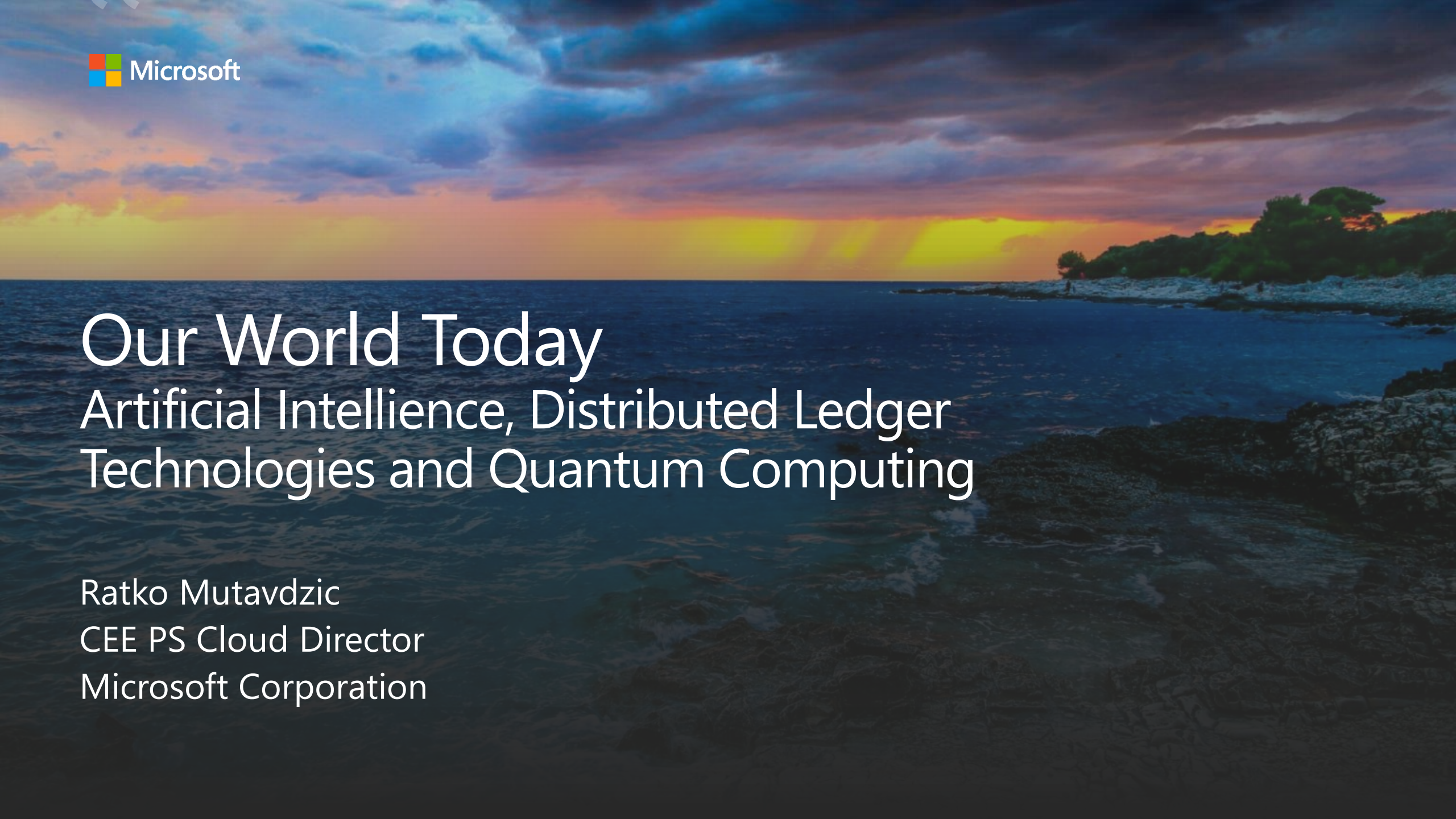
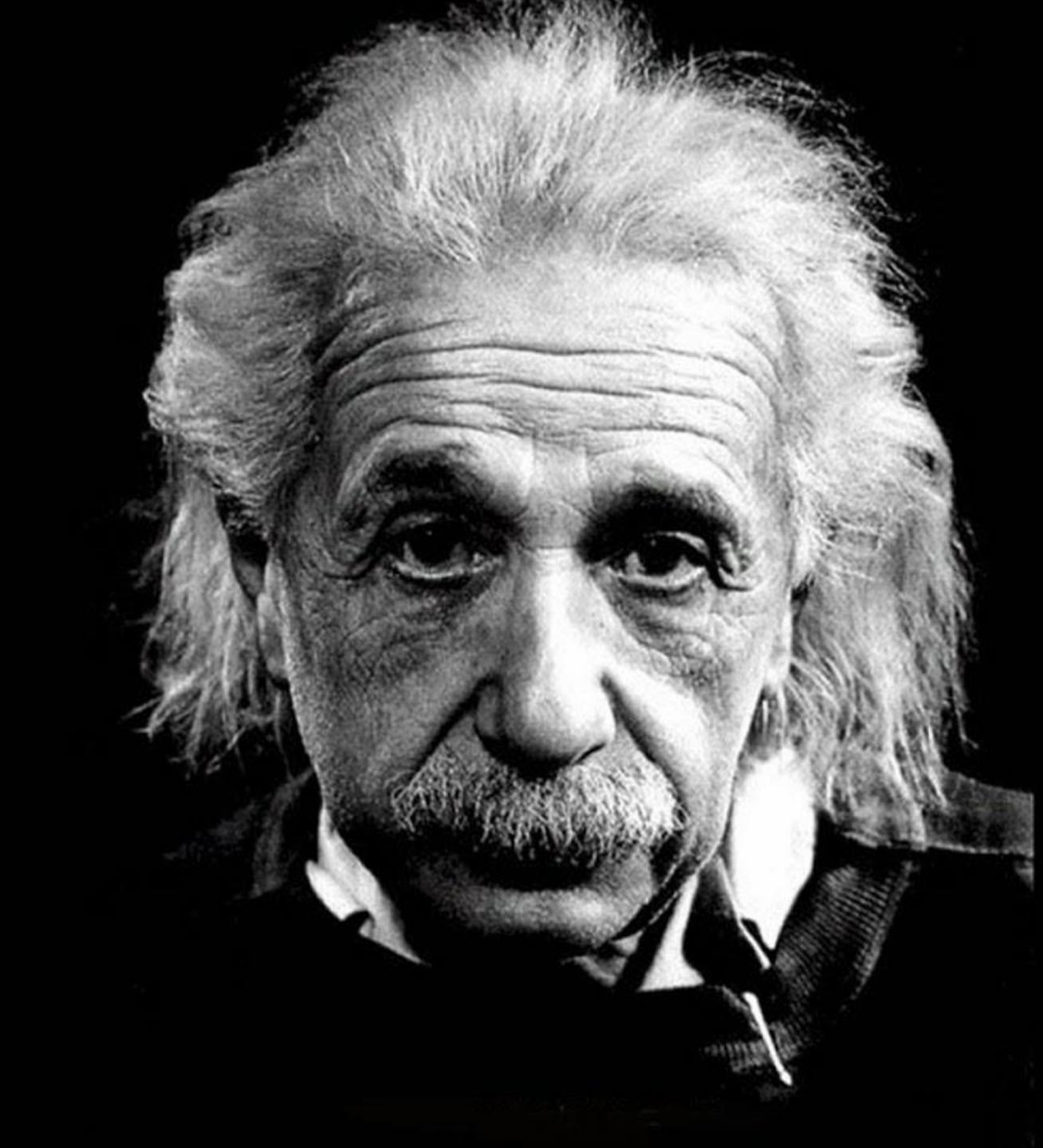


Microsoft

Our World Today

Artificial Intellience, Distributed Ledger Technologies and Quantum Computing

Ratko Mutavdzic
CEE PS Cloud Director
Microsoft Corporation



Microsoft

Solving the problems we haven’t see yet.

„If I had an hour to solve a problem I’d spend 55 minutes thinking about the problem and 5 minutes thinking about solutions.”

- Albert Einstein

Microsoft

Problem 1:
Limits of Humankind

How can we augment human capacity to do “more” in this new era of computing?

As thinking machines, human beings do have some limitations.

The Man who started the Revolution

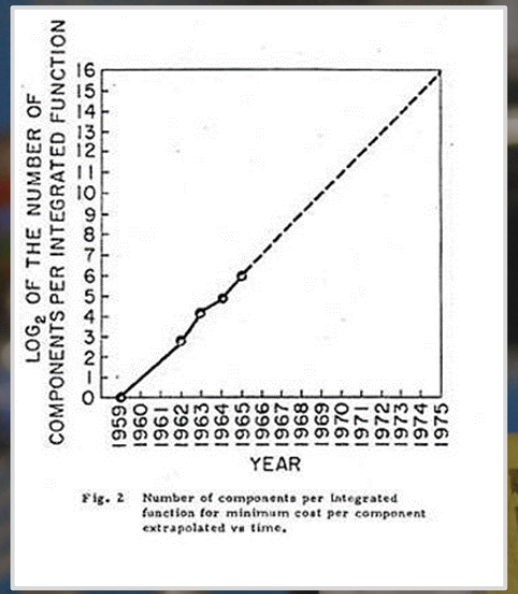
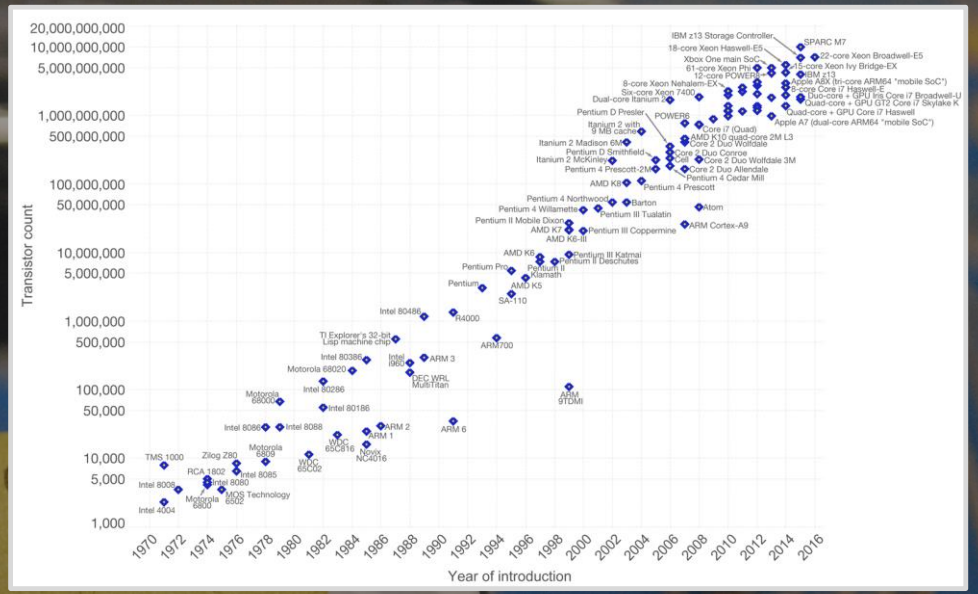
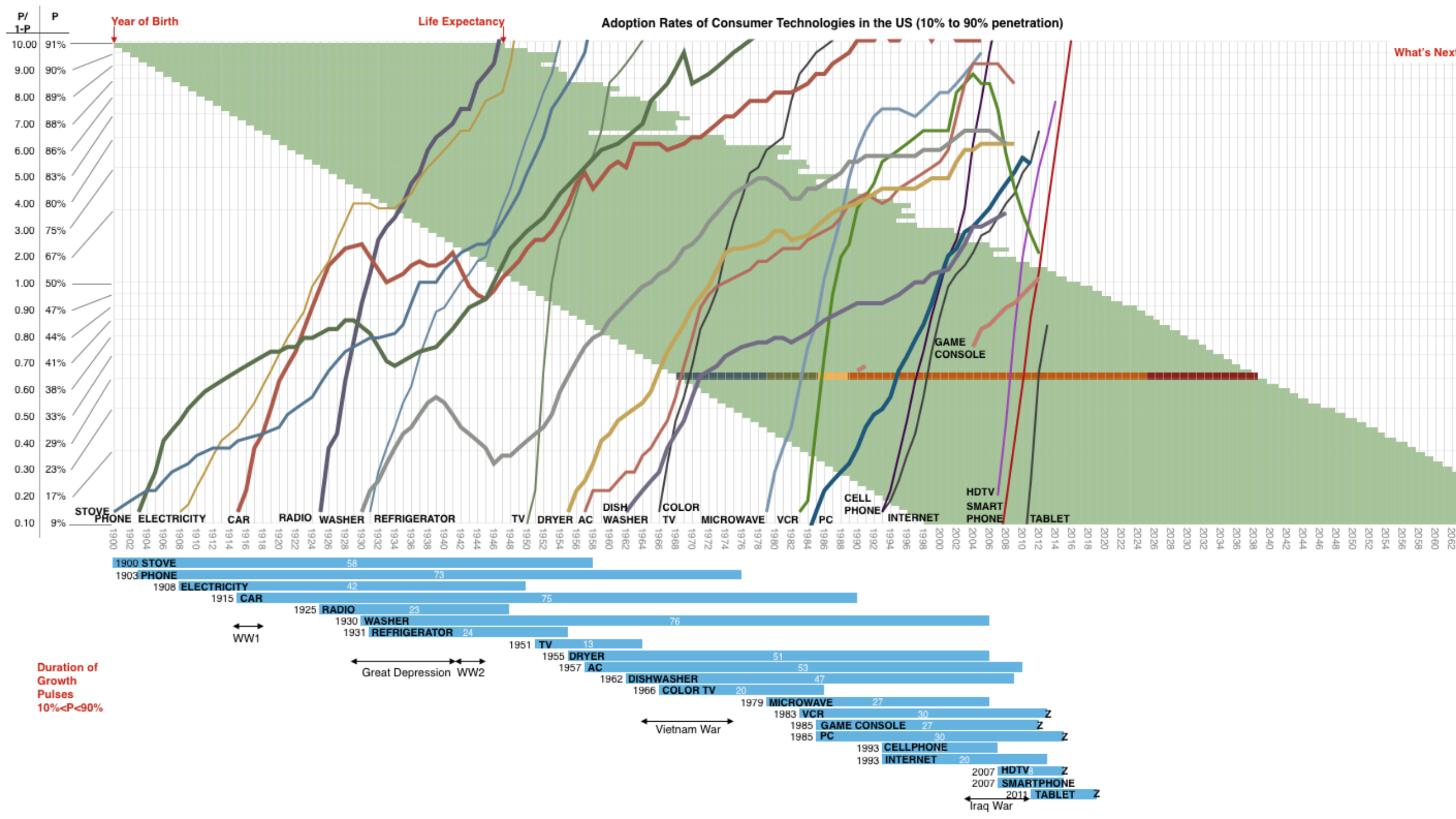


Fig. 2 Number of components per integrated function for minimum cost per component extrapolated vs time.



George Moore, known for **Moore's Law**

- „the observation that the number of transistors on integrated circuits doubles approximately every two years"
- the law was described as early as **1965** by the Intel co-founder Gordon E. Moore after whom it is name: "There is no reason to believe it will not remain nearly constant for at least 10 years".
- He was not only right about the next ten years but astonishingly the regularity he found is true for more than half a century now.

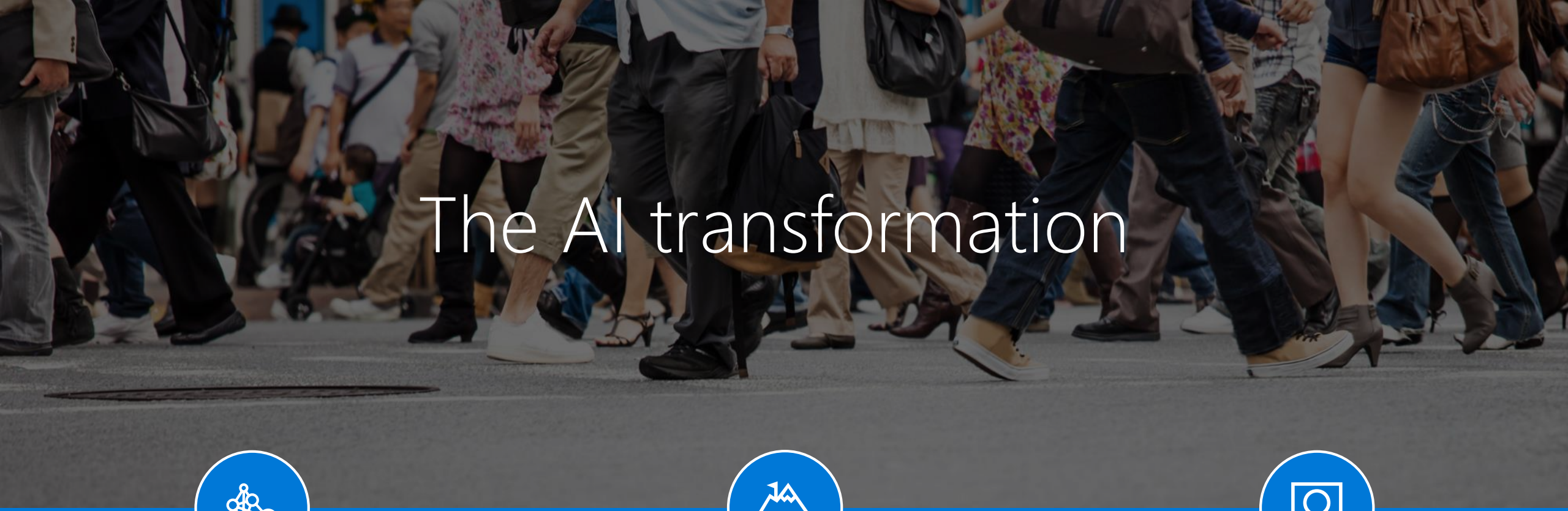

Adoption Rates of Consumer Technologies in the US (10% to 90% penetration)
Year of Birth
Life Expectancy
What's Next
P/ 1-P
P
10.00 91%
9.00 90%
8.00 89%
7.00 88%
6.00 86%
5.00 83%
4.00 80%
3.00 75%
2.00 67%
1.00 50%
0.90 47%
0.80 44%
0.70 41%
0.60 38%
0.50 33%
0.40 29%
0.30 23%
0.20 17%
0.10 9%
STOVE
PHONE
ELECTRICITY
CAR
RADIO
WASHER
REFRIGERATOR
TV
DRYER
AC
DISH WASHER
COLOR TV
MICROWAVE
VCR
PC
CELL PHONE
INTERNET
GAME CONSOLE
HDTV
SMART PHONE
TABLET
1900 STOVE 58
1903 PHONE 73
1908 ELECTRICITY 42
1915 CAR 75
1925 RADIO 23
1930 WASHER 76
1931 REFRIGERATOR 24
WW1
1951 TV 13
1955 DRYER 51
1957 AC 53
Great Depression
WW2
1962 DISHWASHER 47
1966 COLOR TV 20
1979 MICROWAVE 27
1983 VCR 30 Z
1985 GAME CONSOLE 27 Z
1985 PC 30 Z
Vietnam War
1993 CELLPHONE
1993 INTERNET 20
2007 HDTV 8 Z
2007 SMARTPHONE
2011 TABLET Z
Iraq War
Duration of Growth Pulses 10%<P<90%

Why Now?

Big Data
We are generating data in exa, soo to generate zettabytes

Computing in Cloud
cloud computing democratized
massive scale computing

Powerful Algorithms
algorithms that utilizing infinite compute power



The AI transformation

Digital Agents

Transform your engagement with customers and employees

Intelligent Apps

Leverage AI to create the future business applications

Business Processes

Transform critical business processes with AI

Source: Forrester, IDC

Current State of A.I.

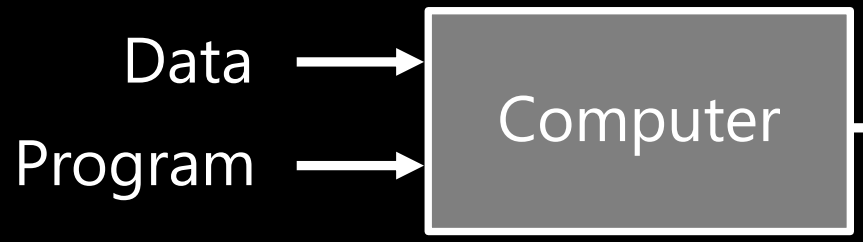
Artificial General Intelligence

Hi, I'm Cortana.

Artificial Narrow Intelligence

How computers learn?

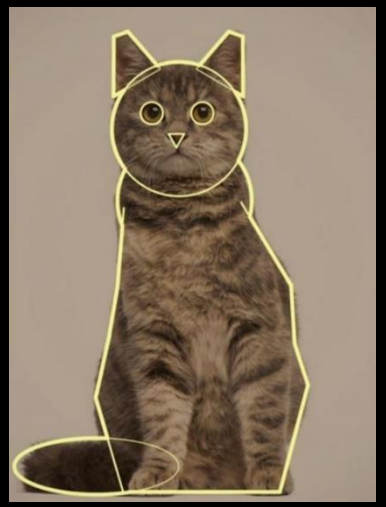
Traditional Programming



2+3=5 EASY!

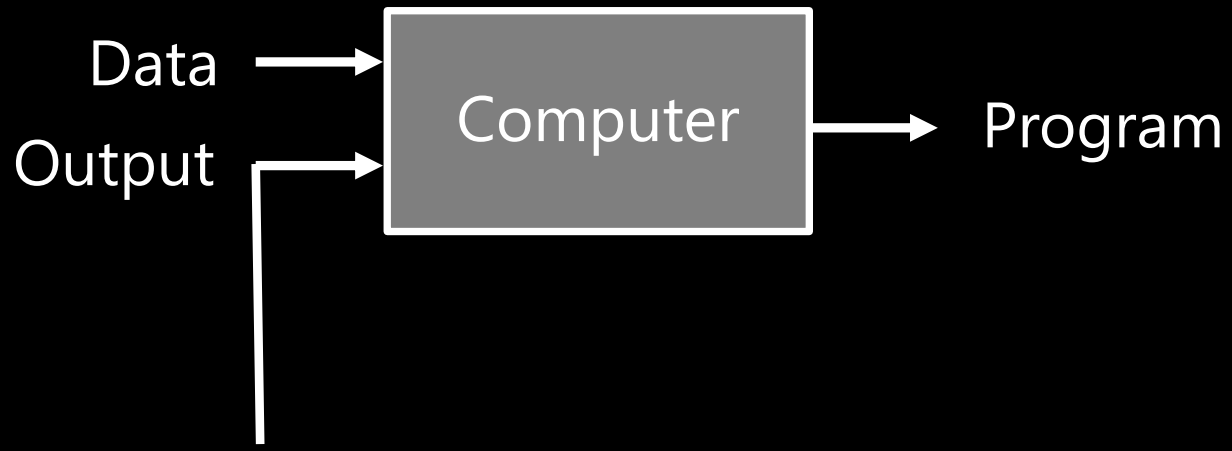
NOT EASY!

VERY DIFFICULT!

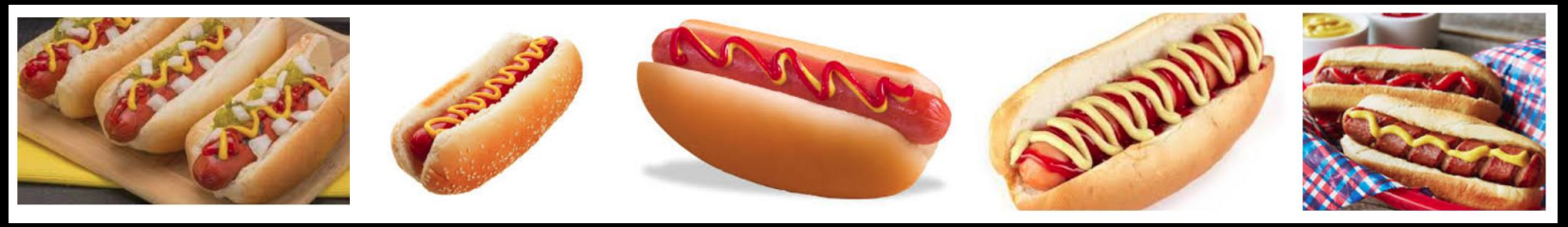


How computers learn?

Machine Learning



For Each Photo... Hotdog? Yes/No



How computers learn?

Traditional Programming

- Program written by humans
- Specific to defined task
- Algorithm is “fixed”
- Algorithm “easy” to describe

Machine Learning

- Program written by software
- Goal: ability to generalize
- Algorithm depends on training data
- Algorithm can “morph” over time

Cognitive Services

Adding „Smart" to your Apps:

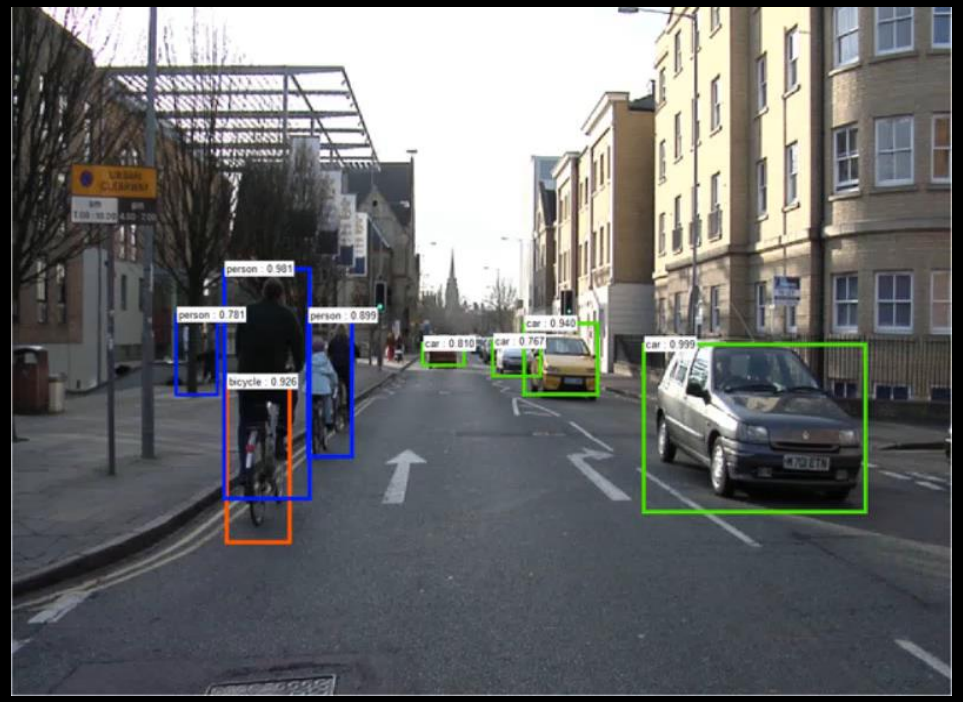
- Image Stabilization, Image Analysis
- Real Time Object Recognition
- Language Understanding
- Text Recognition, Face Recognition

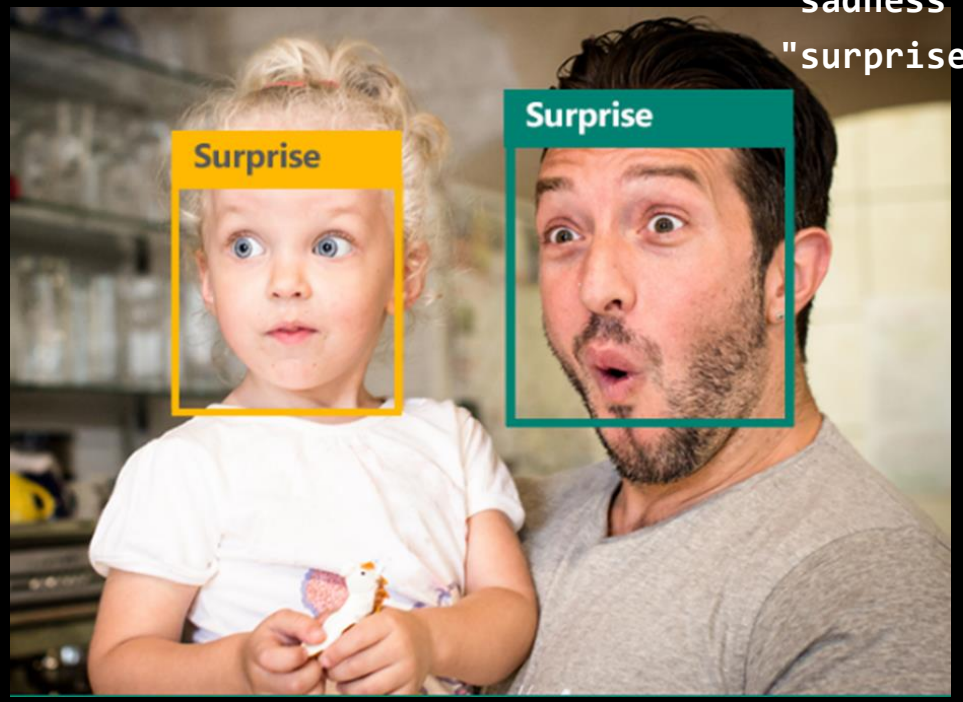
Face Detection

```
"faceRectangle": {"width": 193,
                  "height": 193,
                  "left": 326,
                  "top": 204} ...
```

Emotion Scores

```
“scores": { "anger": 5.182241e-8,
            "contempt": 0.0000242813,
            "disgust": 5.621025e-7,
            "fear": 0.00115027453,
            "happiness": 1.06114619e-8,
            "neutral": 0.003540177,
            "sadness": 9.30888746e-7,
            "surprise": 0.9952837}
```

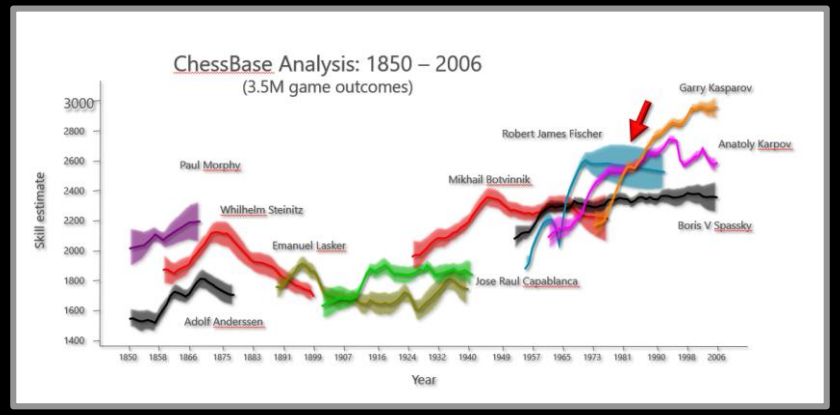


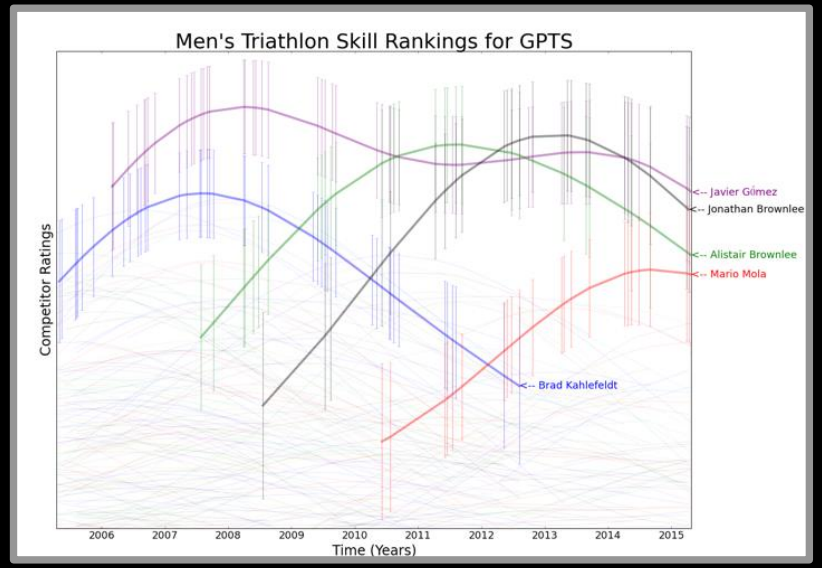


Machine Learning

Learning how to play: TrueSkill

- System for estimating **„Player Skills”:** Knowing the players' skills allows for scheduling an interesting balanced game
- Skill correlations
  - Leverage skill from one game/mode/platform to correlate skill in another
- Player performance characteristics
  - Kills, deaths, revives, headshots, etc.
- Beginner players
  - Skill dynamics while the player is learning fast
- Partial play
  - Players who quit or drop
- Does this work in a REAL LIFE?





Augmenting Reality

Example of „de-augmentation"

- Our writing abilities can be de-augmented as in „Augumenting Human Intellect: A Conceptual Framework", 1962, link, by Doug Engelbart
- Doug's message: a tool doesn't "just" make something easier — it allows for new, previously-impossible ways of thinking, of living, of being.

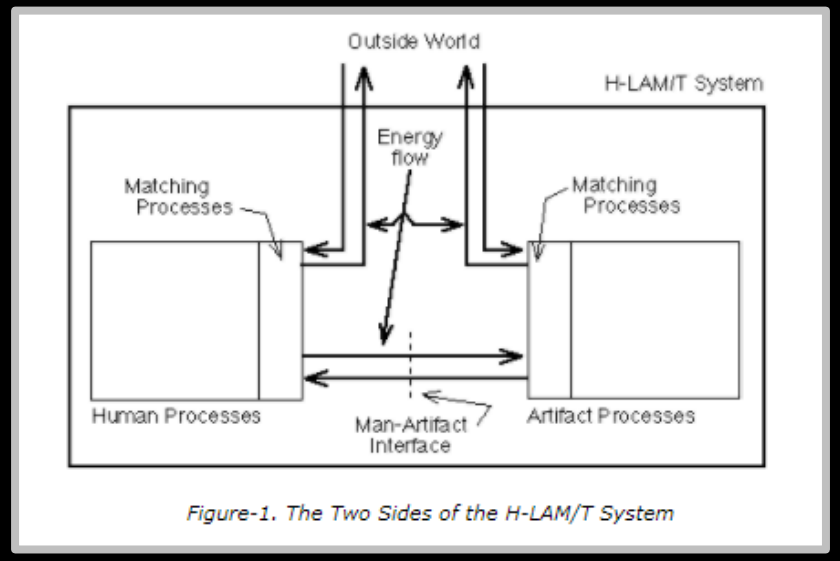
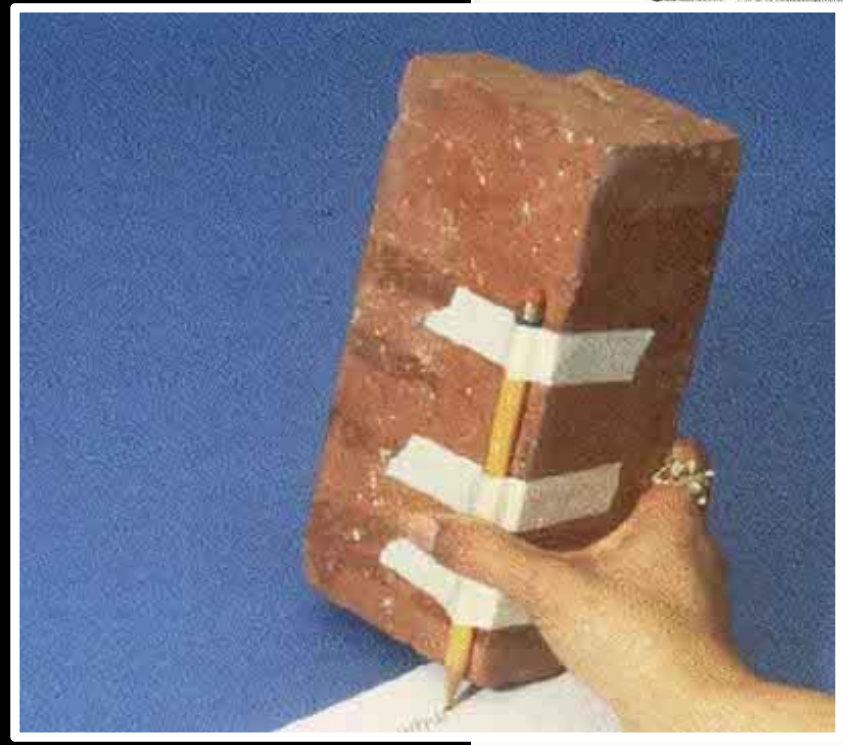


Figure-1. The Two Sides of the H-LAM/T System



Augmentation is fundamentally a matter of organization.
(typewriter, 7 seconds)

Augmentation is fundamentally a matter of organization. (cursive script, 20 seconds).

Augmentation is fundamentally a matter of organization. ("de-augmented" cursive script, 65 seconds).

Augmentation

Fundamentally

matter of

ve script, large size--42 seconds to complete whole
on separate sheet)].

Fig. 2
esults of Tying a Brick to a Pencil
e-Augment" the Individual

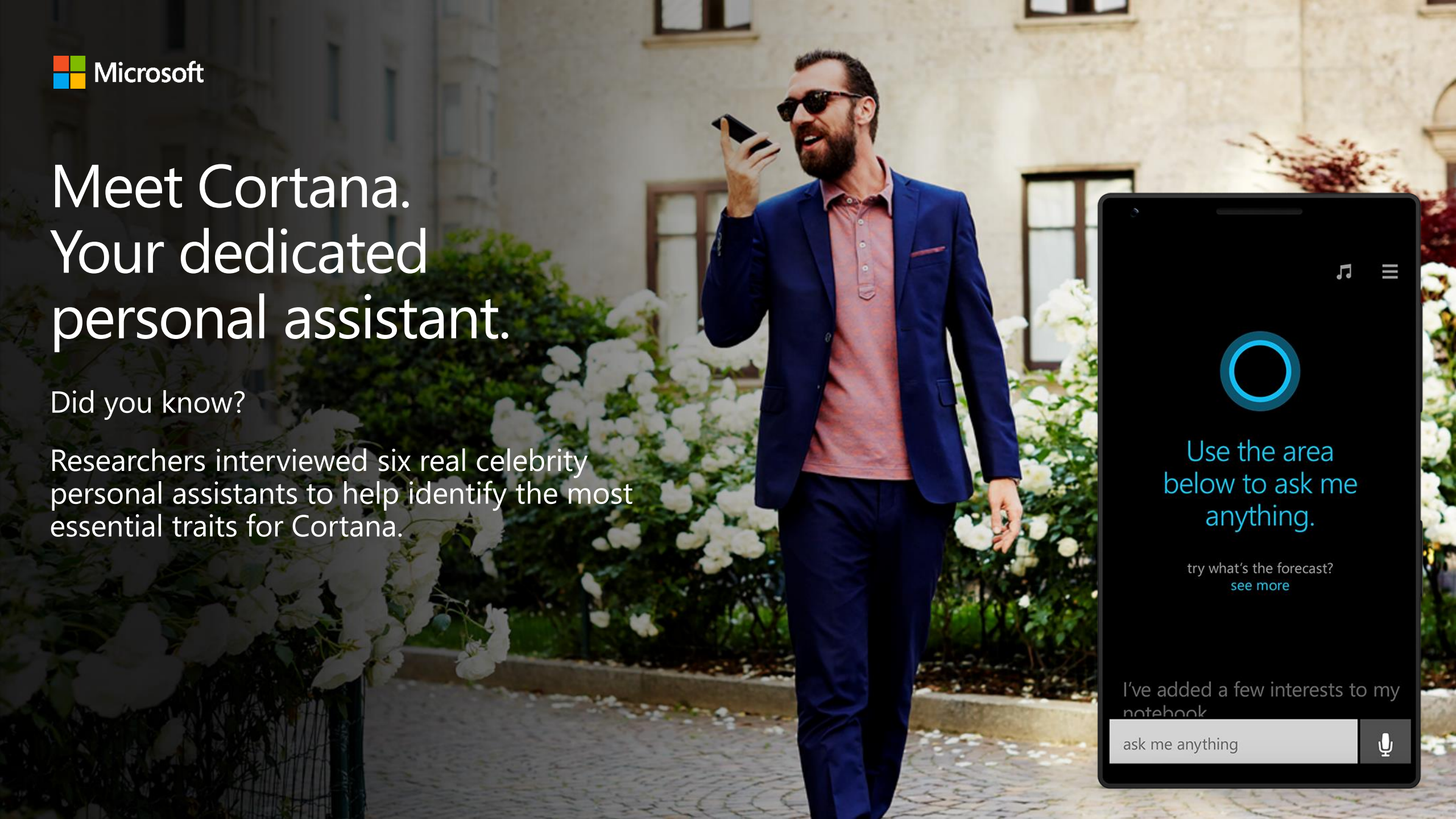
27

Microsoft

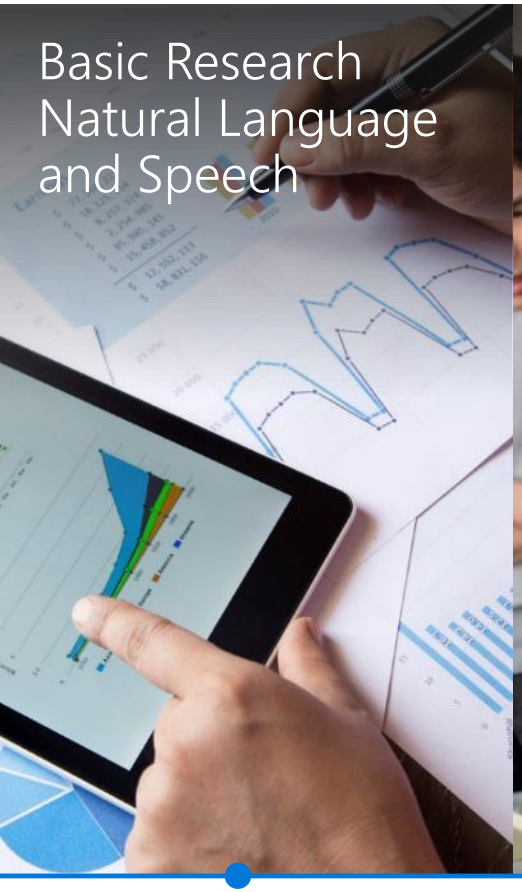
Meet Cortana. Your dedicated personal assistant.

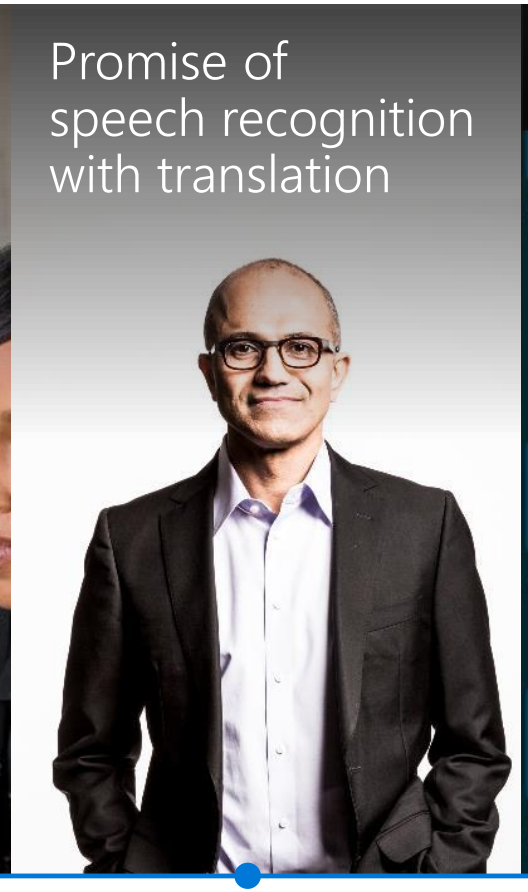
Did you know?

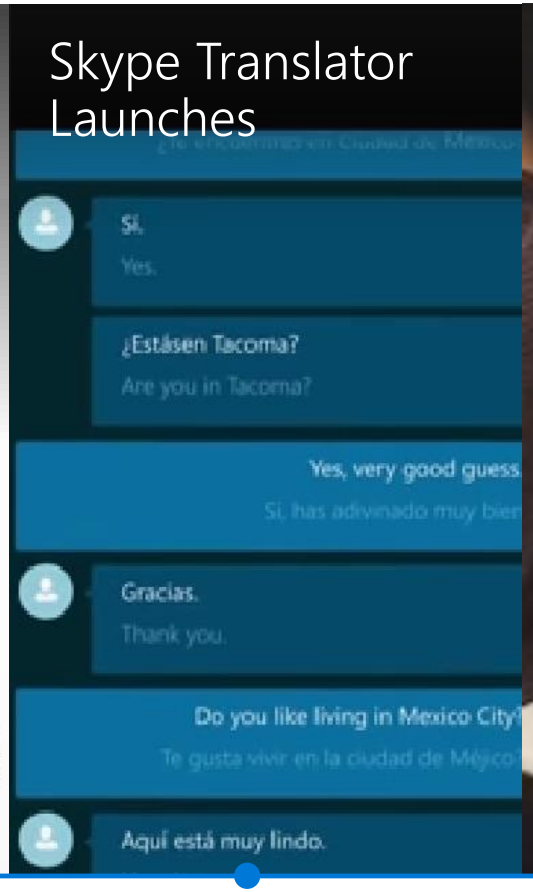
Researchers interviewed six real celebrity personal assistants to help identify the most essential traits for Cortana.

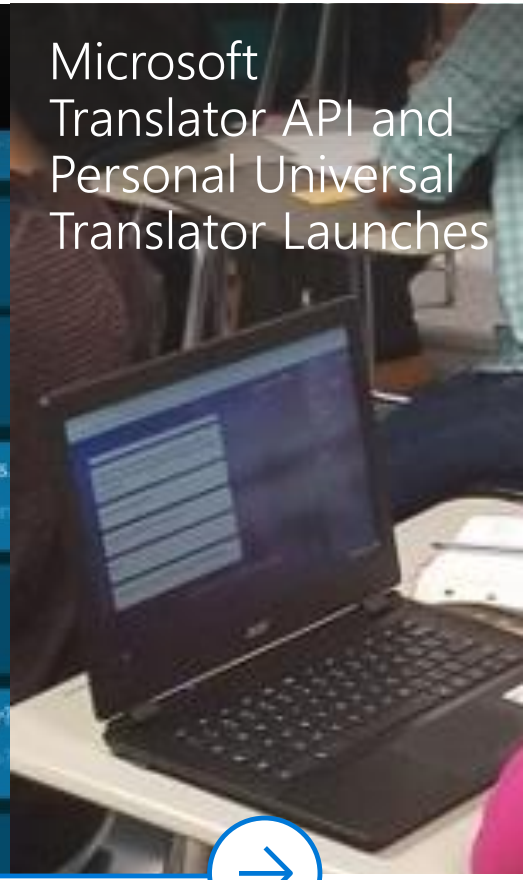


Invest in the long-term: Microsoft Translator









1991 2007 2014 2015 2016

Microsoft

Supercomputers in our hands.

The Apollo 11 computers, that led us to the Moon, had less processing power that a smartphone in your hands.

Microsoft AI Portfolio

People




Agent

Cortana

Applications

Office 365

Dynamics 365

SwiftKey

Pix

Customer Service and Support

Services

Bot Framework

Cognitive Services

Cortana Intelligence

Cognitive Toolkit

Infrastructure

Azure Machine Learning

Azure N Series

FPGA

Cognitive Services

Vision

Language

Speech

Search

Knowledge

Computer vision
Face
Emotion
Content Moderator
Video

NEW
Video Indexer

NEW
Cognitive Services Labs

Text analytics
Spell check
Web language model
Linguistic analysis
Translator

Speaker recognition
Speech

Web search
Image search
Video search
News search
Autosuggest

Academic knowledge
Entity linking service
Knowledge exploration
Recommendations
QnA maker

NEW
Custom
Vision Service

Custom
Language Understanding

Custom
Speech Service

NEW
Custom
Search

NEW
Custom
Decision Service

General Artificial Intelligence

The AI/GI Engine is a “general AI brain” that can optimize any system

- **Near-Term Goals**
  - The AI/GI Engine can represent knowledge, including commonsense knowledge
  - The AI/GI Engine can converse in natural language
  - The AI/GI Engine can learn on its own
- **Longer-Term Goals**
  - The AI/GI Engine can create and infer new knowledge through reasoning
  - The AI/GI Engine can generalize to new tasks through transfer learning
  - The AI/GI Engine can create a plan to achieve a goal

Should we trust Artificial Intelligence?

What will be AI capable of?

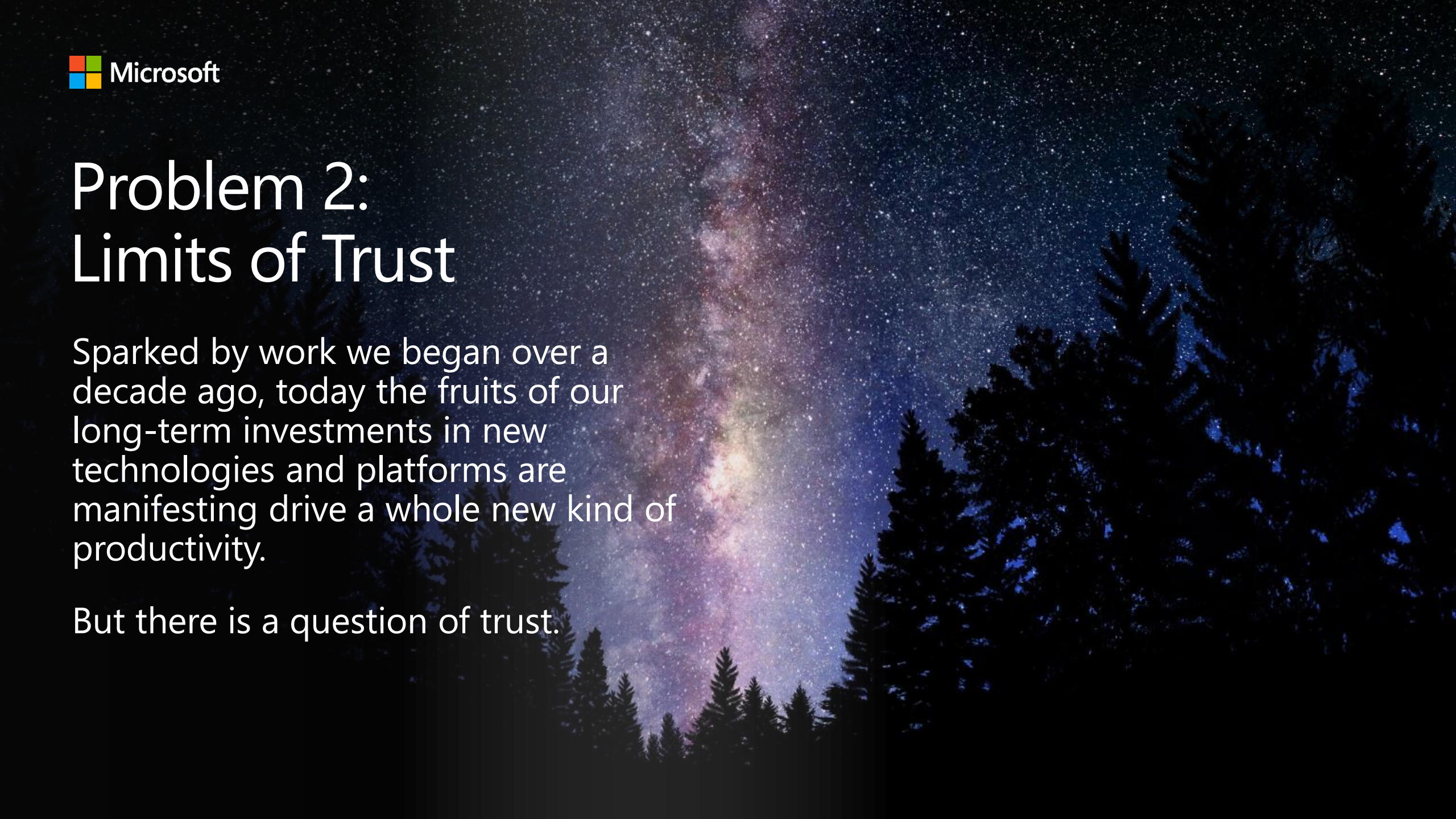
„A quantum computer is a machine that performs calculations based on the laws of quantum mechanics, which is the behavior of particles at the sub-atomic level."

Should we challenge what we have?

We are at the moment in time when we feel that we are ready for significant questions:

- Should we invent a better ourselves?
- Do we **trust** society models as we know them?
- Should we try to change our future?

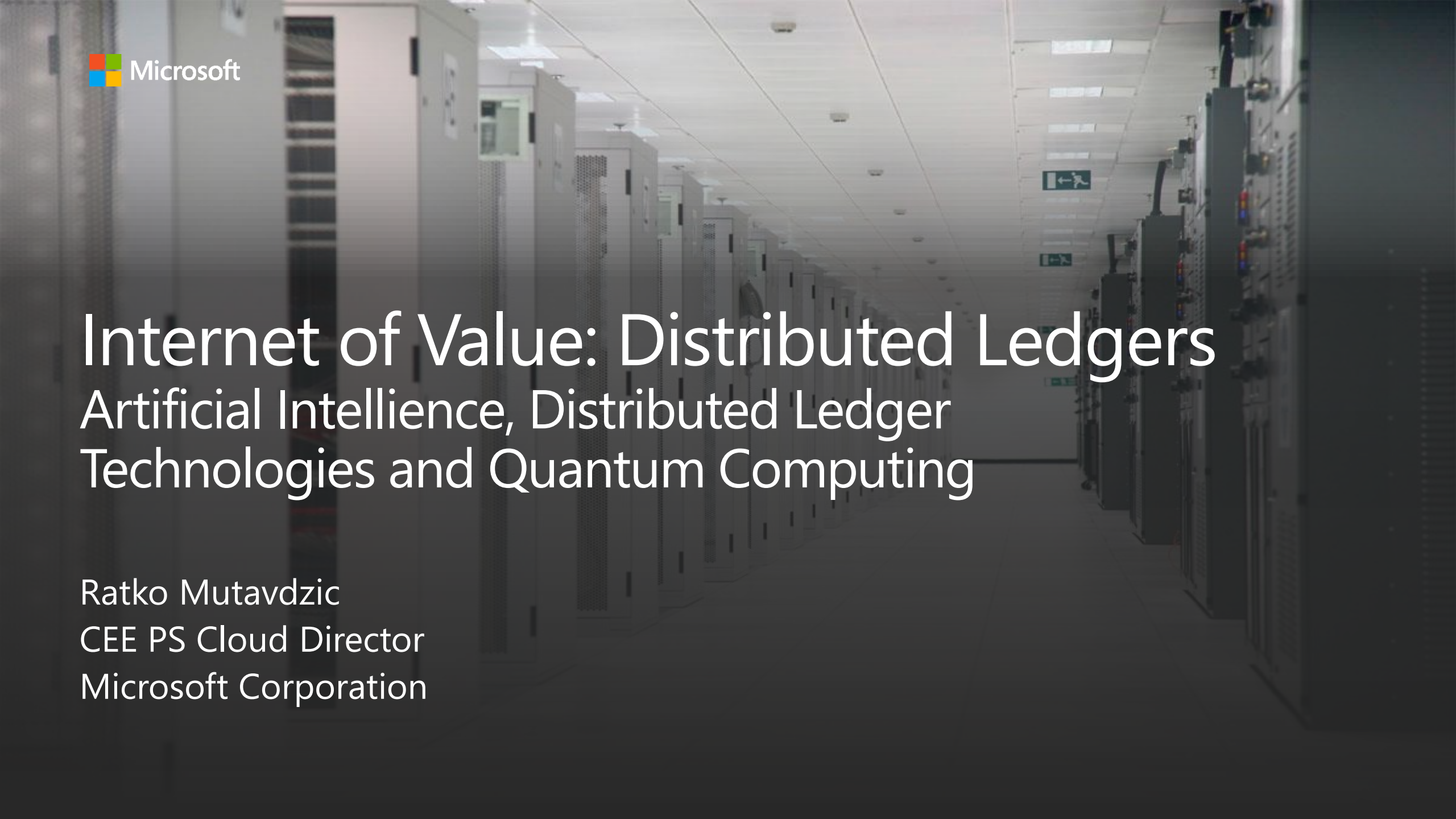
Stephen William Hawking CH CBE FRS FRSA was an English theoretical physicist, cosmologist, author, and director of research at the Centre for Theoretical Cosmology at the University of Cambridge.



Problem 2: Limits of Trust

Sparked by work we began over a decade ago, today the fruits of our long-term investments in new technologies and platforms are manifesting drive a whole new kind of productivity.

But there is a question of trust.



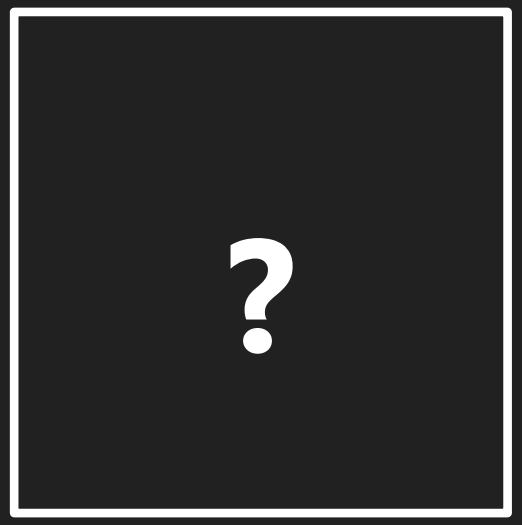
Microsoft

Internet of Value: Distributed Ledgers

Artificial Intellience, Distributed Ledger Technologies and Quantum Computing

Ratko Mutavdzic
CEE PS Cloud Director
Microsoft Corporation

Limitation of trust in the system

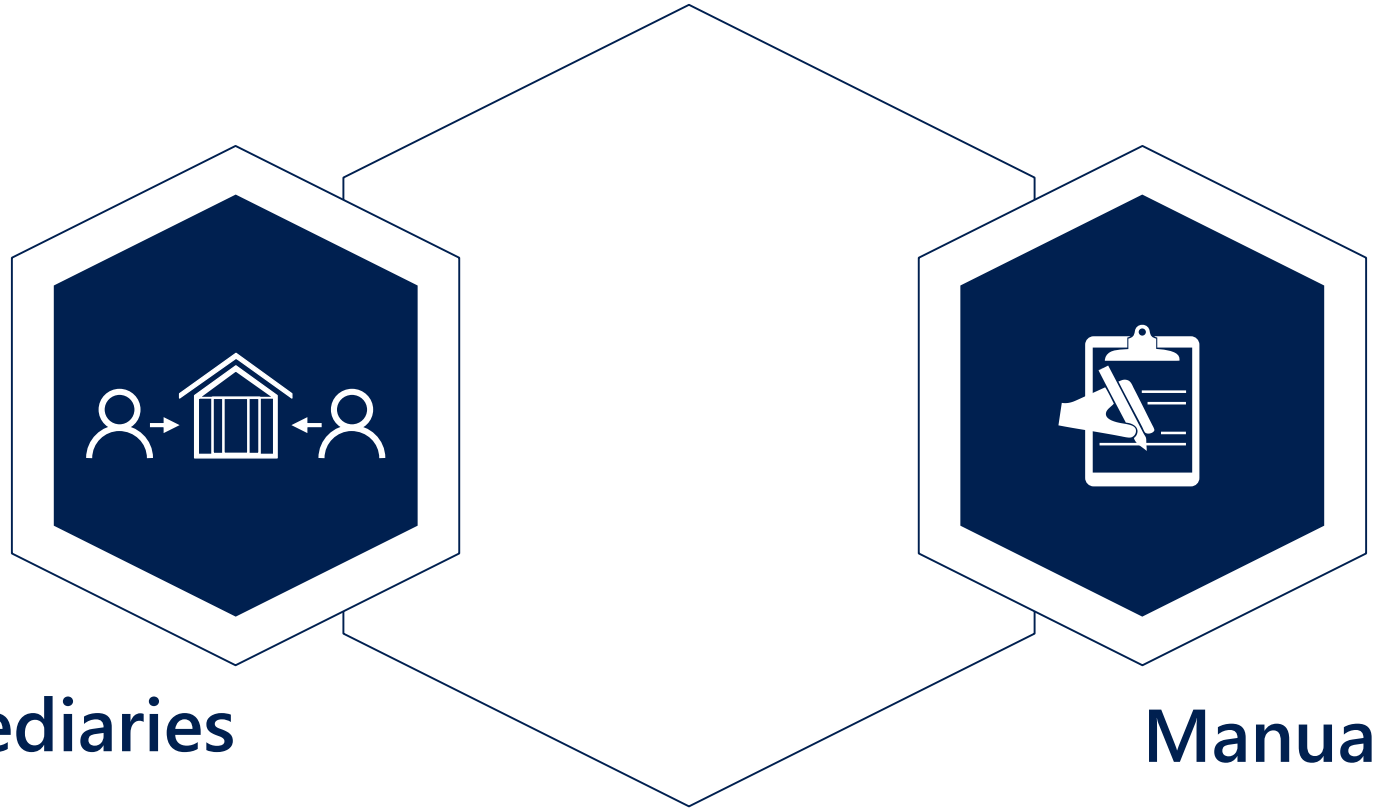


Distributed Ledger: mechanism for trust?

„A viable alternative to the current procedural, organizational, and technological infrastructure required to create institutionalized trust."

- "Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System | Oct 31, 2008.
- **Satoshi Nakamoto** is the name used by the unknown person or people who designed bitcoin and created its original reference implementation. As part of the implementation, they also devised the first blockchain database.

Traditional methods of trust are failing



Intermediaries

increase cost and reduce direct contact with consumers

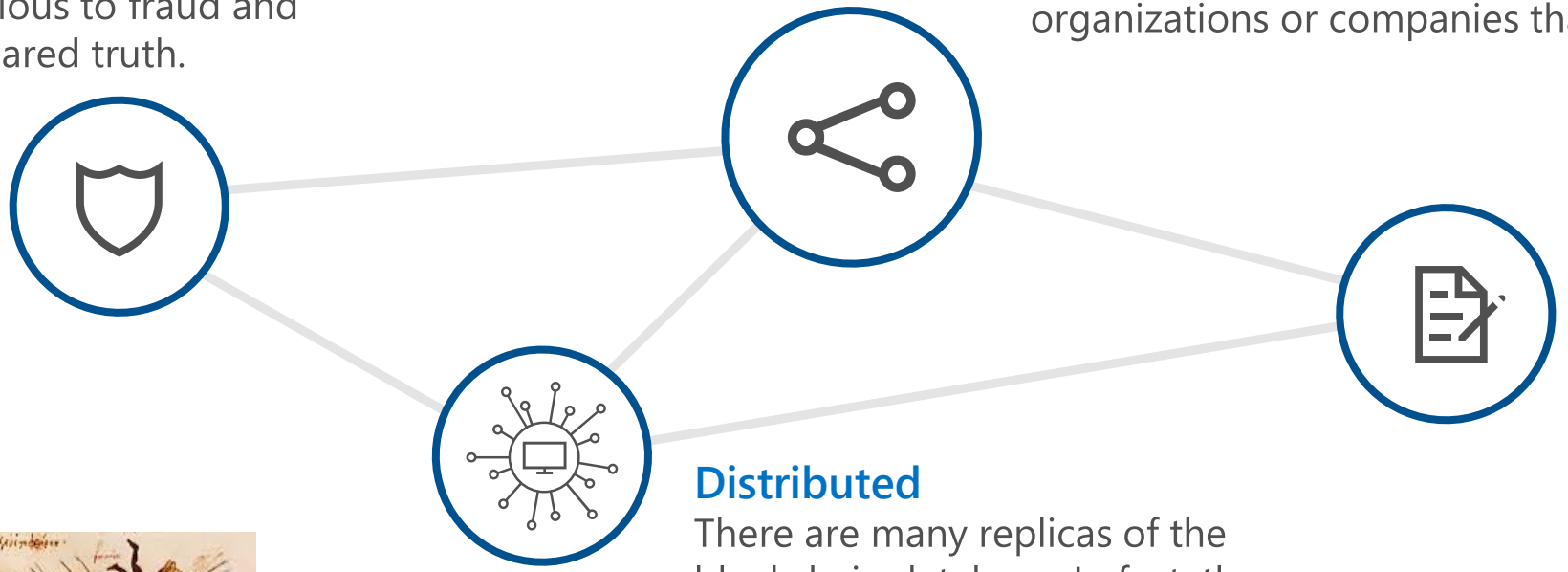
Manual verification

is time-consuming and error-prone

Blockchain is a secure, shared, distributed ledger

Secure
Uses cryptography to create transactions that are impervious to fraud and establishes a shared truth.

Shared
Blockchain's value is directly linked to the number of organizations or companies that participate in them.



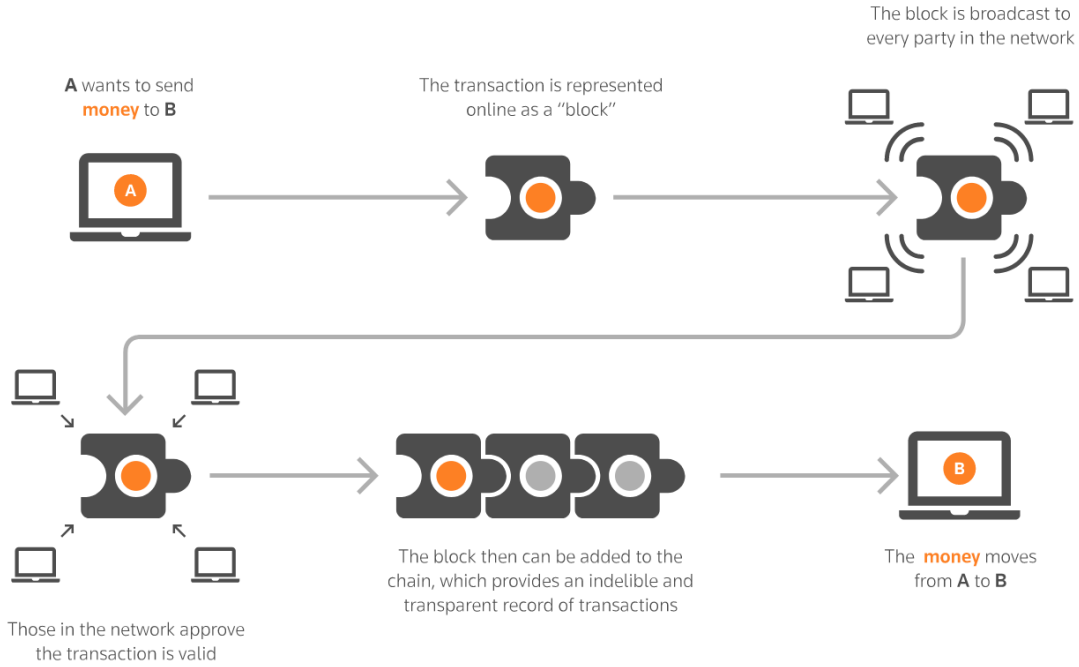
Ledger
The database is append only so it is an immutable record of every transaction that occurs.

Distributed
There are many replicas of the blockchain database. In fact, the more replicas there are the more authentic it becomes.

Byzantine General Problem
What is needed is an electronic system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party.
- Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System | Oct 31, 2008

Blockchain replaces AUTHORITY with CRYPTOGRAPHY
What is needed is an electronic system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party.
- Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System | Oct 31, 2008

Blockchain Technology

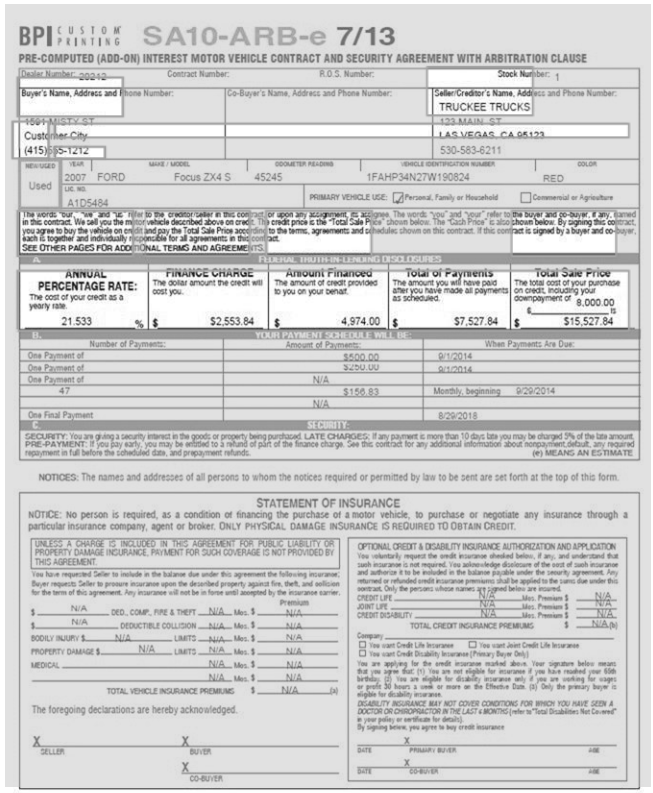


1. New transactions are **broadcast** to the bitcoin network (all nodes).
2. Each participant **collects new transactions into a block** and time stamps them (aka 'hash').
3. Each node works on finding a **difficult proof-of-work for** its block, called mining
4. When a participant finds a proof-of-work, it **broadcasts** the block to all nodes.
5. The individual nodes accept the block only if all transactions in it **are valid and not already spent.**
6. Nodes express their acceptance of the block by working on **creating the next block** in the chain.

Reference: Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System | Oct 31, 2008

Blockchain 2.0 Smart Contracts

Traditional Contract


BPI CUSTOM PRINTING SA10-ARB-e 7/13

PRE-COMPUTED (ADD-ON) INTEREST MOTOR VEHICLE CONTRACT AND SECURITY AGREEMENT WITH ARBITRATION CLAUSE

Dealer Number: 20012 Contract Number: R.O.S. Number: Stock Number: 1

Buyer's Name, Address and Phone Number: Co-Buyer's Name, Address and Phone Number: Seller/Creditor's Name, Address and Phone Number: TRUCKEE TRUCKS 123 MAIN ST LAS VEGAS, CA 95123 530-583-6211

4591 MISTY CT Customer City (415) 555-1212

NEW/USED	YEAR	MAKE / MODEL	ODOMETER READING	VEHICLE IDENTIFICATION NUMBER	COLOR
Used	2007	FORD Focus ZX4 S	45245	1FAHP34N27W190824	RED

LIC. NO. A1D5484 PRIMARY VEHICLE USE: ☑ Personal, Family or Household ☐ Commercial or Agriculture

The words "buyer," "you" and "your" refer to the creditor/seller in this contract or upon any assignment, its assignee. The words "you" and "your" refer to the buyer and co-buyer, if any, named in this contract. We sell you the motor vehicle described above on credit. This credit price is the "Total Sale Price" shown below. The "Cash Price" is also shown below. By signing this contract, you agree to buy the vehicle on credit and pay the Total Sale Price according to the terms, agreements and schedules shown on this contract. If this contract is signed by a buyer and co-buyer, each is together and individually responsible for all agreements in this contract.

SEE OTHER PAGES FOR ADDITIONAL TERMS AND AGREEMENTS.

A. FEDERAL TRUTH-IN-LENDING DISCLOSURES

ANNUAL PERCENTAGE RATE: The cost of your credit as a yearly rate.	FINANCE CHARGE The dollar amount the credit will cost you.	Amount Financed The amount of credit provided to you on your behalf.	Total of Payments The amount you will have paid after you have made all payments as scheduled.	Total Sale Price The total cost of your purchase on credit, including your downpayment of $ 8,000.00
21.533 %	$ 2,553.84	$ 4,974.00	$ 7,527.84	$ 15,527.84

B. YOUR PAYMENT SCHEDULE WILL BE:

Number of Payments:	Amount of Payments:	When Payments Are Due:
One Payment of	$500.00	9/1/2014
One Payment of	$250.00	9/1/2014
One Payment of	N/A	
47	$156.83	Monthly, beginning 9/29/2014
	N/A	
One Final Payment		8/29/2018

C. SECURITY: SECURITY: You are giving a security interest in the goods or property being purchased. LATE CHARGES: If any payment is more than 10 days late you may be charged 5% of the late amount. PRE-PAYMENT: If you pay early, you may be entitled to a refund of part of the finance charge. See this contract for any additional information about nonpayment, default, any required repayment in full before the scheduled date, and prepayment refunds. (e) MEANS AN ESTIMATE

NOTICES: The names and addresses of all persons to whom the notices required or permitted by law to be sent are set forth at the top of this form.

STATEMENT OF INSURANCE

NOTICE: No person is required, as a condition of financing the purchase of a motor vehicle, to purchase or negotiate any insurance through a particular insurance company, agent or broker. ONLY PHYSICAL DAMAGE INSURANCE IS REQUIRED TO OBTAIN CREDIT.

UNLESS A CHARGE IS INCLUDED IN THIS AGREEMENT FOR PUBLIC LIABILITY OR PROPERTY DAMAGE INSURANCE, PAYMENT FOR SUCH COVERAGE IS NOT PROVIDED BY THIS AGREEMENT.

You have requested Seller to include in the balance due under this agreement the following insurance: Buyer requests Seller to procure insurance upon the described property against fire, theft, and collision for the term of this agreement. Any insurance will not be in force until accepted by the insurance carrier.

	Premium
$ N/A DED., COMP., FIRE & THEFT	N/A Mos. $ N/A
$ N/A DEDUCTIBLE COLLISION	N/A Mos. $ N/A
BODILY INJURY $ N/A LIMITS	N/A Mos. $ N/A
PROPERTY DAMAGE $ N/A LIMITS	N/A Mos. $ N/A
MEDICAL	N/A Mos. $ N/A
	N/A Mos. $ N/A
TOTAL VEHICLE INSURANCE PREMIUMS	$ N/A (a)

The foregoing declarations are hereby acknowledged.

X SELLER X BUYER X CO-BUYER

OPTIONAL CREDIT & DISABILITY INSURANCE AUTHORIZATION AND APPLICATION

You voluntarily request the credit insurance checked below, if any, and understand that such insurance is not required. You acknowledge disclosure of the cost of such insurance and authorize it to be included in the balance payable under the security agreement. Any returned or refunded credit insurance premiums shall be applied to the sums due under this contract. Only the persons whose names are signed below are insured.

		Mos.	Premium	
CREDIT LIFE	N/A		$	N/A
JOINT LIFE	N/A		$	N/A
CREDIT DISABILITY	N/A		$	N/A
TOTAL CREDIT INSURANCE PREMIUMS			$	N/A (b)

Company:

☐ You want Credit Life Insurance ☐ You want Joint Credit Life Insurance

☐ You want Credit Disability Insurance (Primary Buyer Only)

You are applying for the credit insurance marked above. Your signature below means that you agree that: (1) You are not eligible for insurance if you have reached your 65th birthday; (2) You are eligible for disability insurance only if you are working for wages or profit 30 hours a week or more on the Effective Date. (3) Only the primary buyer is eligible for disability insurance.

DISABILITY INSURANCE MAY NOT COVER CONDITIONS FOR WHICH YOU HAVE SEEN A DOCTOR OR CHIROPRACTOR IN THE LAST 6 MONTHS (refer to "Total Disabilities Not Covered" in your policy or certificate for details).

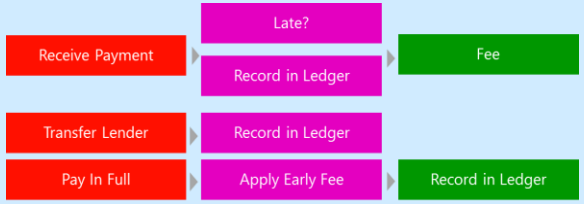
By signing below, you agree to buy credit insurance

X DATE PRIMARY BUYER AGE

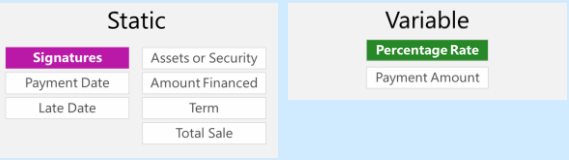
X DATE CO-BUYER AGE

Smart Contract Package

Logic



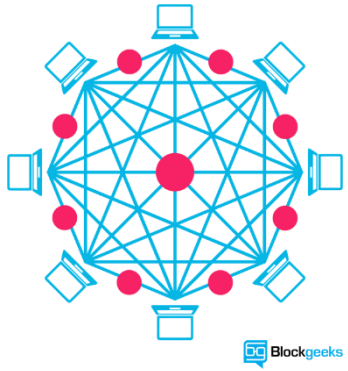
Properties



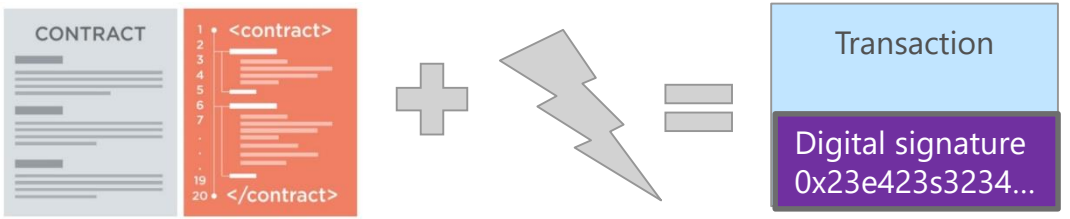
Ledger

Date	Payment	Late Fee
12/1/2016	$500.00	$0
1/1/2017	$500.00	$0
…		

Deployed to Nodes



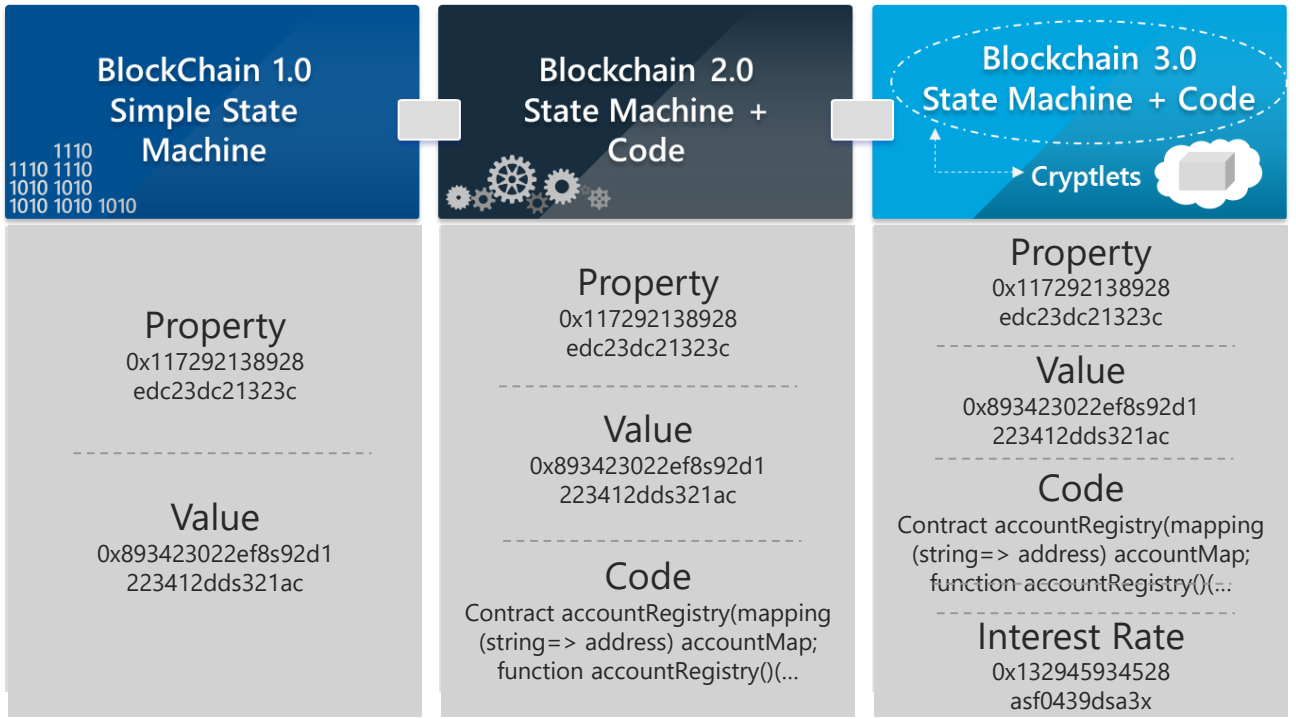
Smart Contract Logic



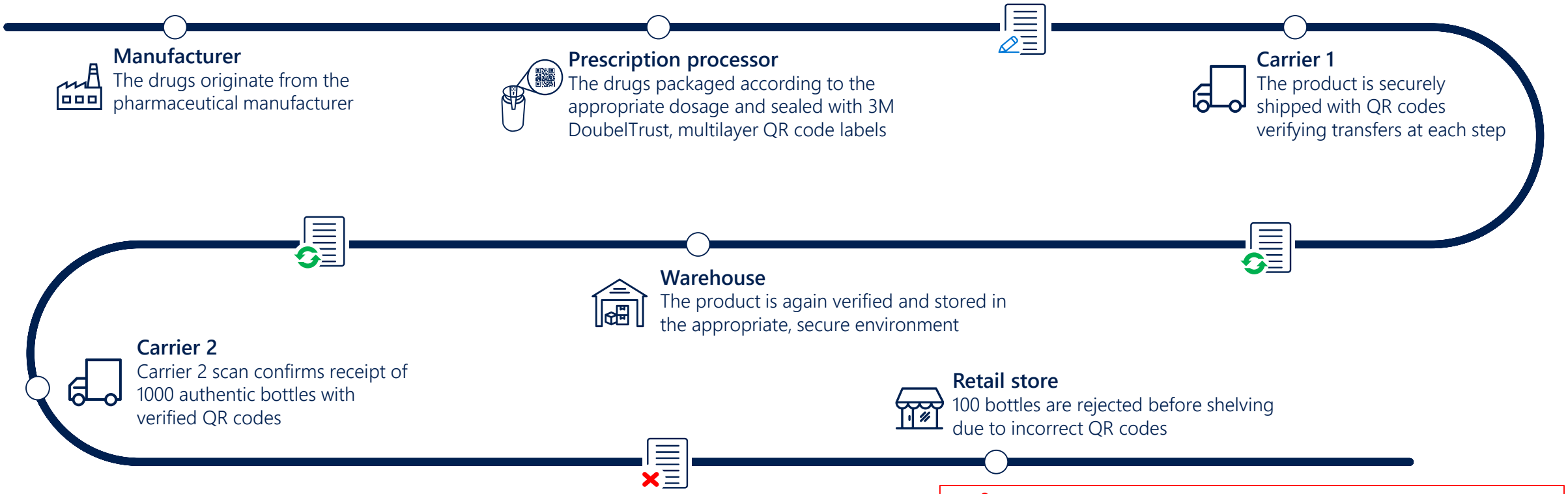
- Blockchain 2.0 expands the power of the ledger to include additional logic (code) through Smart Contracts
  - Smart Contracts contain code and execute various terms written in that contract
  - Like normal contracts, these Smart Contracts are based on reaching agreed-upon conditions
  - Smart Contracts are now stored on and exist within Blockchain 2.0's distributed ledger
  - Think of Smart Contracts as the computer code representation of a legal contract

Blockchain 3.0 | State-of-the-art cryptlets innovation

- Blockchain 2.0 introduced the power of Smart Contracts…
- …but Smart Contracts are unable to access external data or events based on time or market conditions
  - Calling code or data outside of a Smart Contract or blockchain breaks the general trust barrier and authenticity of transactions
- Cryptlets will **allow the blockchain to access external data securely, while maintaining the integrity of the blockchain**
- Cryptlets are a Microsoft innovation and solve a significant hurdle to enterprise blockchain adoption



Blockchain in Action | Pharmaceutical Authenticity



The integrity of the product have been violated.
Carrier 2 is liable for penalty as the amount of Drug A when it reached the retail store was less than the Smart Contract was tracking

SHARED LEDGER

Smart Contract created	Carrier 1	Warehouse	Carrier 2	Retail store
1000 units of Drug A	1000 units of Drug A	1000 units of Drug A	1000 units of Drug A	900 units of Drug A

At various points in the journey, the IoT device scans the QR codes and records the unique serial numbers which are updated on the blockchain

Shared Data Pocesses: Supply Chain Management

SHARED LEDGER

Origin
8°C
60%

- Milk producer supplies Milk to Food Processing Company
- The milk product is sealed in an IoT enabled package for shipping
- The terms of shipping are registered using a **smart contract** on the Blockchain

Warehouse
9°C
64%

Carrier 1 delivers milk to Warehouse 1. The temperature of the package is within prescribed limits on arrival.

Carrier 2
9°C
64%

The package is still within prescribed temperature limits when Carrier 2 arrives to retrieve it for delivery to Retail Store.

Store
11°C
66%

The conditions of the contract have been violated. Carrier 2 is liable for penalty as the temperature of the package when it reached the retail store was above the prescribed limit

Microsoft Enterprise Blockchain Stack

Azure Blockchain

Application Builder
authentication, roles, UI, workflow, analytics and reporting

Standard Messaging Interface
improving blockchain performance, privacy and governance

Enterprise Smart Contracts
multi-party shared environment with identity, key management and external integration. Cross blockchain transactions, enterprise programming languages

Identity, Key Management, Data Services

Confidential Consortium Platform
improving blockchain performance, privacy and governance

Open Cloud:
All Major Platforms
Available in
the Marketplace

ethereum

ENTERPRISE ETHEREUM ALLIANCE

HYPERLEDGER

Chain

corda

- Ledger and Topology Choice
- Identity and Key Management
- Secure Off-Chain Storage and Analytics
- Monitoring and Security
- Workflow Design and Orchestration
- Enterprise Integration
- Partner-Enabled Solutions
  - $ Trade Finance
  - Asset Registry
  - Supply Chain Provenance

Limitation of compute based trust ...

How far can we go with this technology approach?

- For example, all blockchain consensus protocols (eg. Bitcoin, Ethereum, Ripple) have a challenging limitation: every fully participating node in the network must process every transaction..

Microsoft

Problem 3: Limits of Computation

We're ramping up to create the highest performance and most secure infrastructure in the industry, so we and our customers can stay one step ahead of Moore's law.

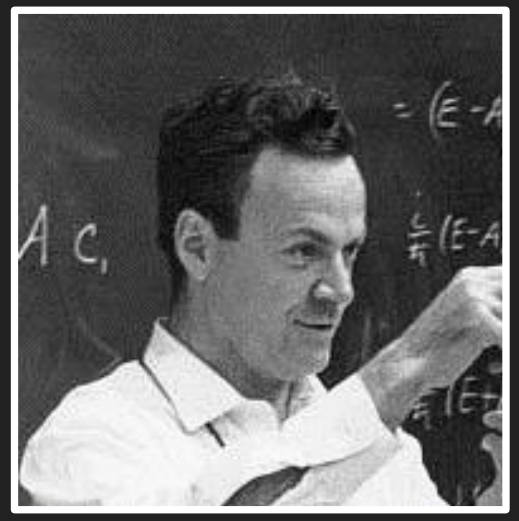
Microsoft

State of Quantum

Artificial Intellience, Distributed Ledger Technologies and Quantum Computing

Ratko Mutavdzic
CEE PS Cloud Director
Microsoft Corporation

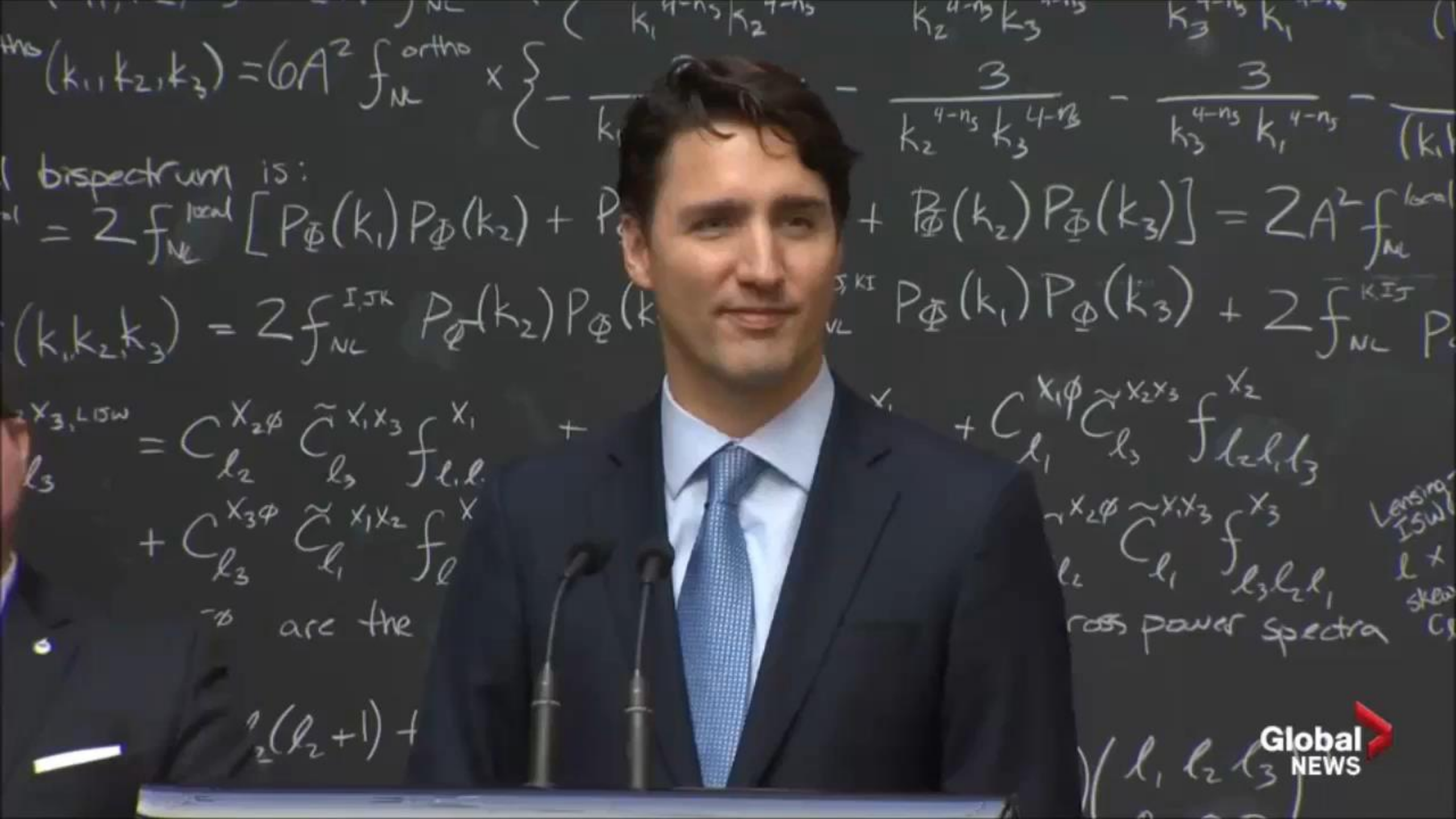
History of Quantum Computing



What is a quantum computer?

„A quantum computer is a machine that performs calculations based on the laws of quantum mechanics, which is the behavior of particles at the sub-atomic level."

- "I think I can safely say that nobody understands quantum mechanics", Richard Feynman
- 1982 – Richard Feynman proposed the idea of creating machines based on the laws of quantum mechanics instead of the laws of classical physics.

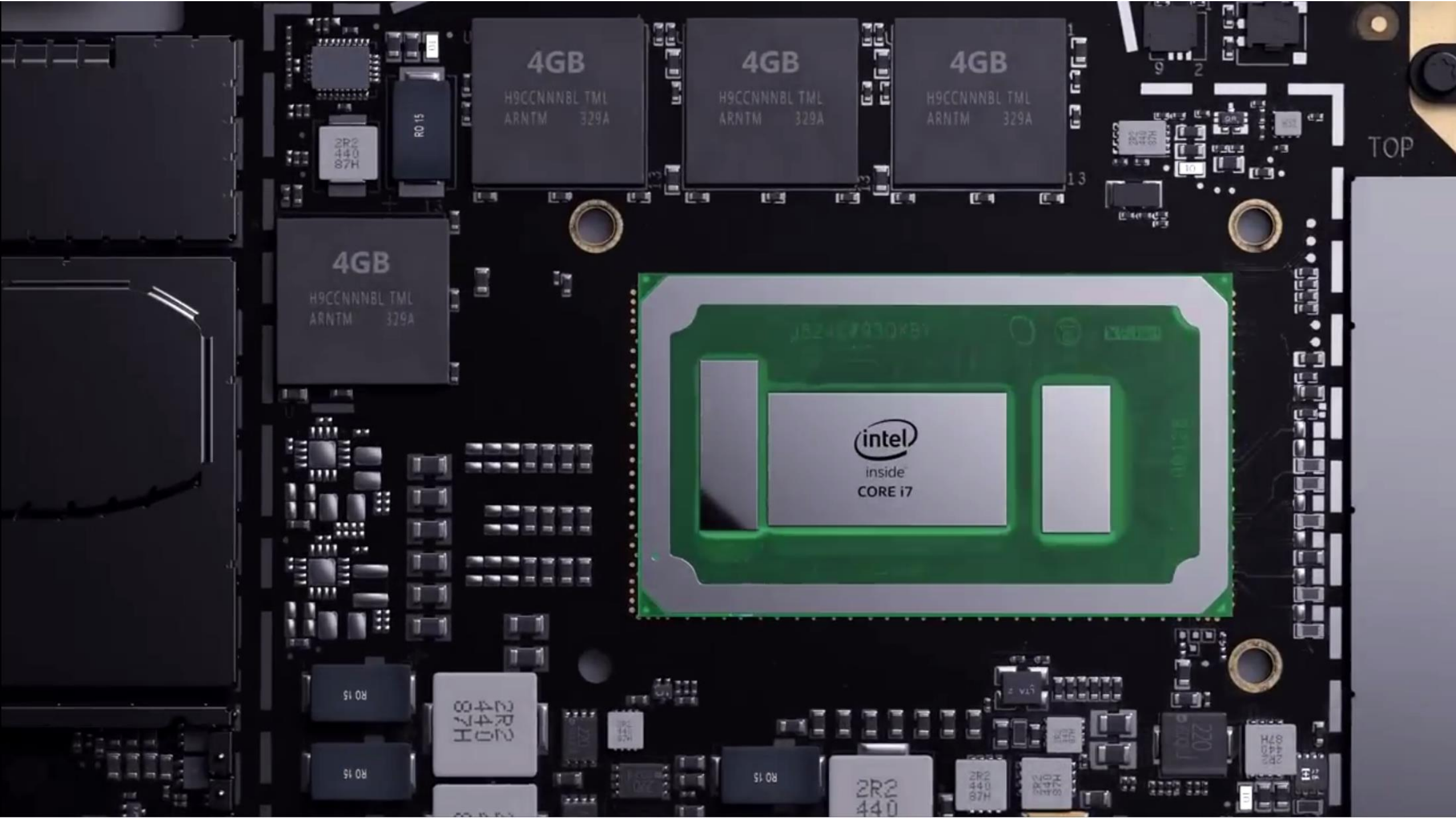

Global
NEWS

Dinner Problem

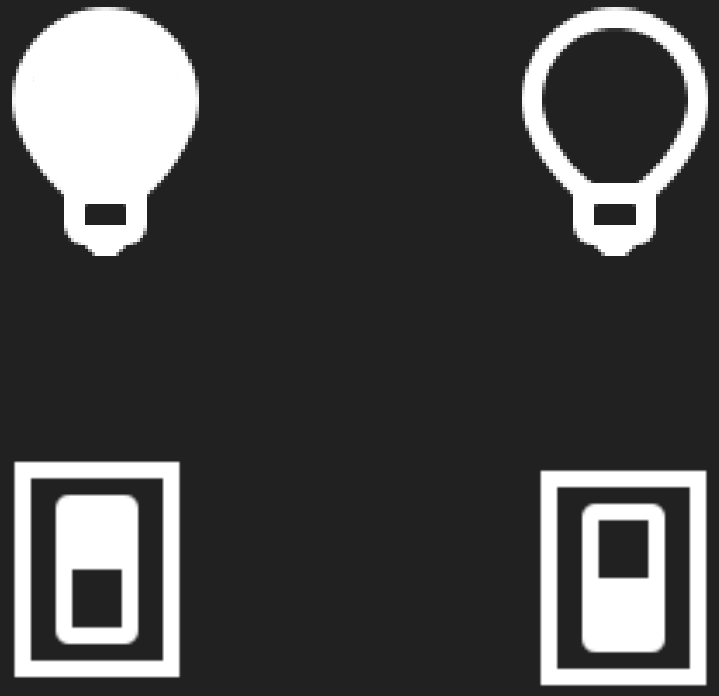
„I want to find **the best** solution out of all of the possible!"

How many combinations for 10 people? (n-1)

- 4! = 24 combinations
- 10! = 3.6 million combinations
- 11! = 39.9 milion combinations
- 12! = 479 milion combinations

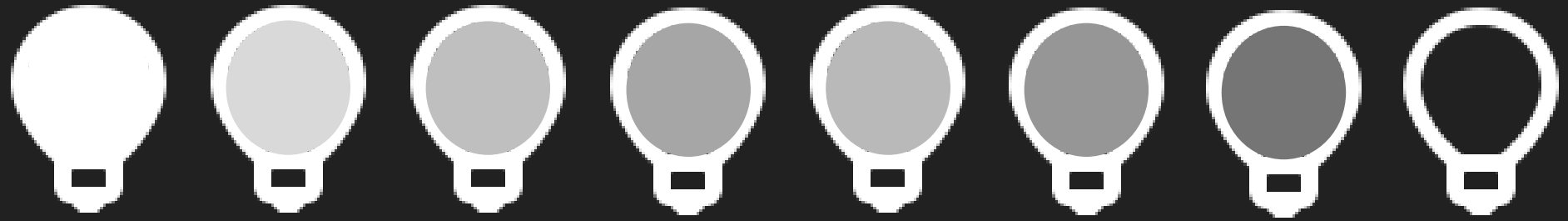

4GB
H9CCNNNBL TML
ARNTM 329A
4GB
H9CCNNNBL TML
ARNTM 329A
4GB
H9CCNNNBL TML
ARNTM 329A
4GB
H9CCNNNBL TML
ARNTM 329A
intel
inside
CORE i7
TOP

Today Classical Computing World



1 0

When we Think about Quantum World...



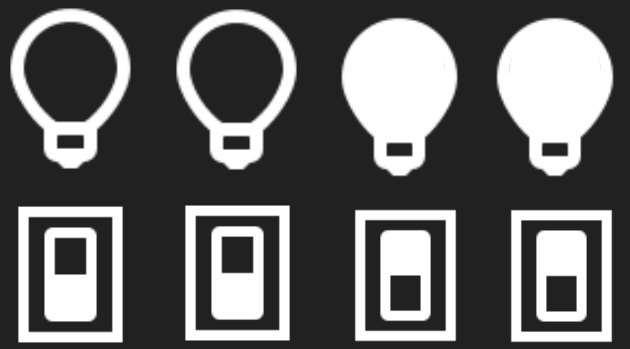
1

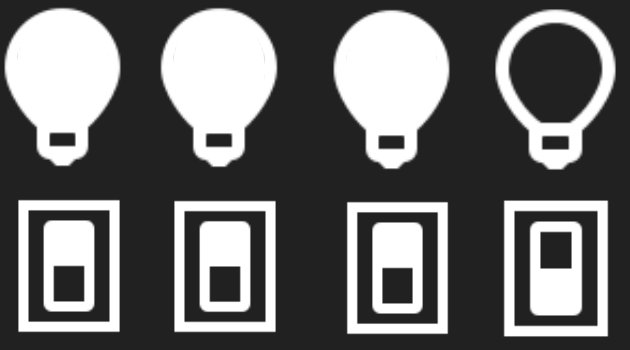
0

superposition

Representing states in Classical Computing

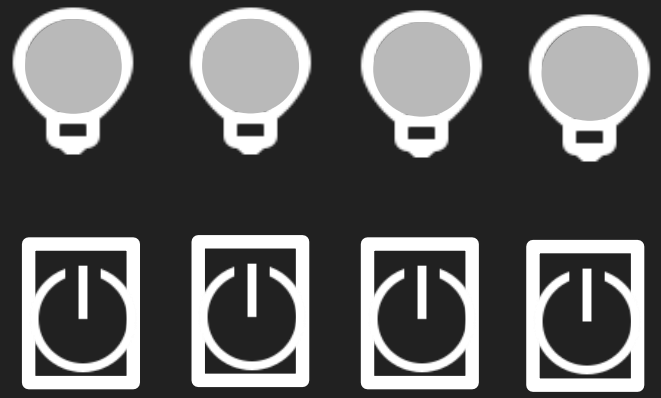
0000	1000
0001	1001
0010	1010
0011	1011
0100	1100
0101	1101
0110	1110
0111	1111





Representing states in Quantum Computing

0000	1000
0001	1001
0010	1010
0011	1011
0100	1100
0101	1101
0110	1110
0111	1111



0 0 0 0

/ / / /

1 1 1 1

Some problems are intractable classically

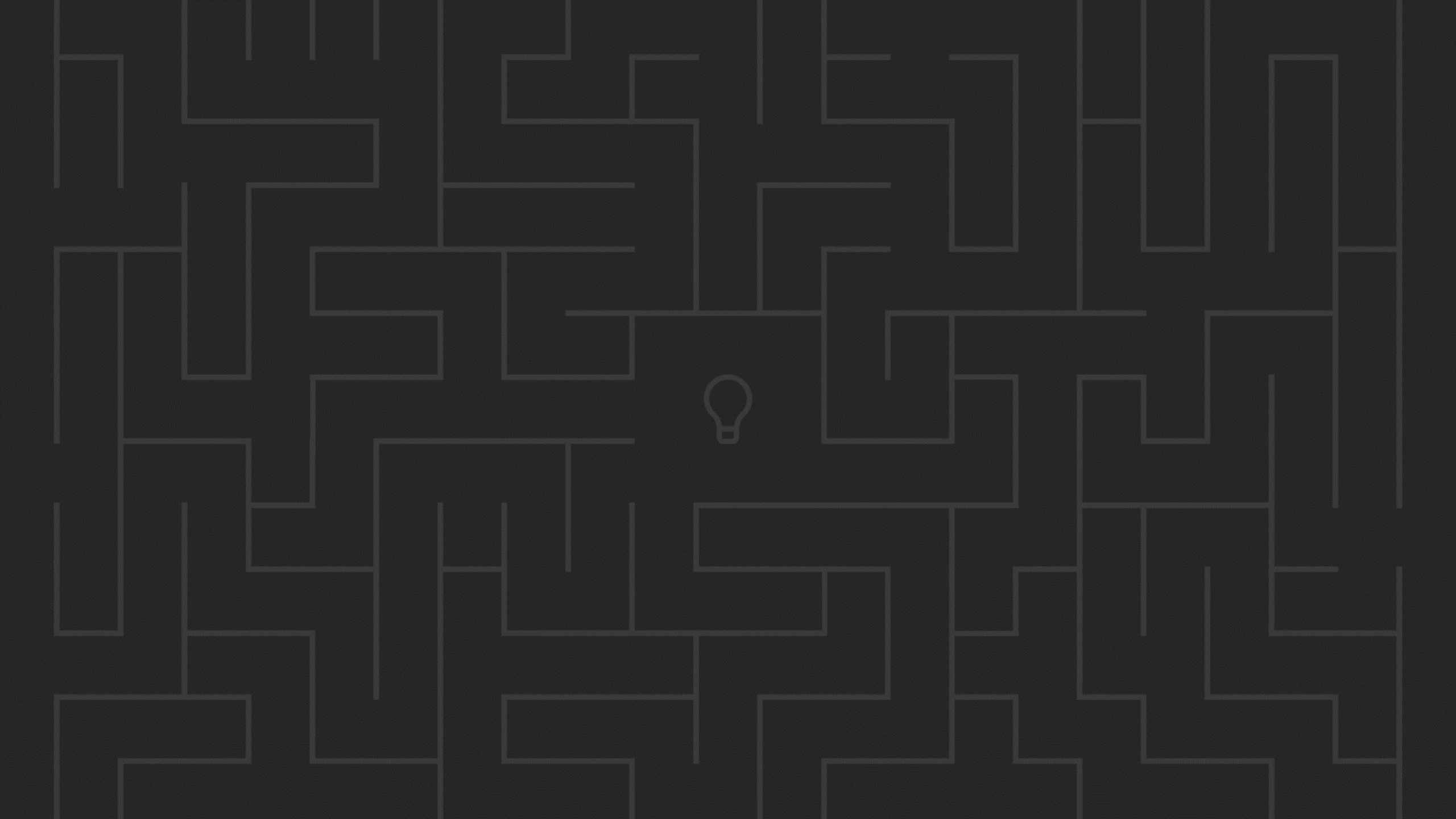
RSA-2048 Challenge Problem

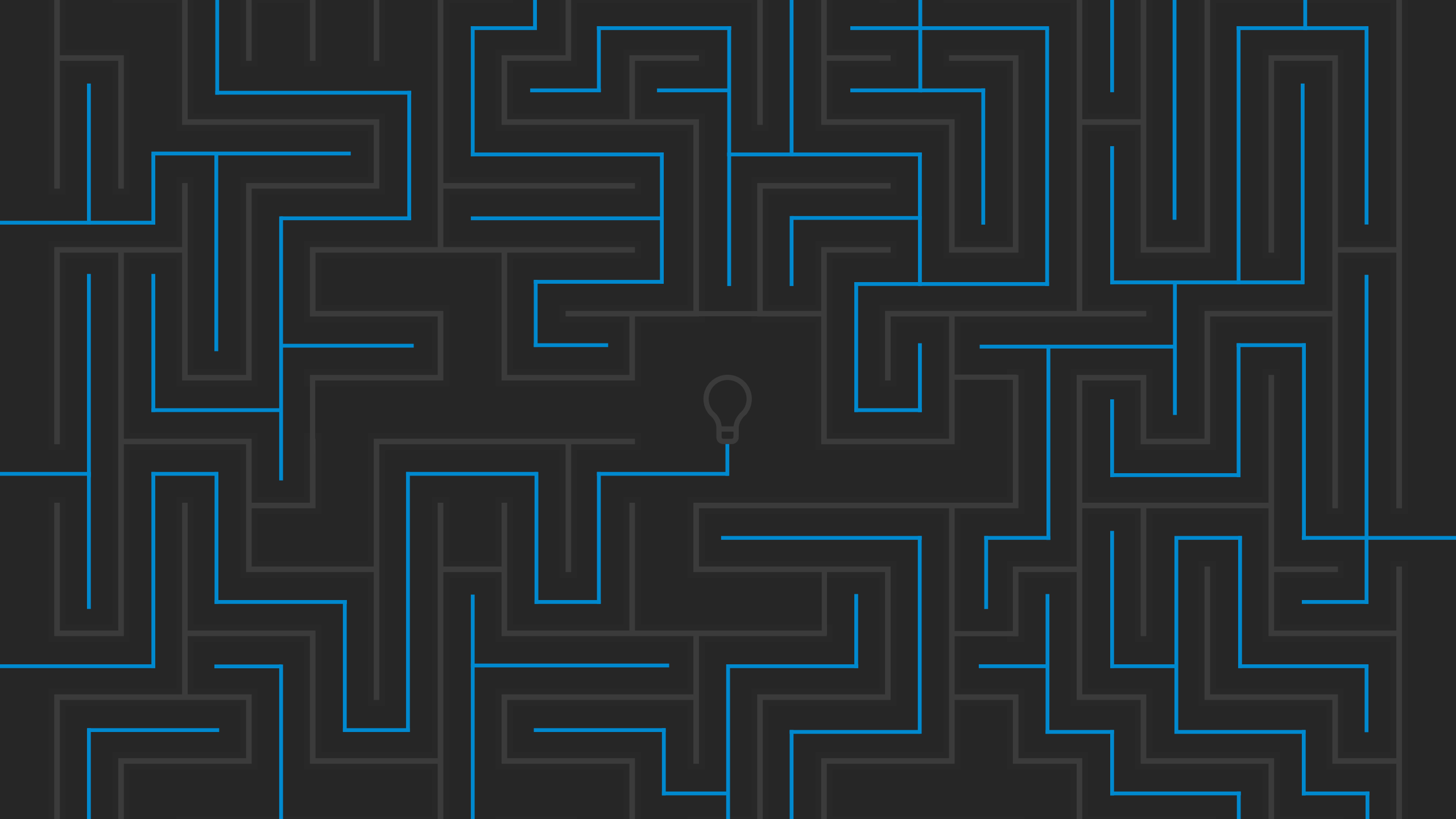
Classical

1 billion years

Quantum

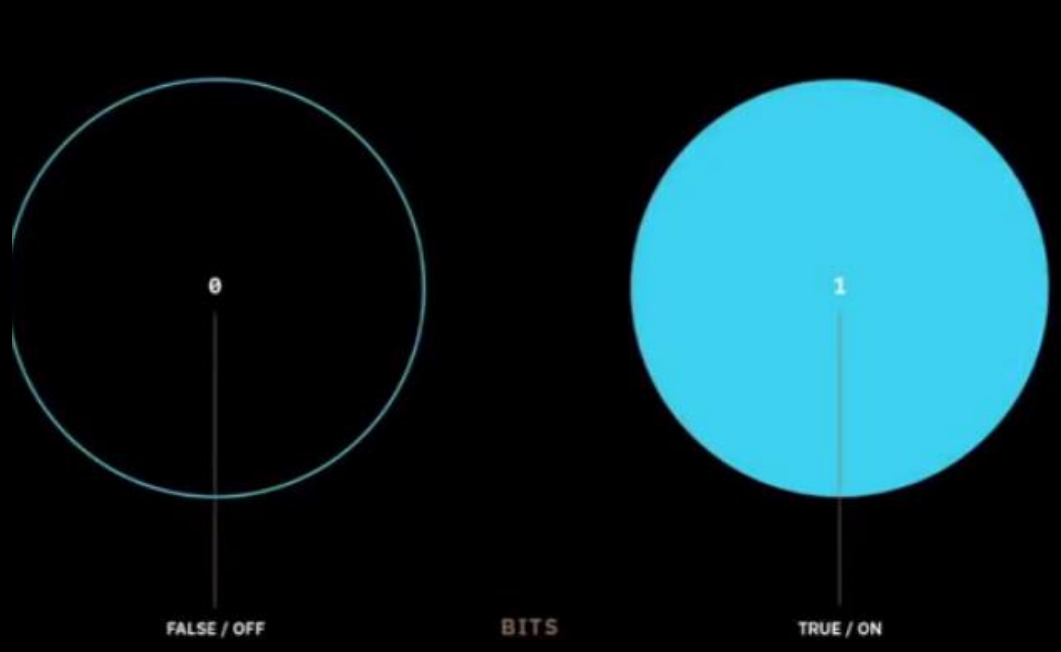
100 seconds

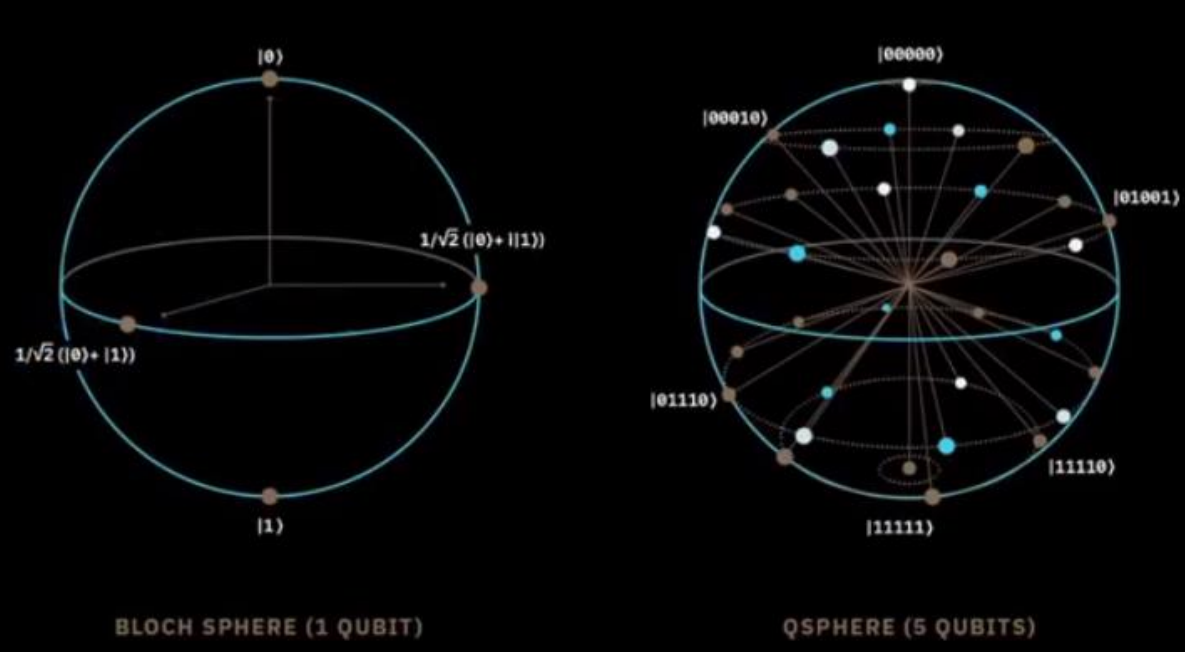




Why is Quantum Different?

1. Superposition





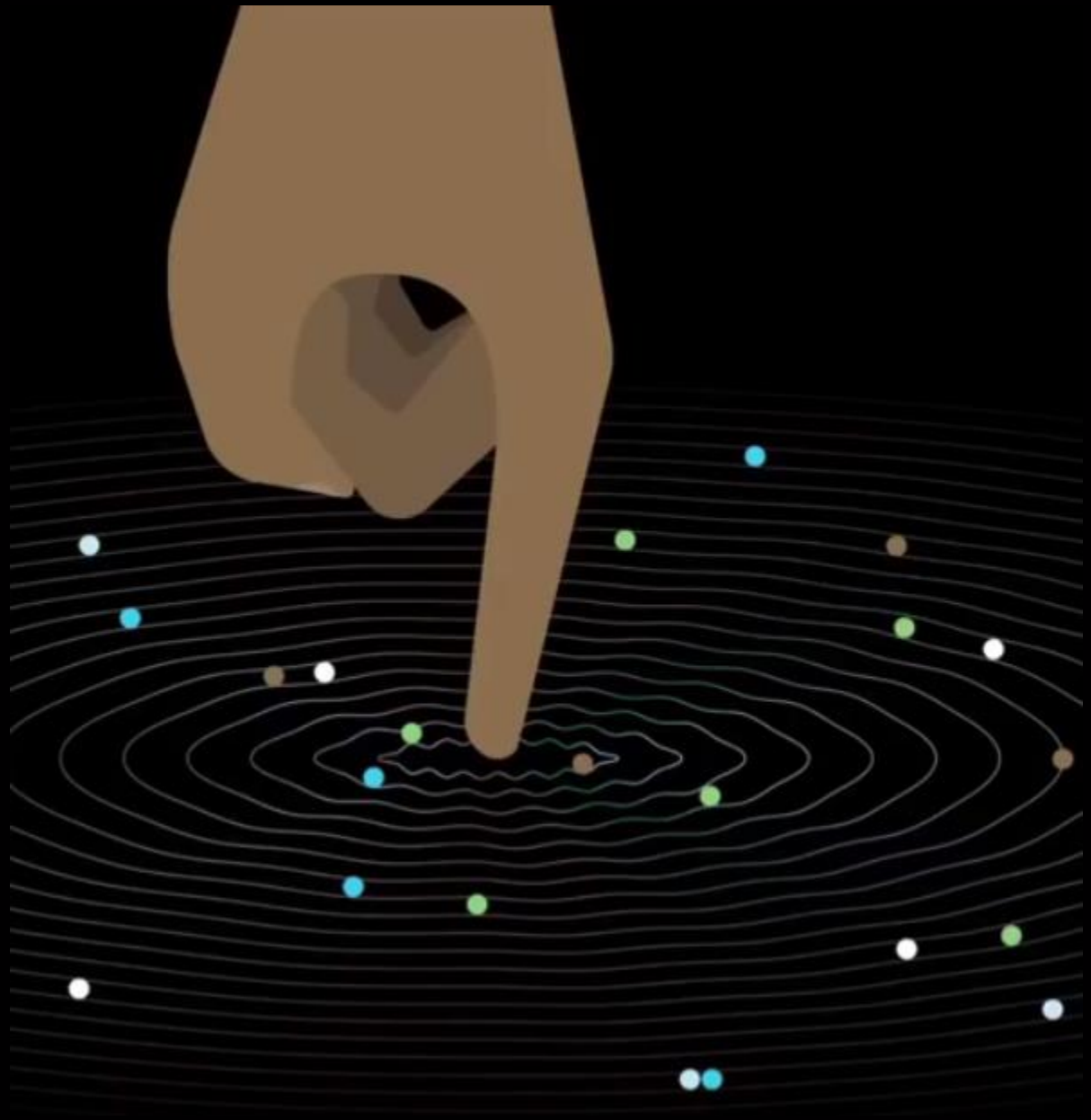
Classical states

Quantum states

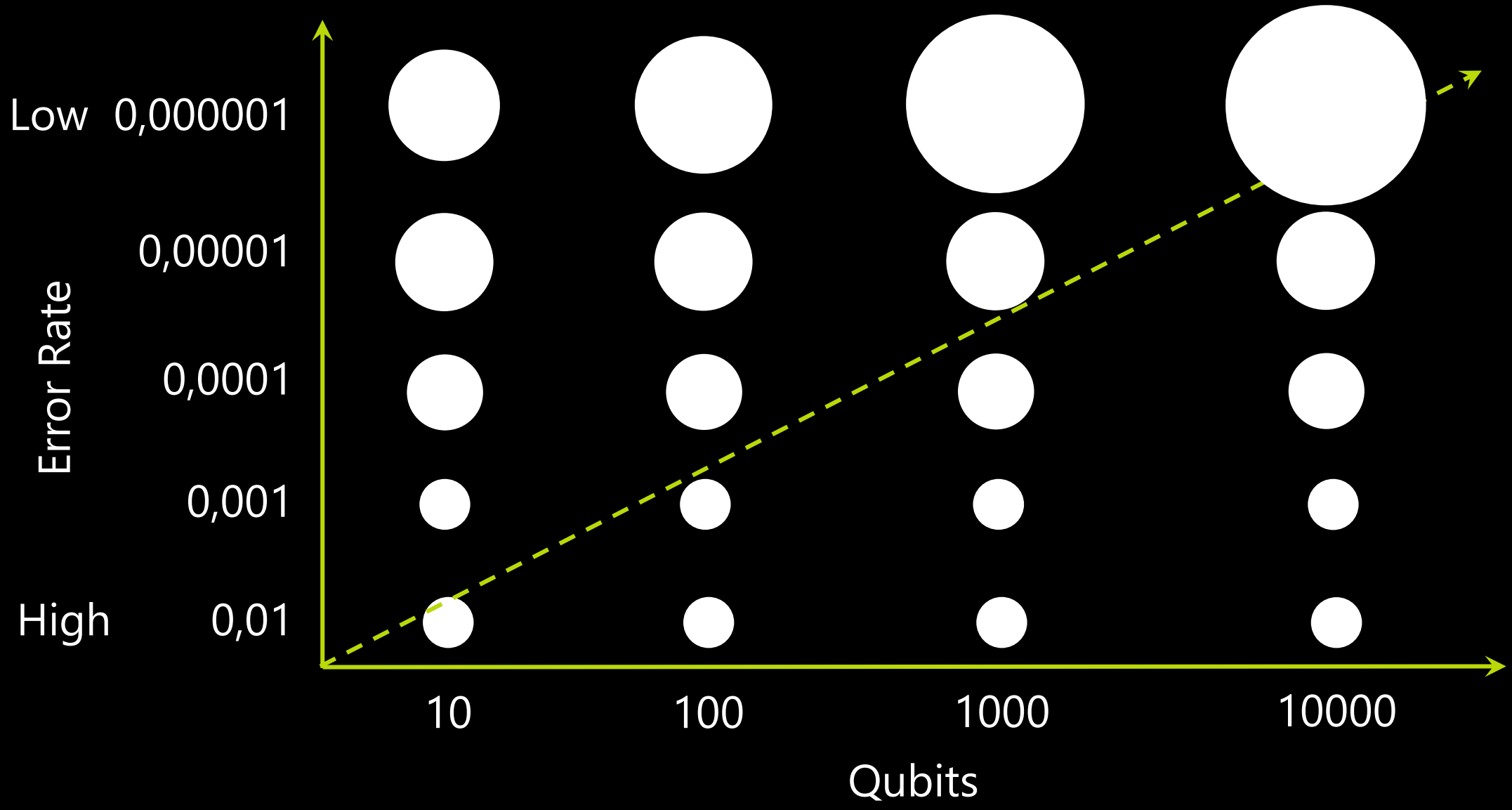
Why is Quantum Different?

2. Entanglement

   The states of entangled qubits cannot be described independently of each other



All qubits are not created equal



Complete scalable Quantum system

+26,85C

-272,15C

-273,14C

300K Room Temperature

100K

Nitrogen

30K

10K

Helium

3K Cryogenic Computer

Deep Space

1K

0.3K

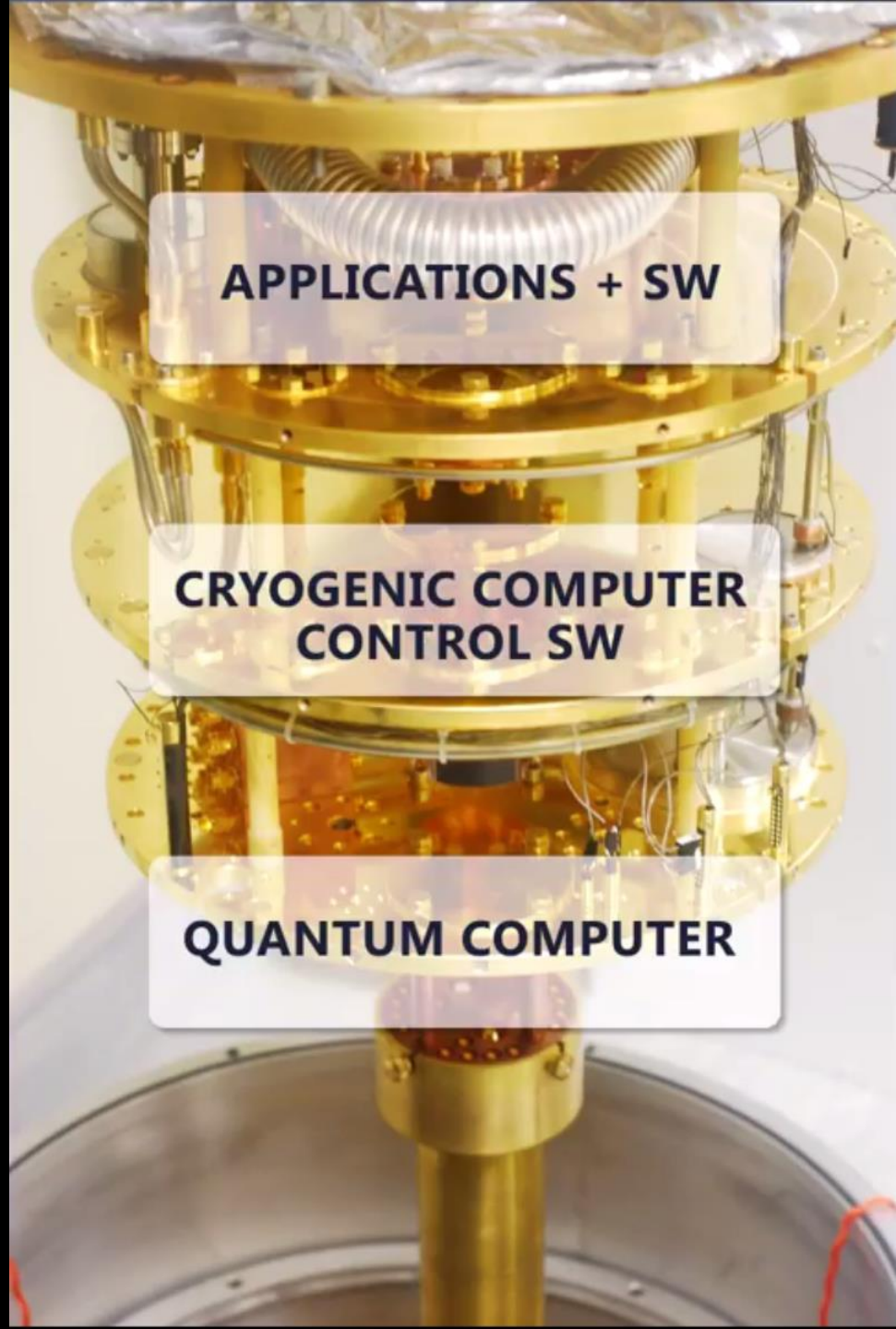
0.1K

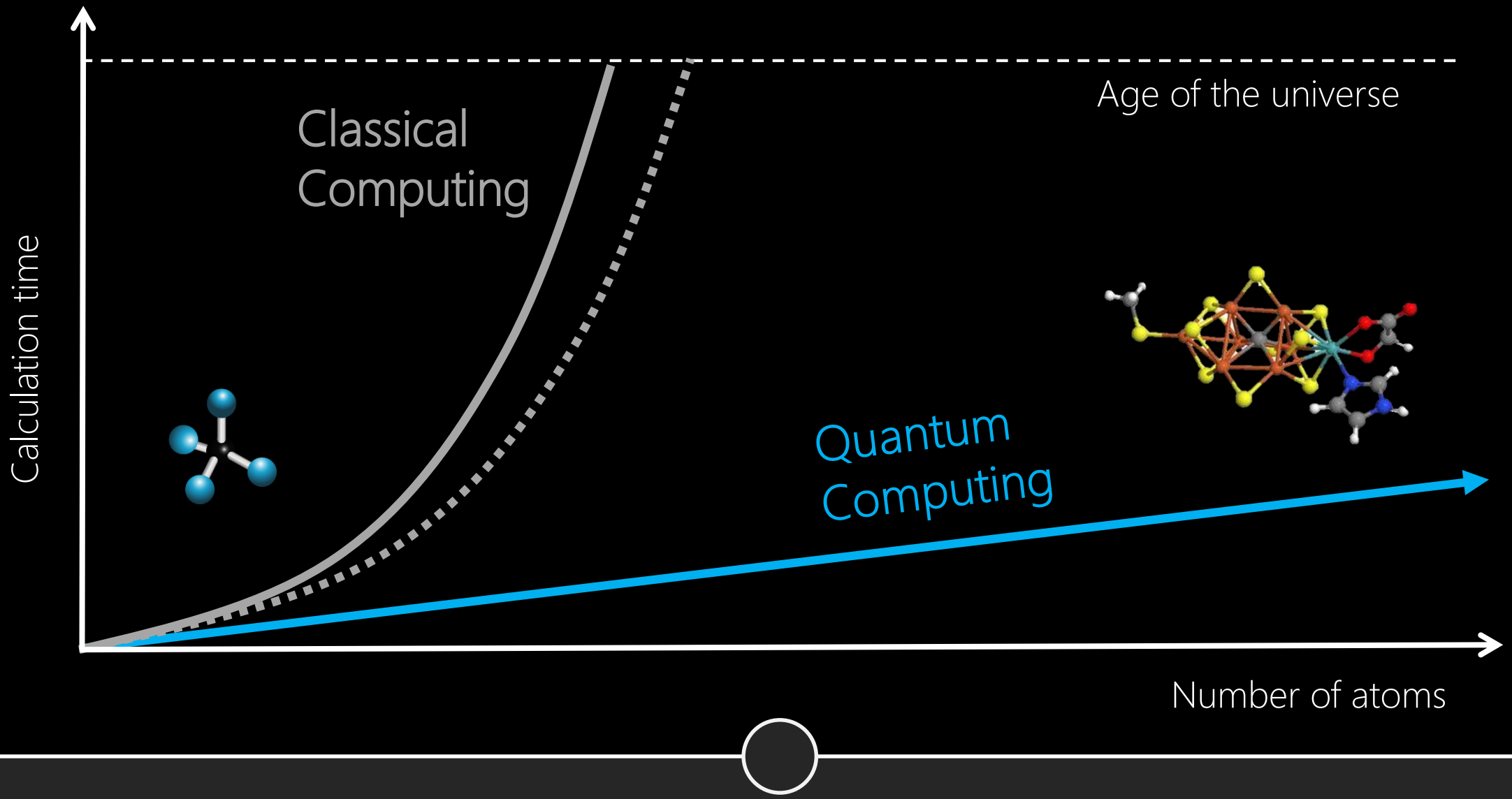
0.03K

Quantum Computer

0.01K

Apsolute Zero Quantum World





Addressing classically intractable problems

Initial applications

Nitrogen Fixation

100-200 qubits

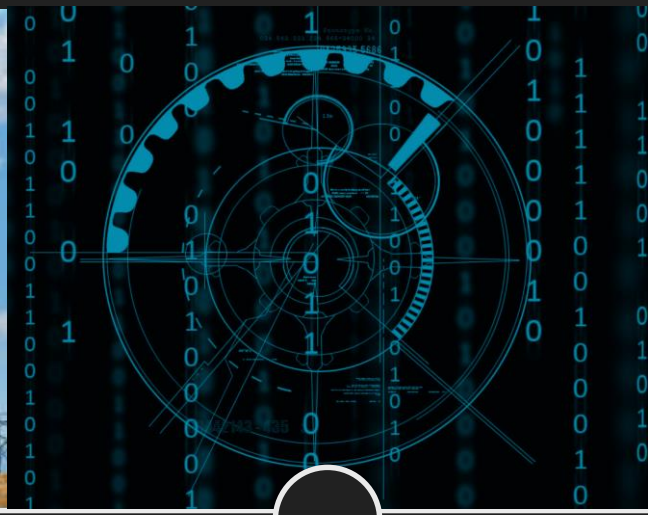
Carbon Capture

100-200 qubits

Materials Science

100s-1000s qubits

Machine Learning

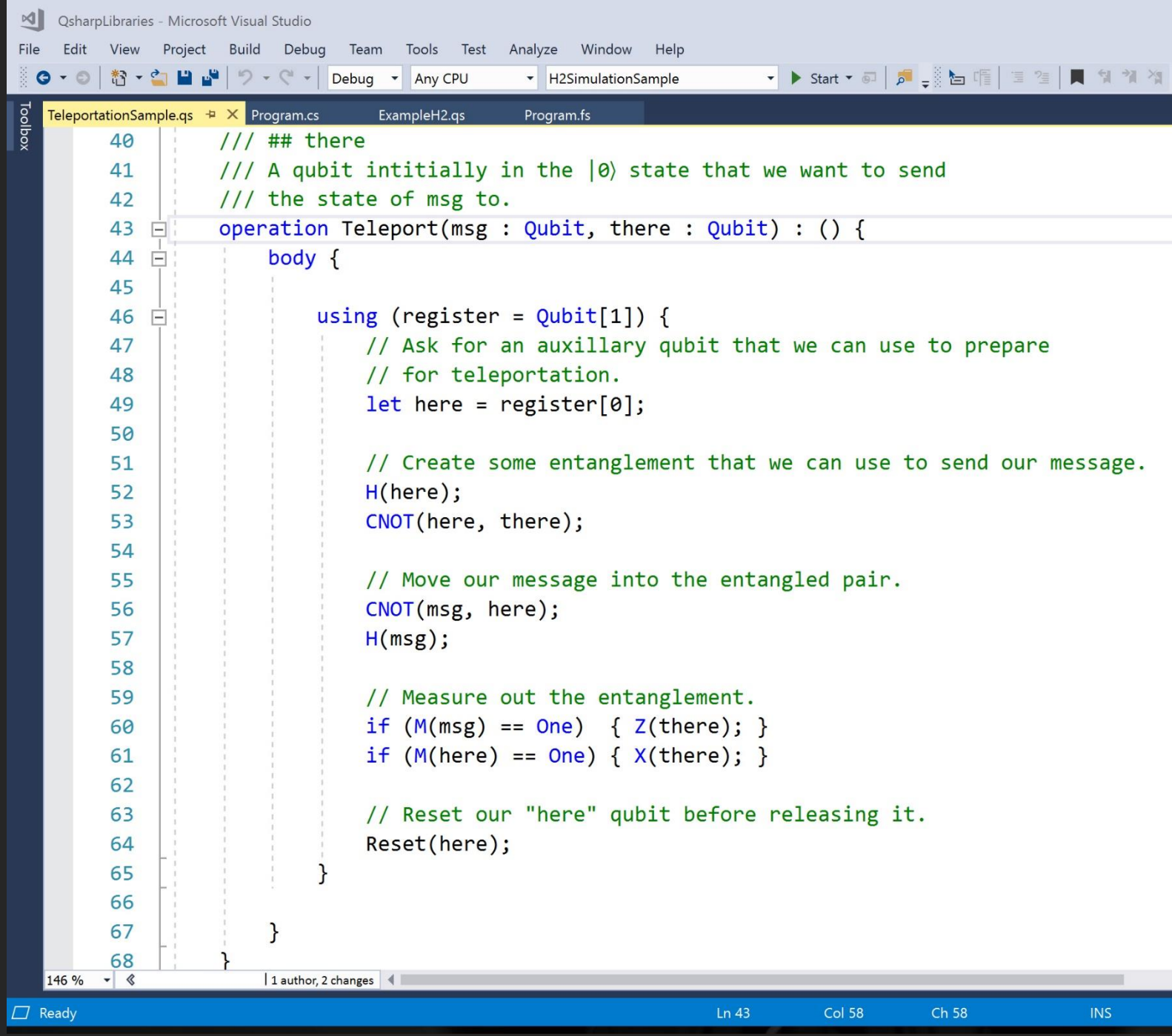


100s-1000s qubits

Microsoft Quantum Development Kit

Quantum-focused programming language (Q#)

- Built ground-up for Quantum
- Support for Windows, macOS, and Linux
- Fully integrated into Visual Studio and VS Code
- Interoperability with Python (Windows only)
- Native type system



Local Simulator

- Simulate a 30 qubit quantum computer
- Integrated into Visual Studio and VS Code
- Full debugging support

Azure Simulator

- Available for quantum solutions needing over 40 qubit simulation

Azure Compute

small workloads

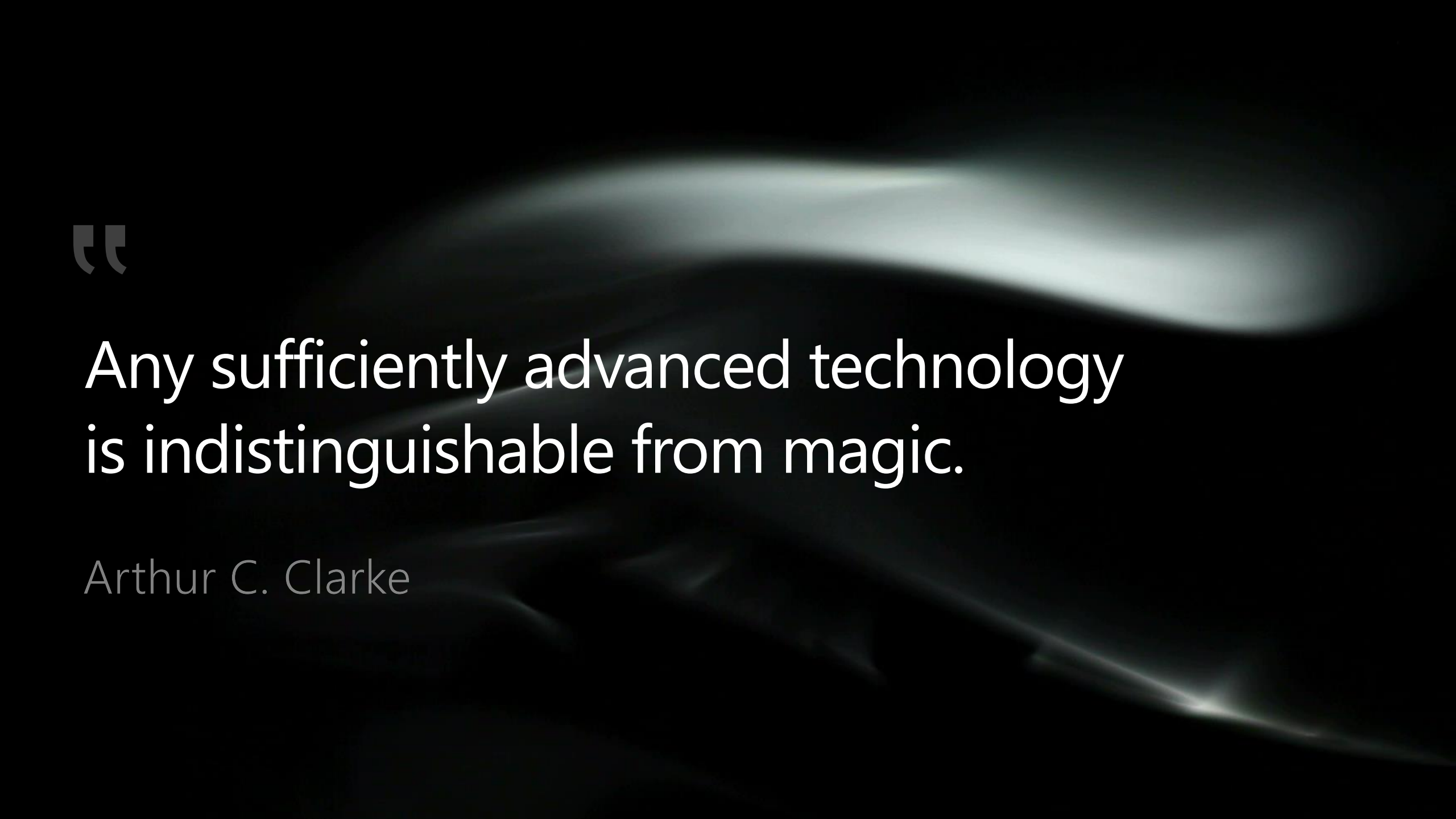
A B D D F G

general purpose storage & database workloads enterprise & HANA

D N L E M S

Azure Compute Options Today

Azure Quantum Compute


“
Any sufficiently advanced technology is indistinguishable from magic.
Arthur C. Clarke


Microsoft