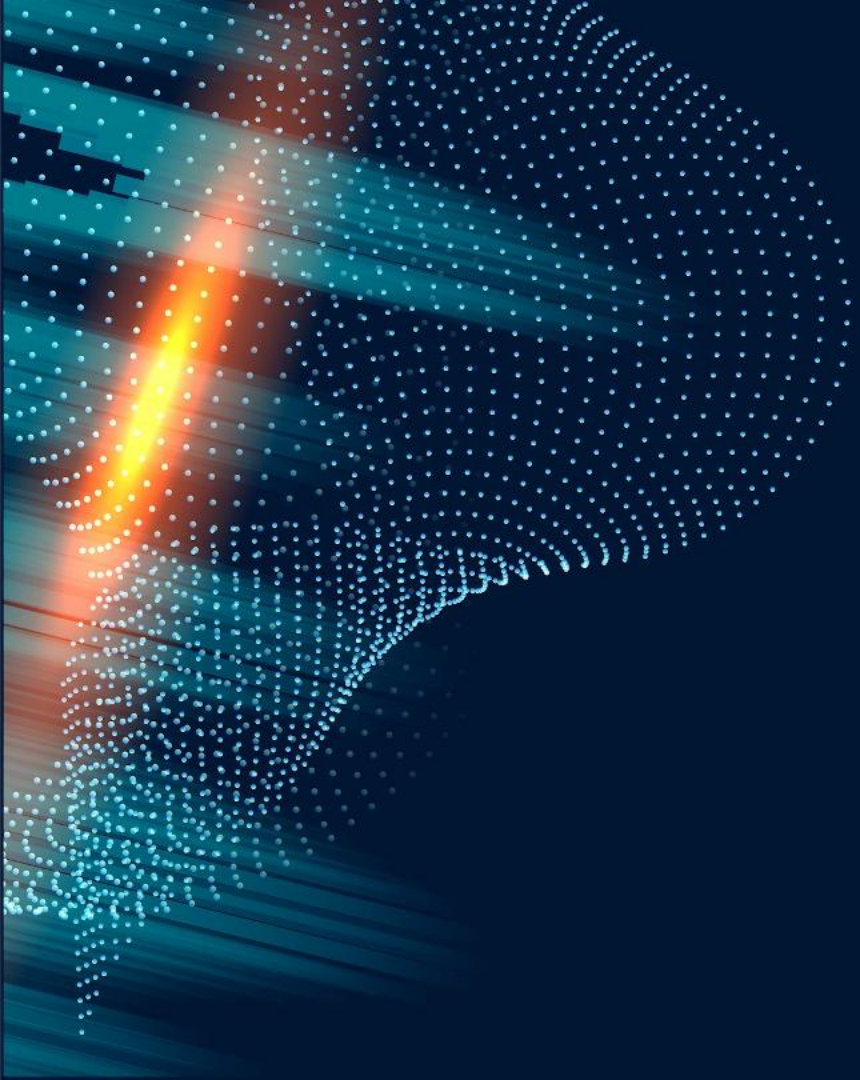


Sovereign Quantum Computing

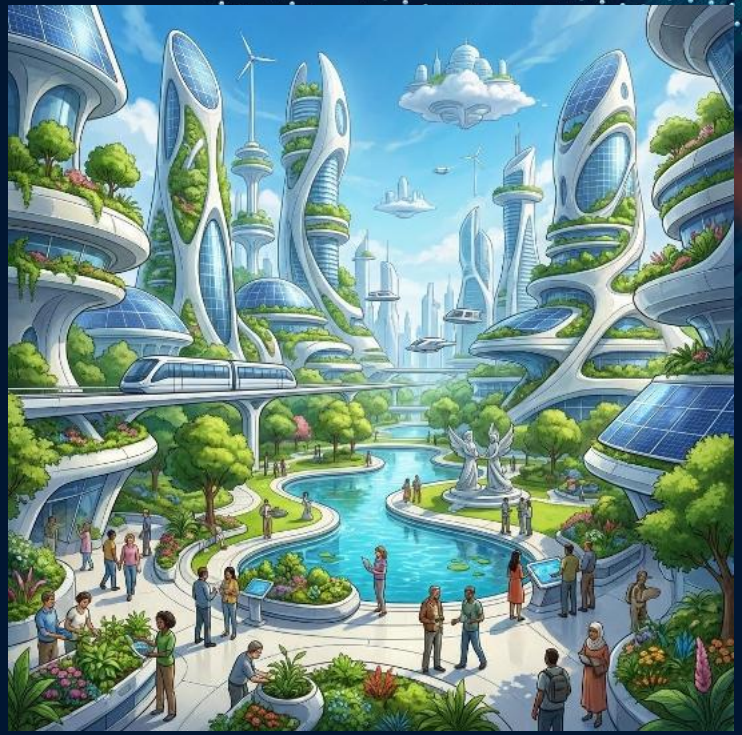




Einfluss

Gesellschaft

- Gesundheitsrevolution
- Energiewende
- Datensicherheit
- Arbeitsmarktverschiebung
- Effizienzsteigerung



Unternehmen

- Nicht für alle relevant, eher für mittel bis große Unternehmen
- Wettbewerbsvorteil?
- Simulation
- Optimierung

Informatiker

- Post-Quantum-Cryptography - Heute
- Andere Denkweise für Problemstellungen - Nächsten Jahren
- Spezialisierung - Jederzeit

Die ultimative Anwendung ;)

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Staff Engineer

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Bewertung

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