IBM Research Technology Vision

TEK at IBM Research 2018
Rueschlikon

March 14, 2018

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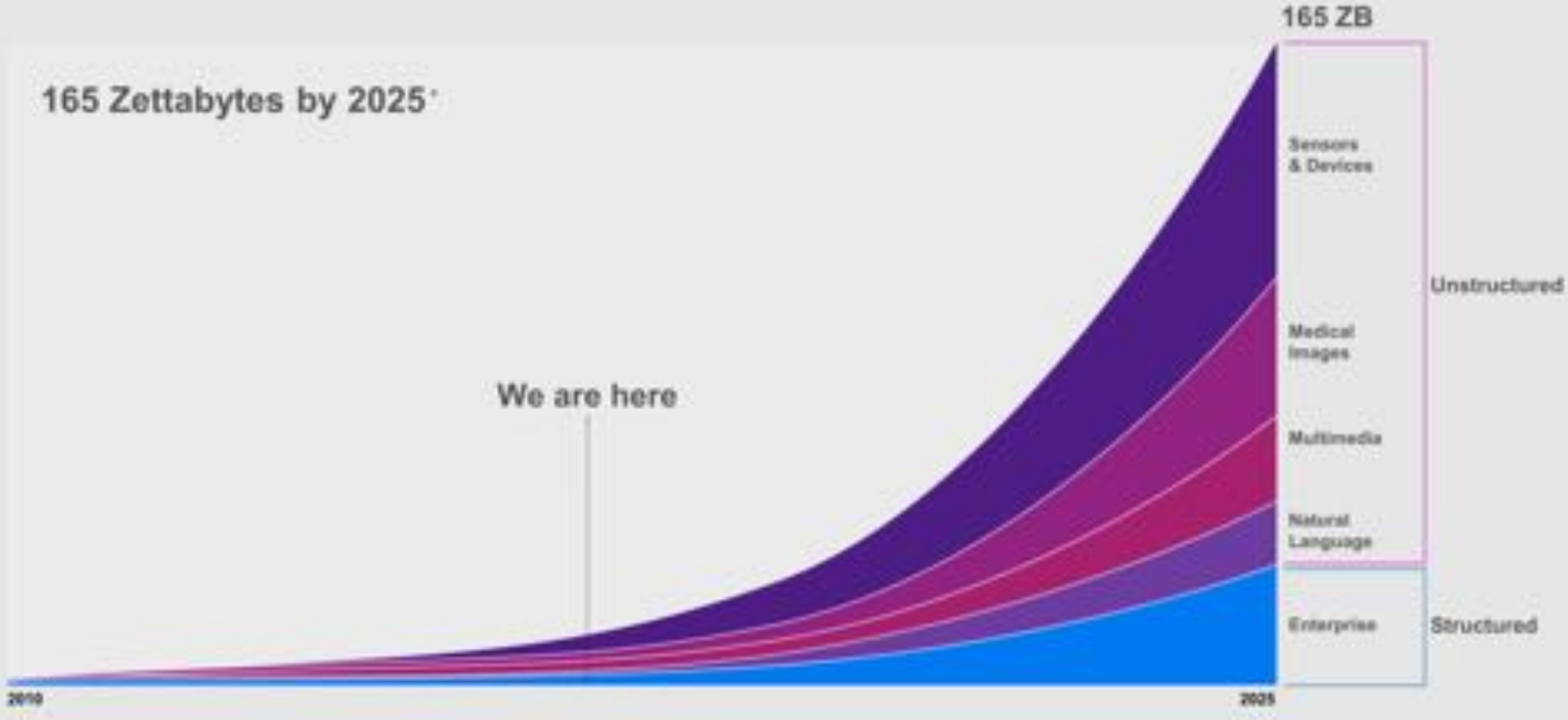
Tsunami Big Data

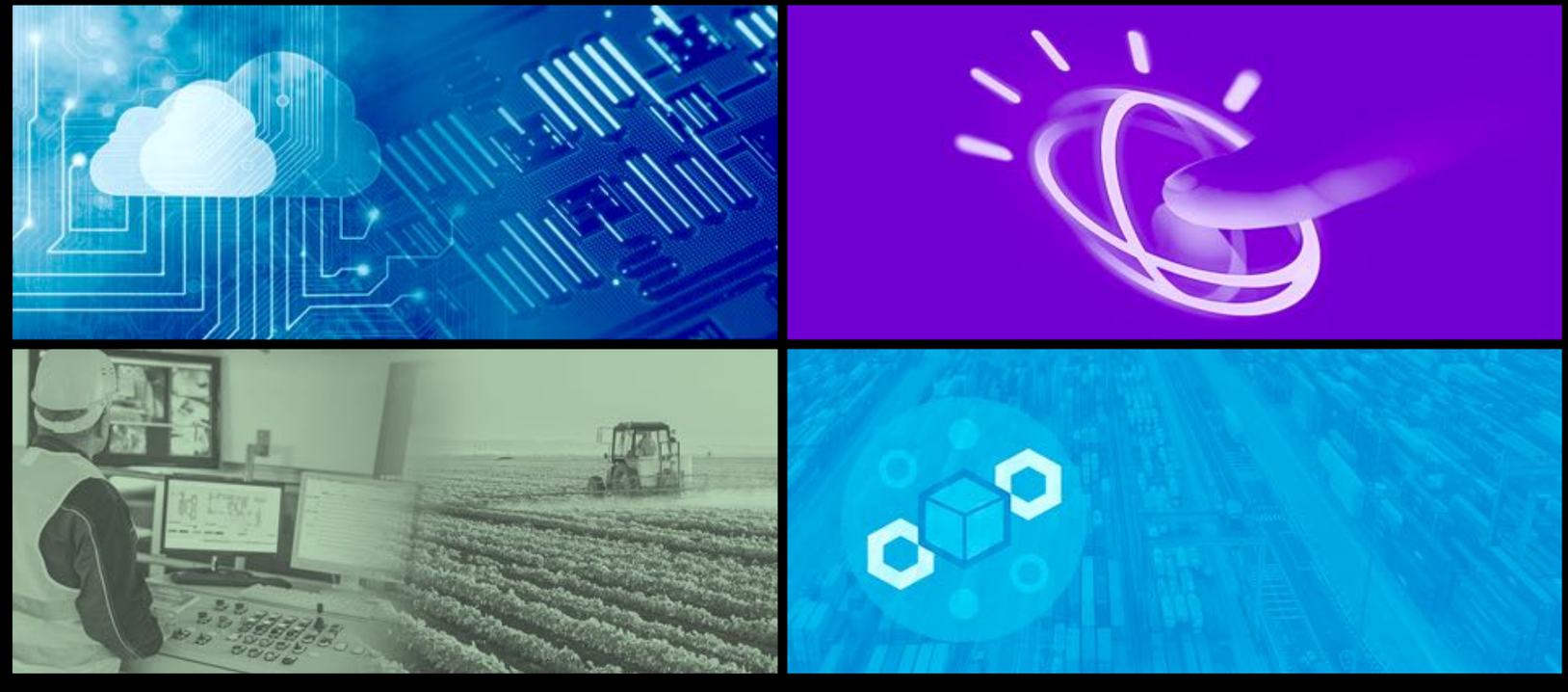
Data is **transforming every industry**



Strategic imperatives

Reimagining computing

Developing core AI

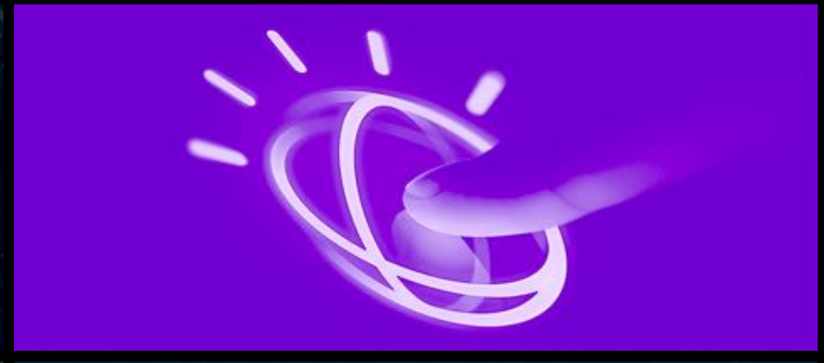


Transforming industries through science and AI

Defining and optimizing blockchain

Strategic imperatives: Developing core AI

AI will have enhanced reasoning abilities and will be widely distributed, helping us make decisions instantly.



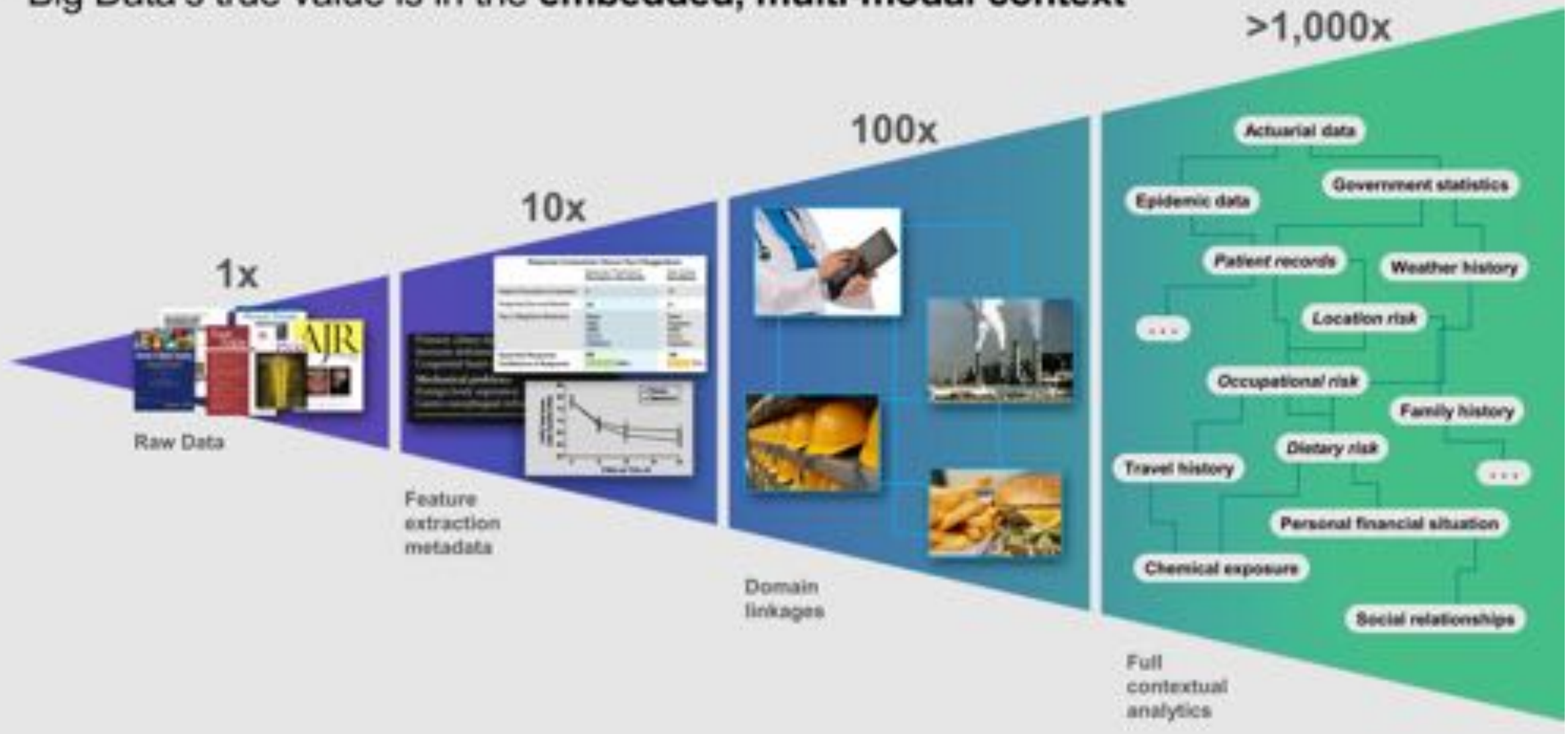
Advancing Broad AI

Signal Comprehension:
From video and text to rich human perception

Learning and Reasoning:
From scalable machine learning to making a case

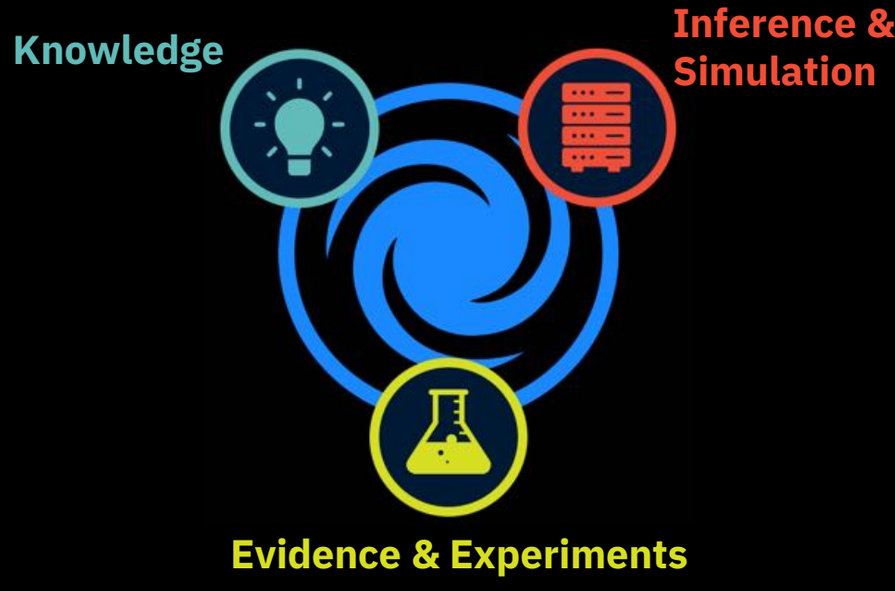
Interaction:
Understanding language, tone, emotion and context

Big Data's true value is in the **embedded, multi-modal context**



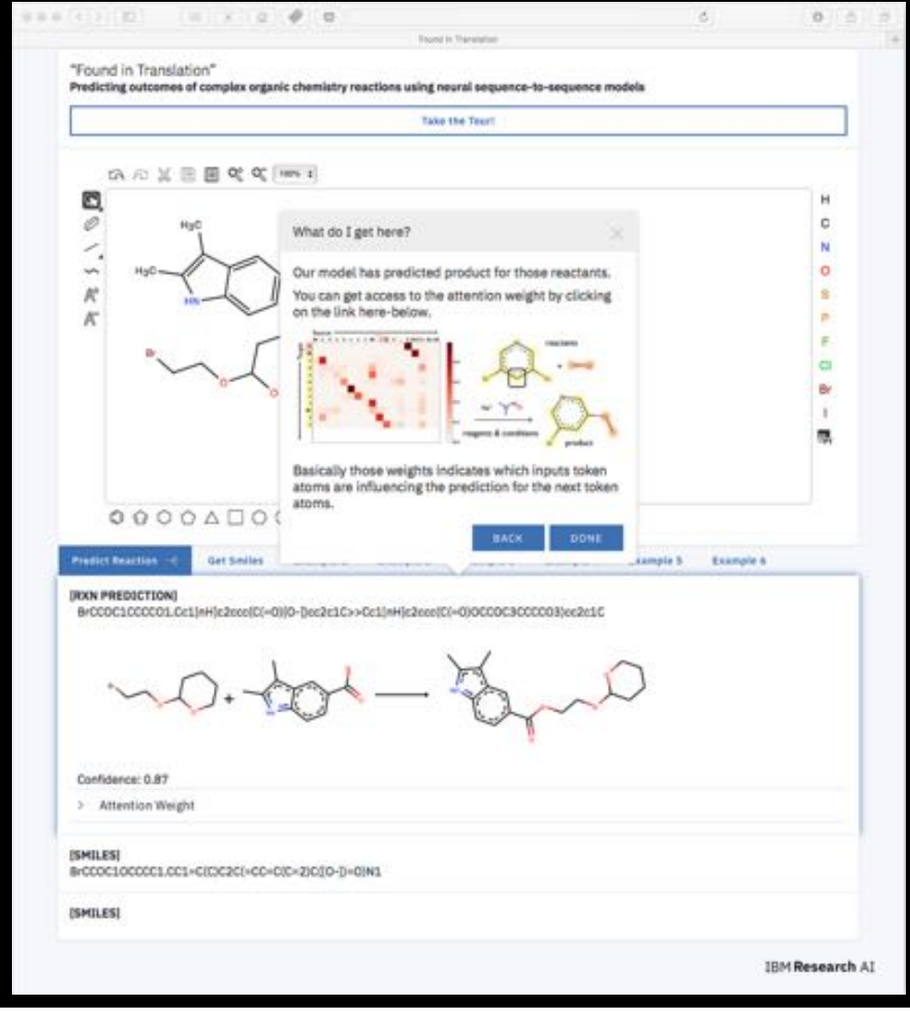
New AI horizons

Cognitive Discovery



Augmenting the scientific discovery process with cognitive approaches

Found in Translation: AI for Organic Chemistry



Smart annotator

9.4.143.71:9000

Annotator

Collections: PhysRev

Skip

Submit

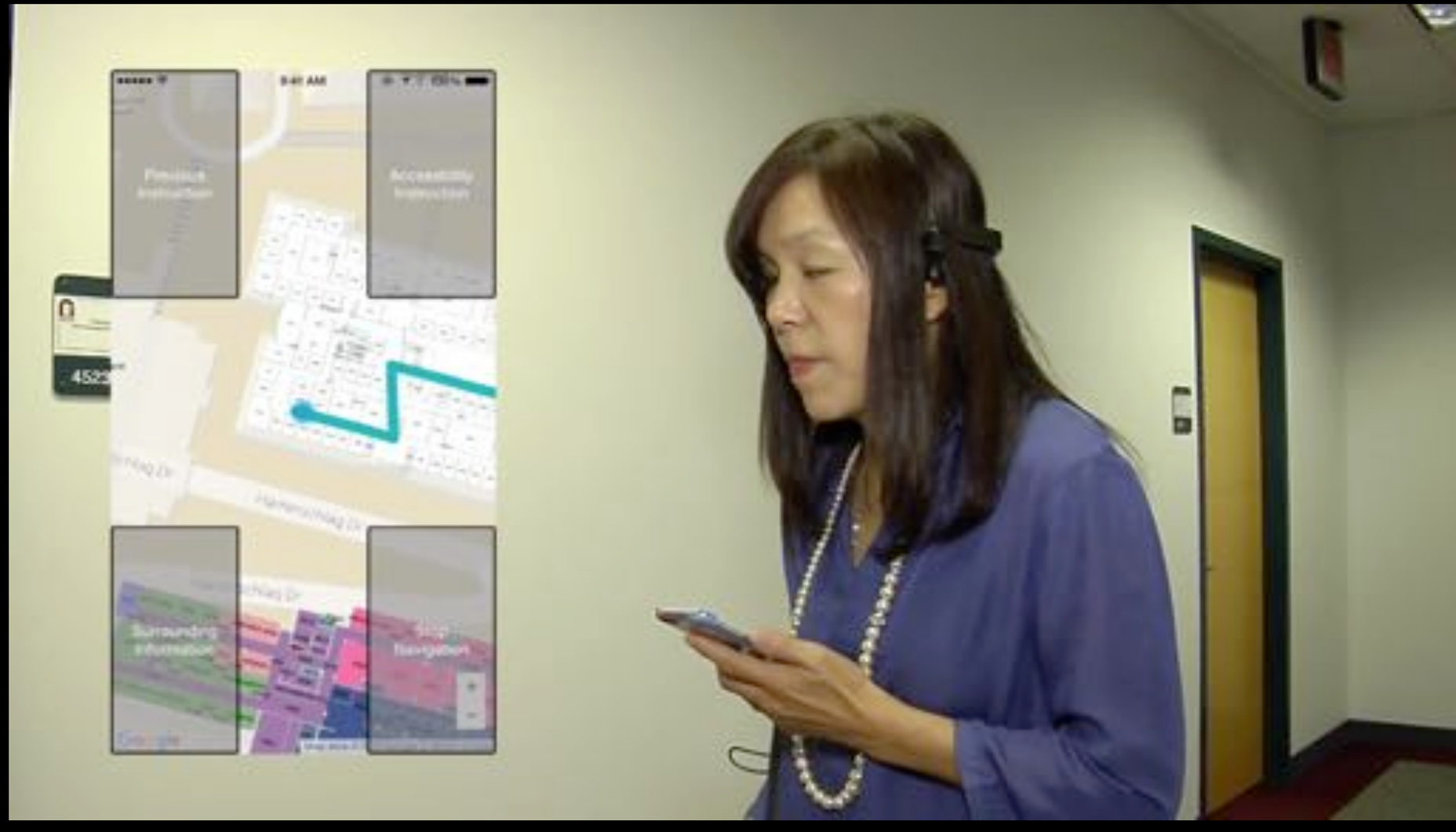
Strategic imperatives: Transforming industries through science and AI

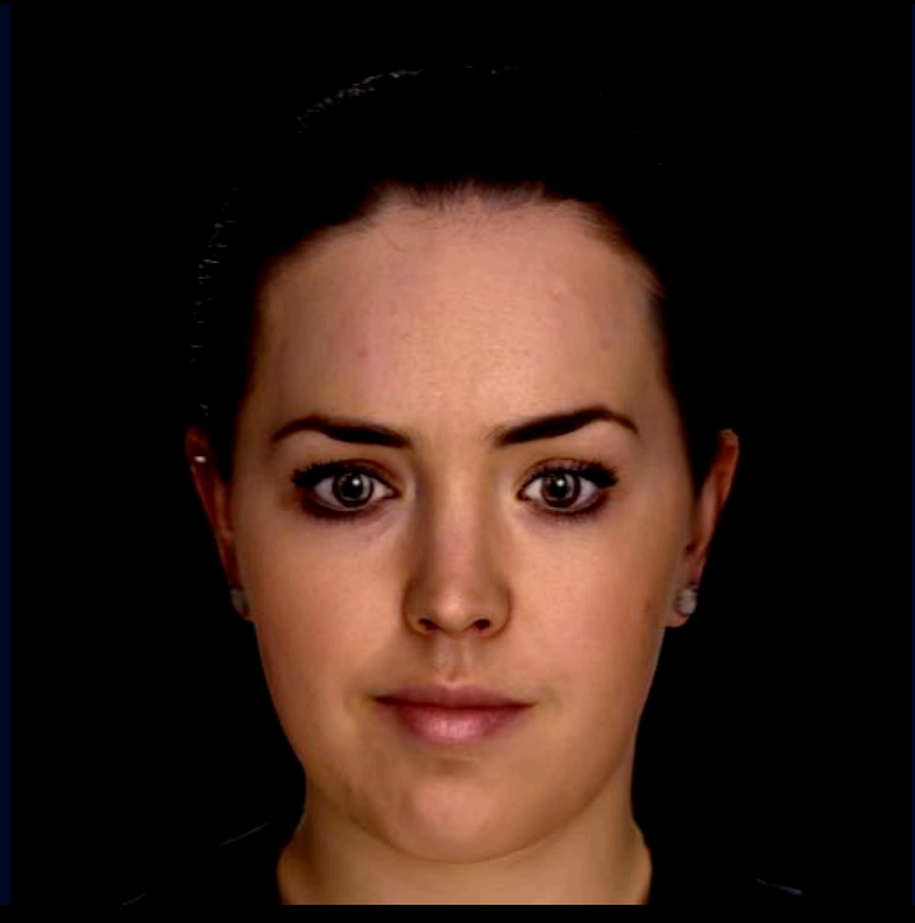
Artificial intelligence will integrate seamlessly into the workplace.

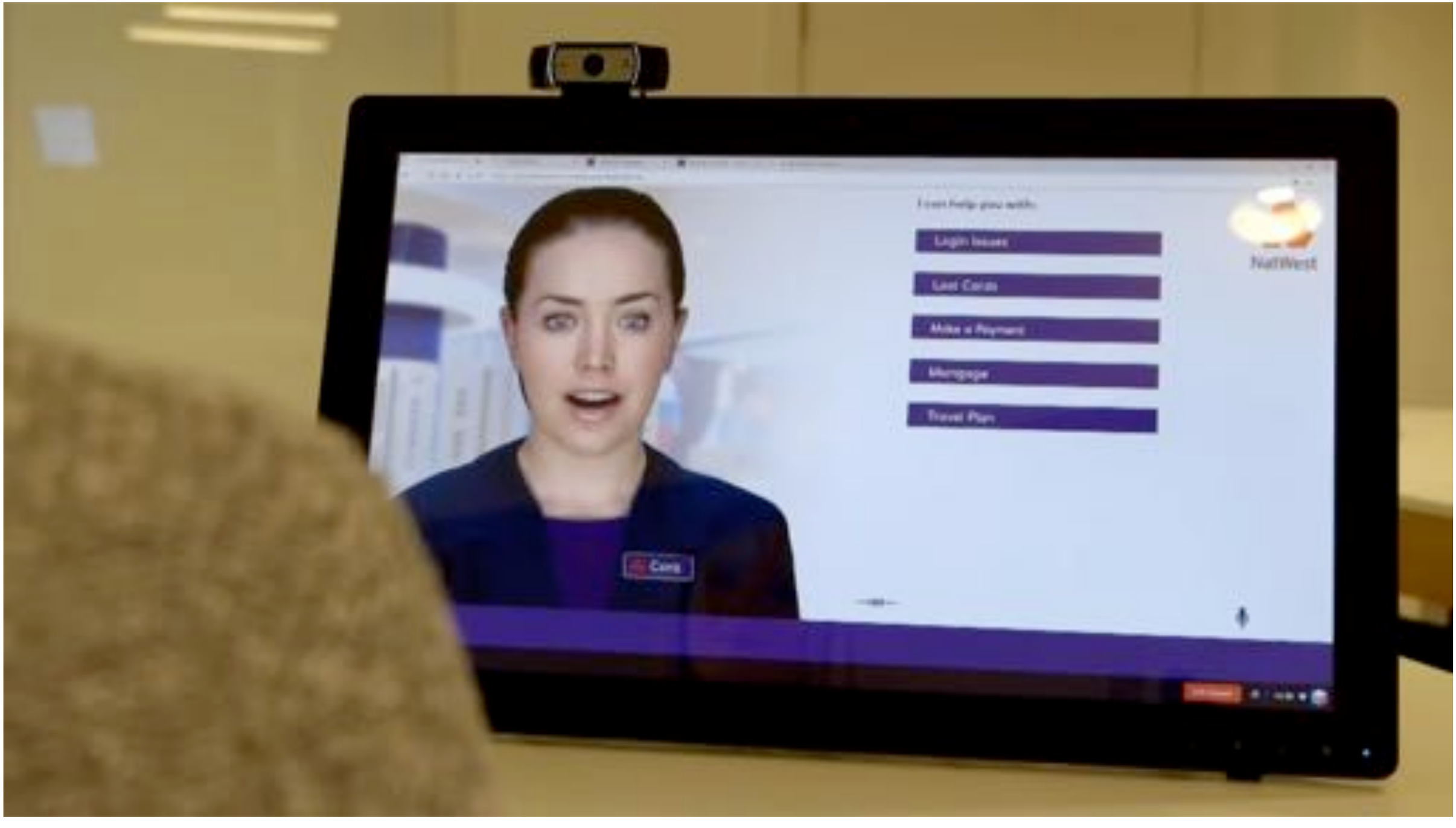

01
02
04
05
Speak now


Human
Machine

Assisting People with Disabilities

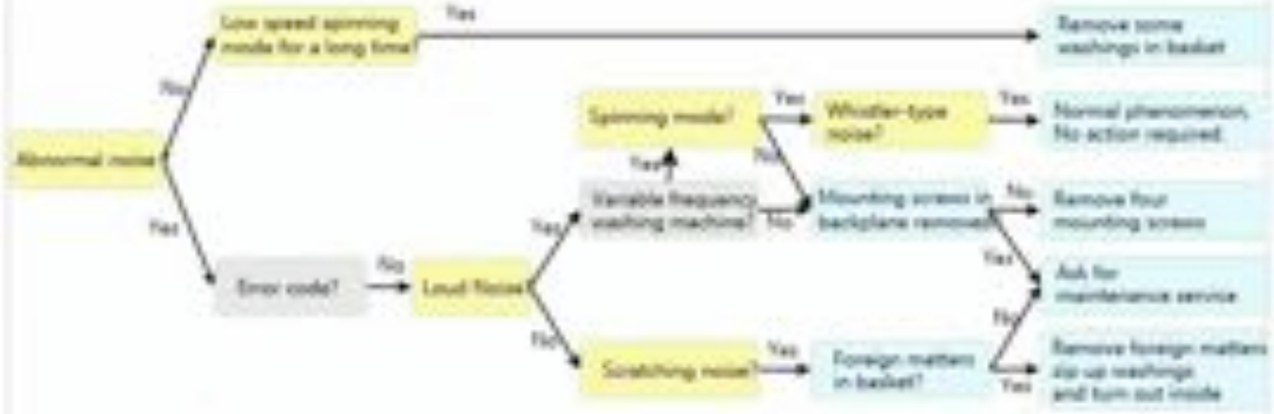





Login Issues
Lost Cards
Make a Payment
Mortgage
Travel Plan
NatWest

Washing Machine

Washing Machine Diagnosis



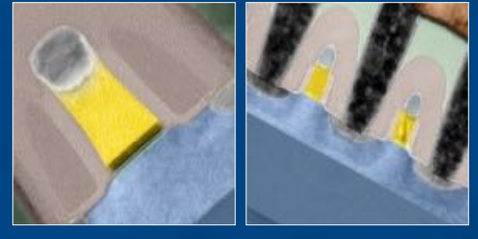
Time	ID	States

Strategic imperatives: Reimagining computing

A quest for new materials, devices and architectures to radically change what it means to compute

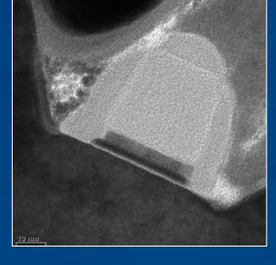
We are pushing the limits of chip technology

Conventional scaling efforts



Scaling:
22, 14, 10, 7, 5 nanometer nodes

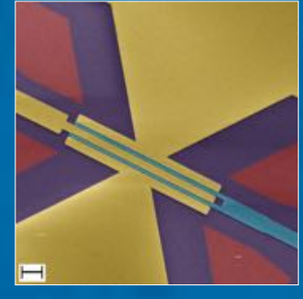
III/V Devices



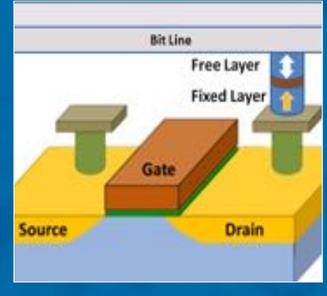
New materials and devices to extend core logic, memory and I/O technology roadmaps

Silicon Photonics

Carbon Devices



MRAM



Phase-change materials

3D

Brain-Inspired Neuromorphic Systems

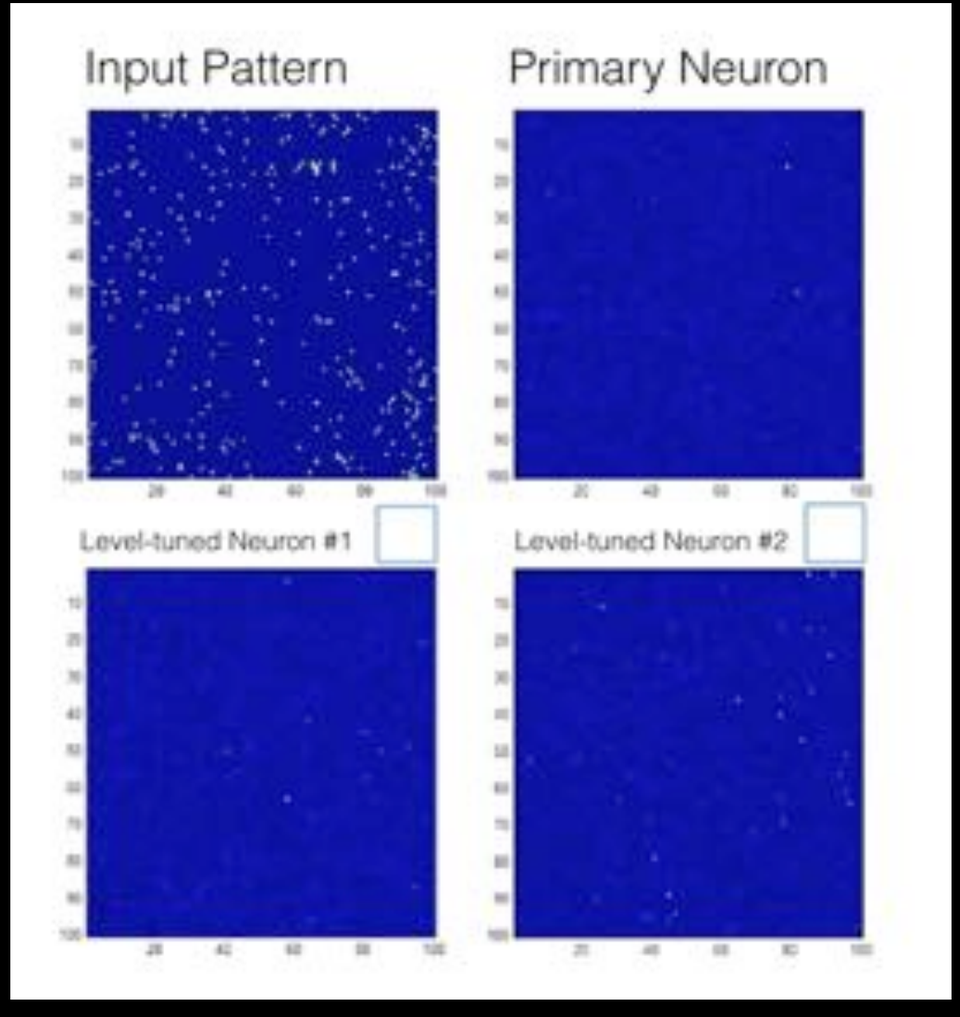
Saliency

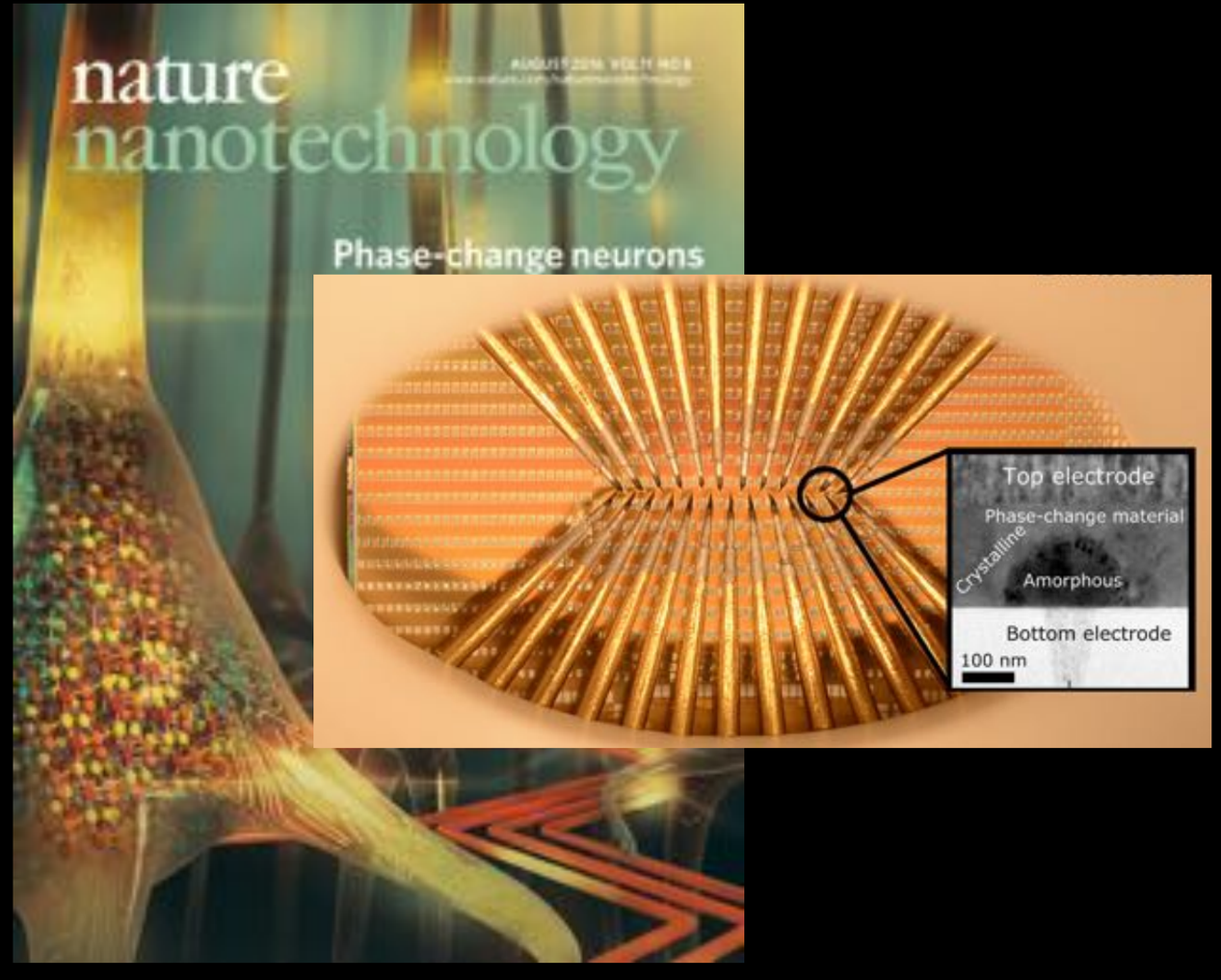
Saliency + Classification

Object Centers

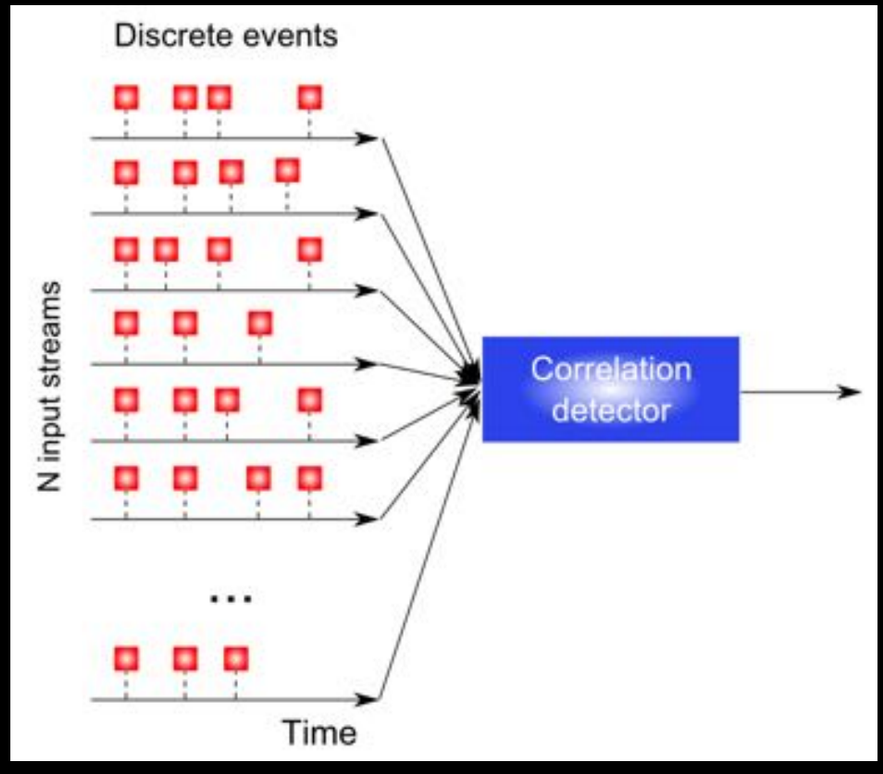
Output

Detecting Correlations with a Spiking Neural Network





Temporal correlation detection



Algorithmic goals

- Determine whether some of the input data streams are statistically correlated
- Gain selectivity specifically to the correlated inputs
- Observe variations in the activity of the correlated input
- Quickly react to occurrence of coincident inputs in the correlated inputs
- Continuously and dynamically re-evaluate the learned statistics

Use only unsupervised learning & consume very low power


FINANCE


SCIENCE


MEDICINE


BIG DATA

IoT at the EDGE

IBM is building first universal quantum computers for business and science

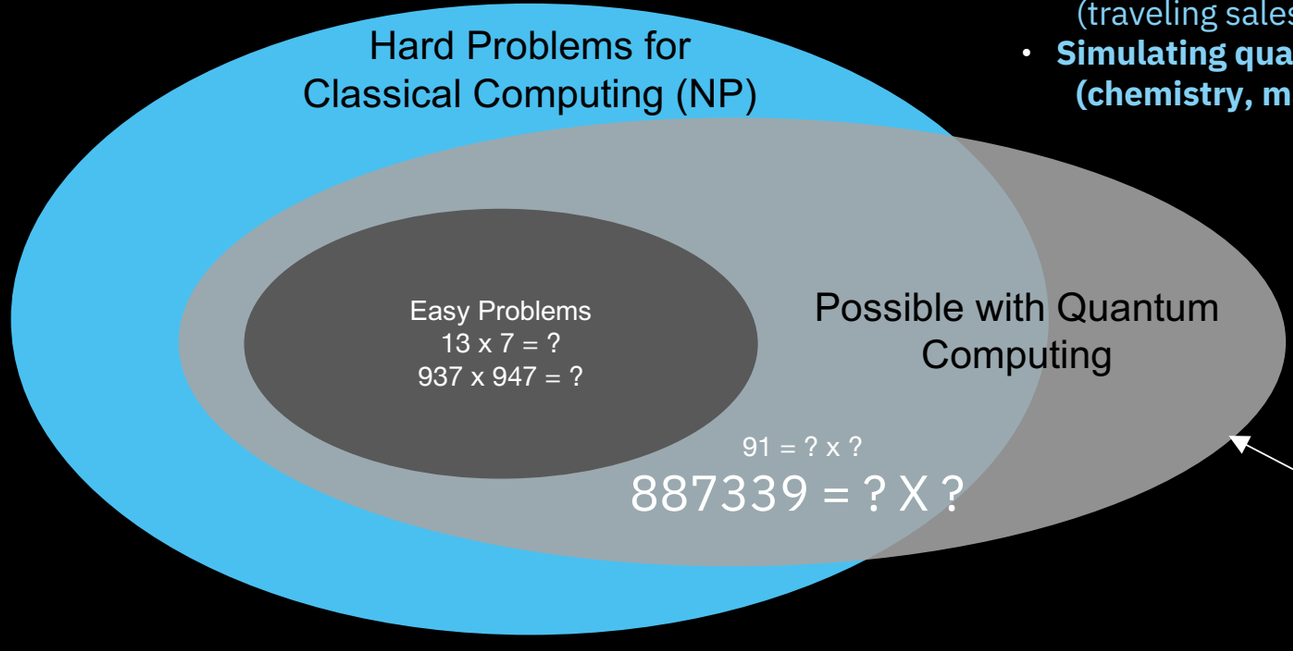
https://www.research.ibm.com/ibm-q/

Quantum Computing as a path to solve intractable problems

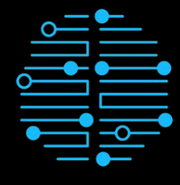
Many problems in business and science are too complex for classical computing systems

“hard” / intractable problems:
(exponentially increasing resources with problem size)

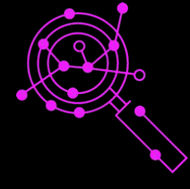
- **Algebraic algorithms**
  e.g. factoring, systems of equations, for machine learning, cryptography,...
- **Combinatorial optimization**
  (traveling salesman, optimizing business processes)
- **Simulating quantum mechanics**
  (chemistry, material science,...)



Material,
Chemistry



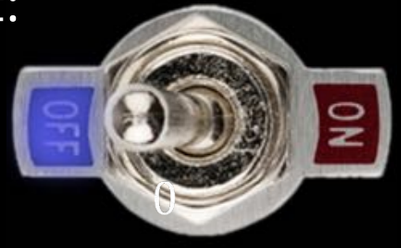
Machine
Learning



Optimization

What are the basic units of information ?

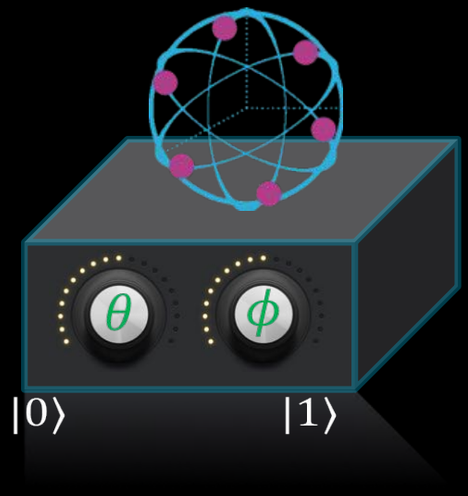
Bit:



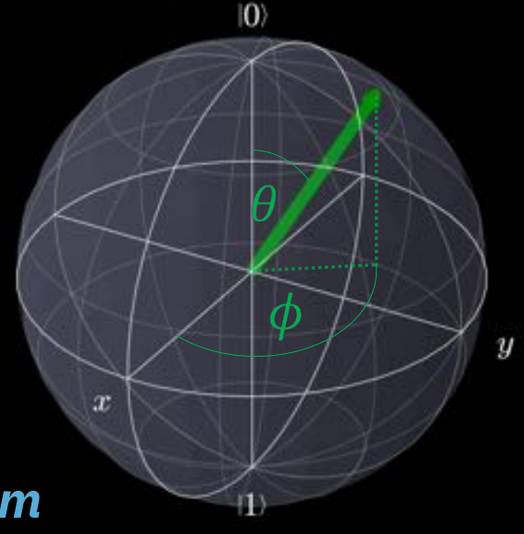
Bit state: 0 or 1

classical

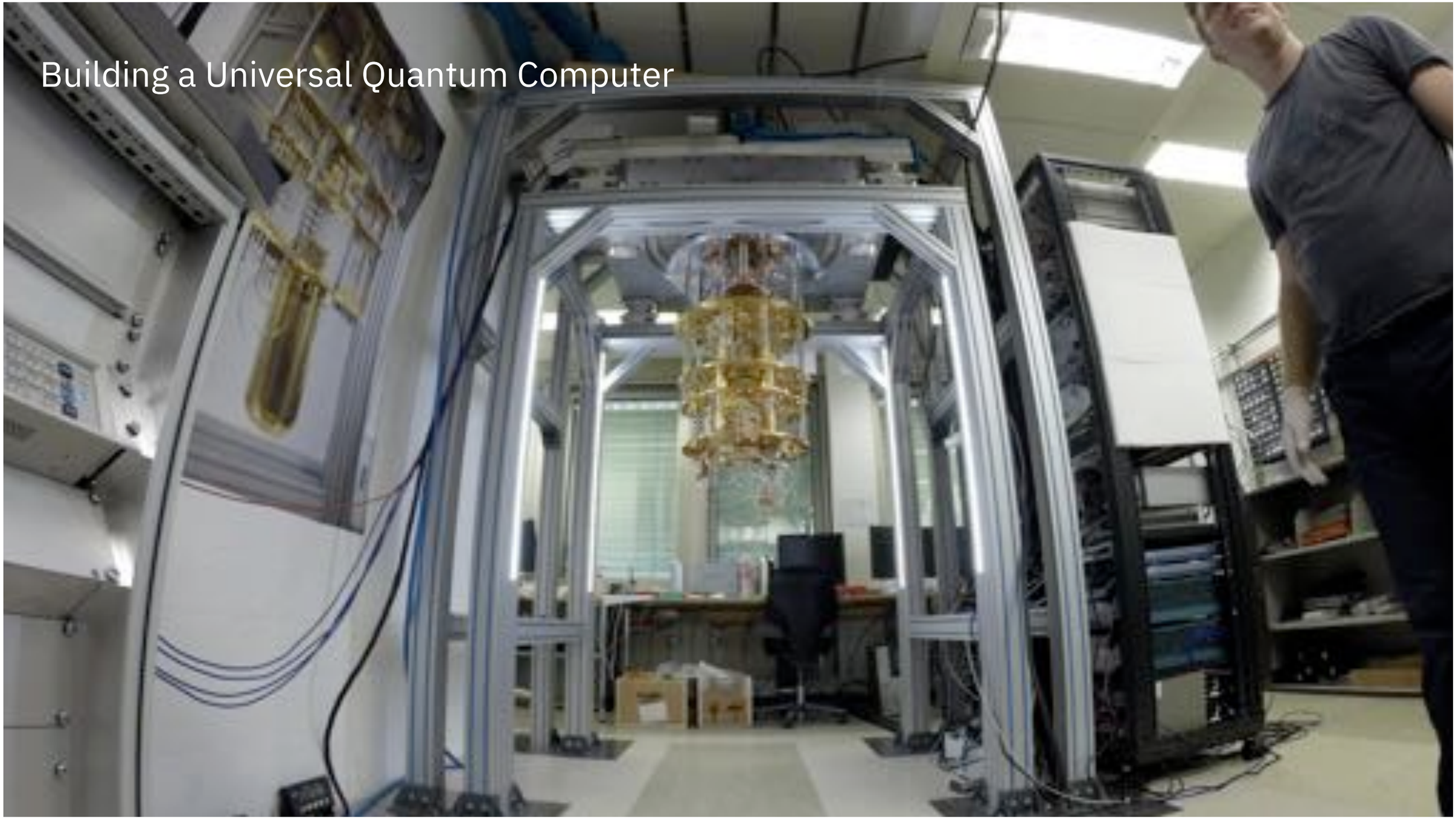
Qubit:



Qubit state: 0 and 1, at the same time (= superposition)
represented by point on (Bloch-)Sphere

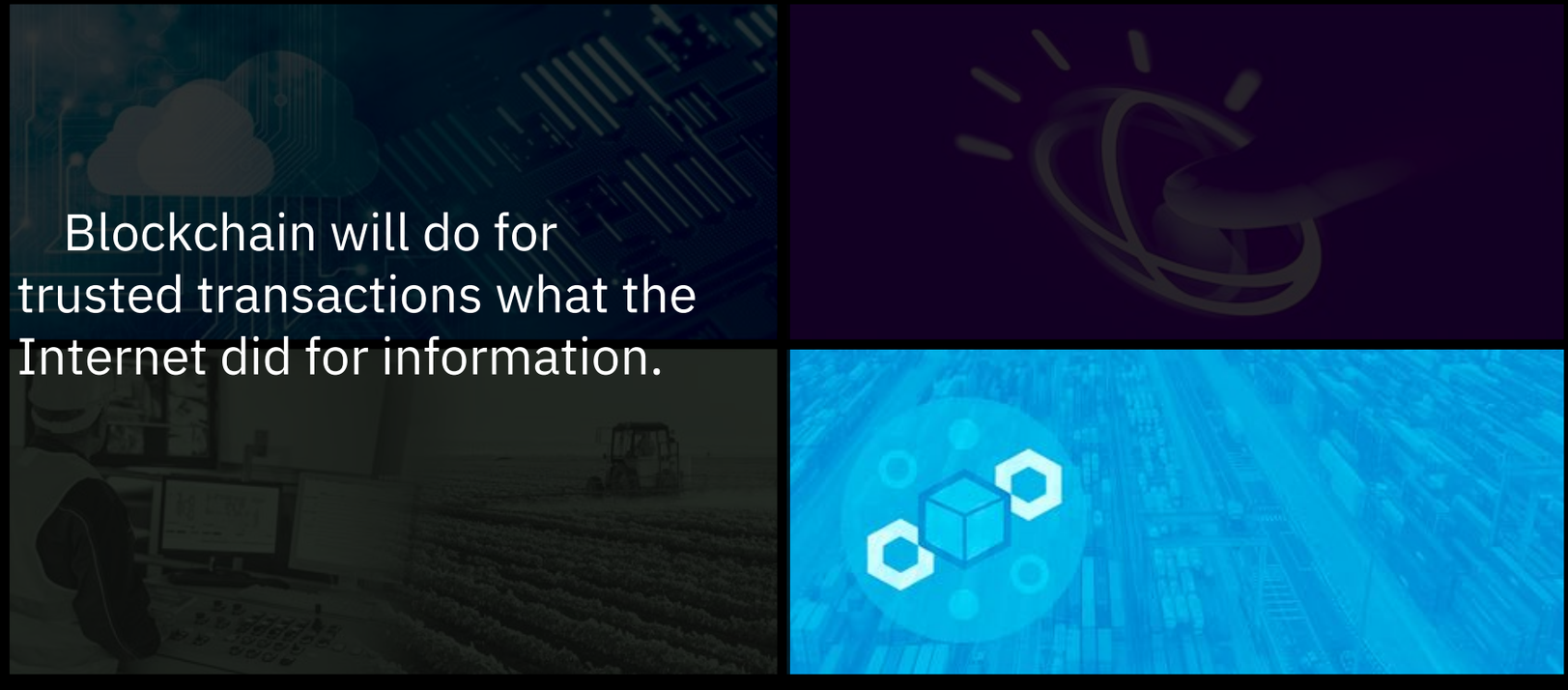


quantum

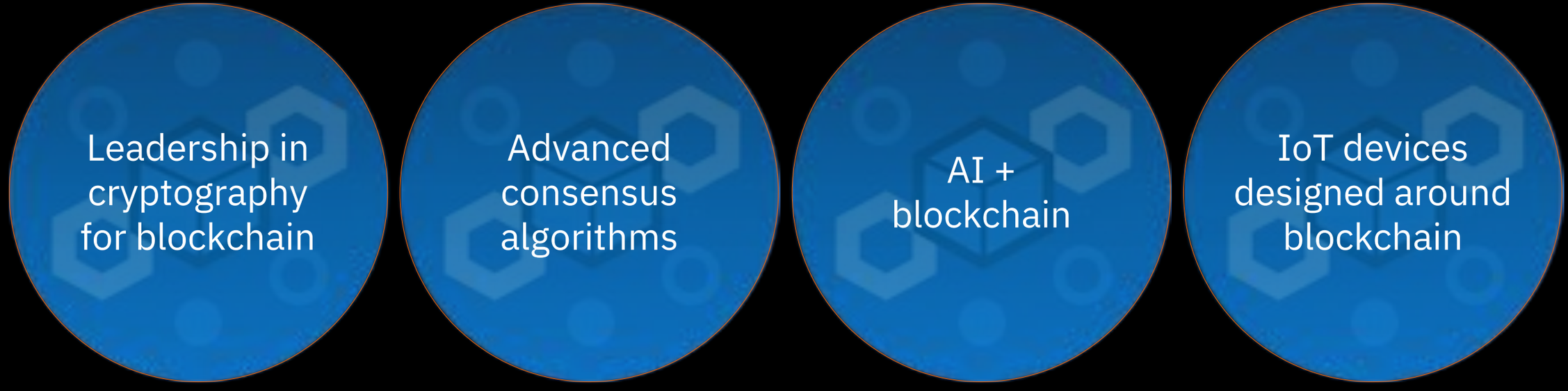

Building a Universal Quantum Computer


IBM Quantum Computing
Quantum Experience
Account
Logout
Directions
Qubit 0 properties
5.35 GHz
54 μs
74.3 μs
2018-04-27 02:47
User Guide
Composer
My Scores
Name: 'Grover's Search Algorithm, !!'
Real Quantum Processor
Simulate
Run
New
Save
Save as
Results
Help
GATES
MEASURE

Strategic imperatives: Defining and optimizing blockchain



Research leadership for IBM Blockchain



Blockchain for Aerospace MRO

An irrefutable ledger to record flight events, operation conditions and maintenance actions. These logs can be kept in the cloud and shared across different parties including the original equipment manufacturer, the airline and the maintenance repair operator.

Image: Wikimedia Commons

Mobile Wallet

The Electric Car Which Pays for Itself

Charging

No need to manage various accounts with different service providers

Parking and Valet Services

Find and pay for desired parking spaces

Immutable Car Pass

A record for all car maintenance, milage, ownership, battery charges

Car Sharing

Accept payments and authorise vehicle access by 3rd parties, such as delivery services

ZF

UBS

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CAR WALLET


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