

Artificial Intelligence

Driven by Innovation in Compute

Sandeep.Alur@Microsoft.com

 @saalur



Mixed
Reality



Elevation
25,643'

Temperature
-22°C

Artificial
Intelligence



Quantum
Computing

Advances that make AI real

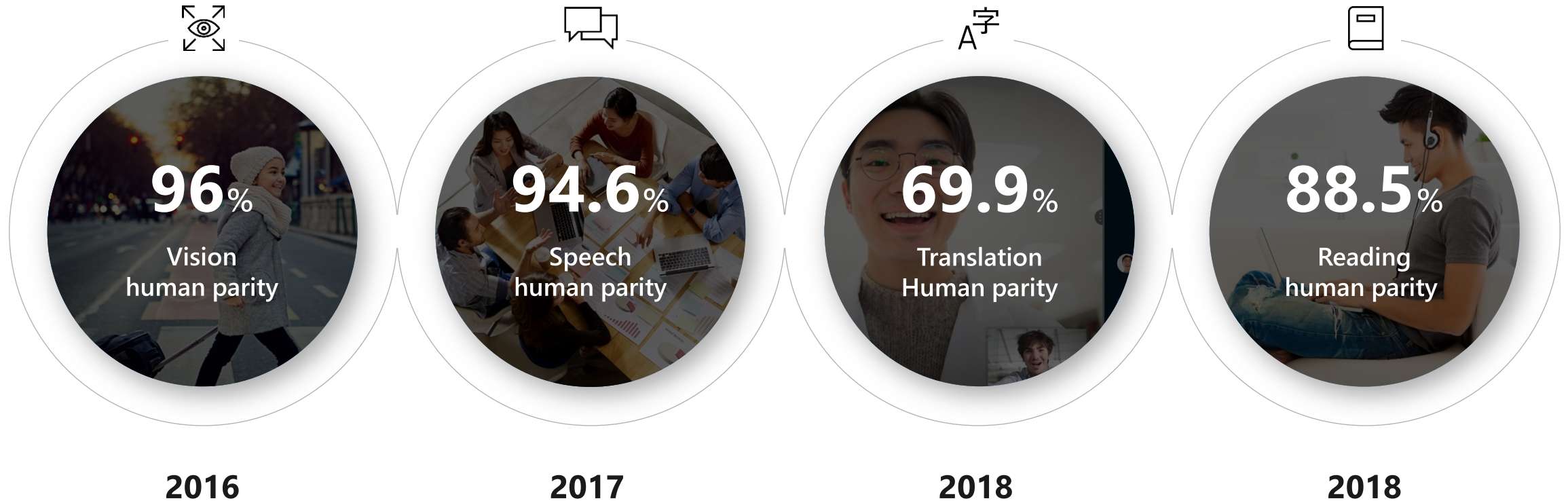
Vast amounts of data



Huge computational power



Reaching human parity

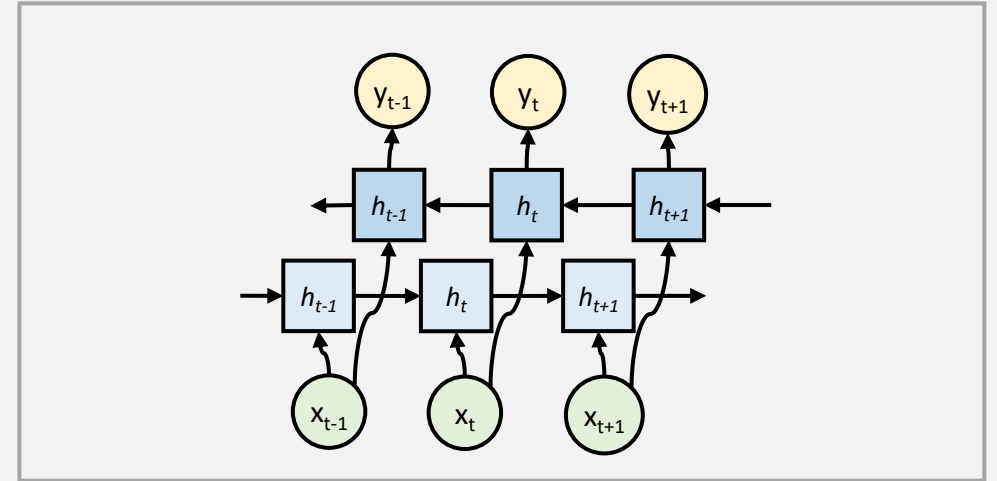


Microsoft AI advancements

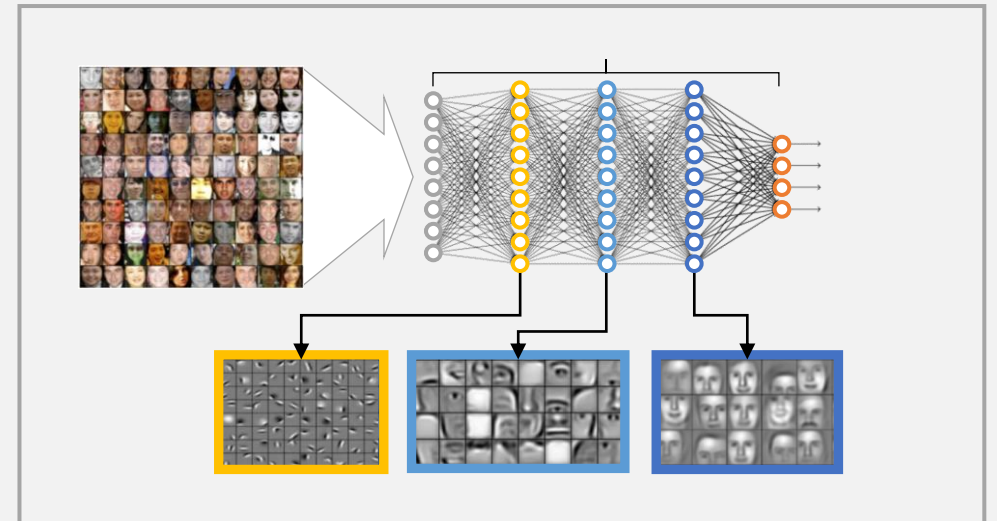
Breakthroughs in deep learning demand real-time AI

- Deep neural networks have enabled major advances in machine learning and AI
- Problem
DNNs are challenging to serve and deploy in large-scale online services

Recurrent Neural Networks



Convolutional Neural Networks



AI demands a faster and more intelligent cloud

→ Flexible scale

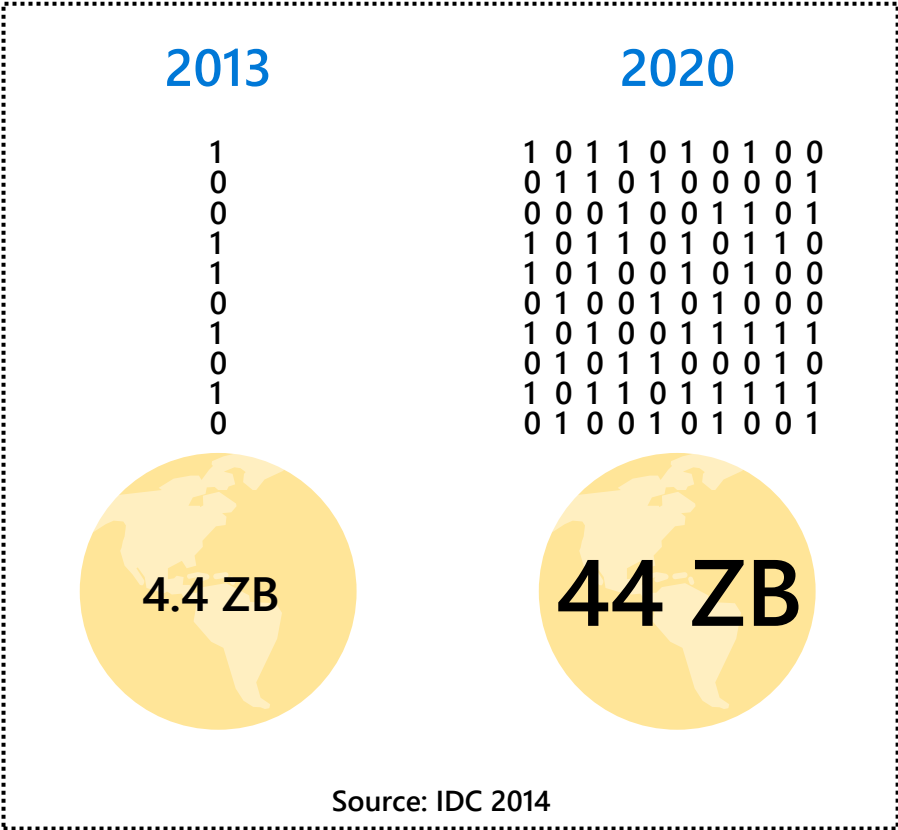
Data explosion: 2013 4.4 ZB - 2020 44 ZB
Machine Learning & AI proliferating

→ Low latency

Real-time insights
Interactive user experiences
Autonomous decision making

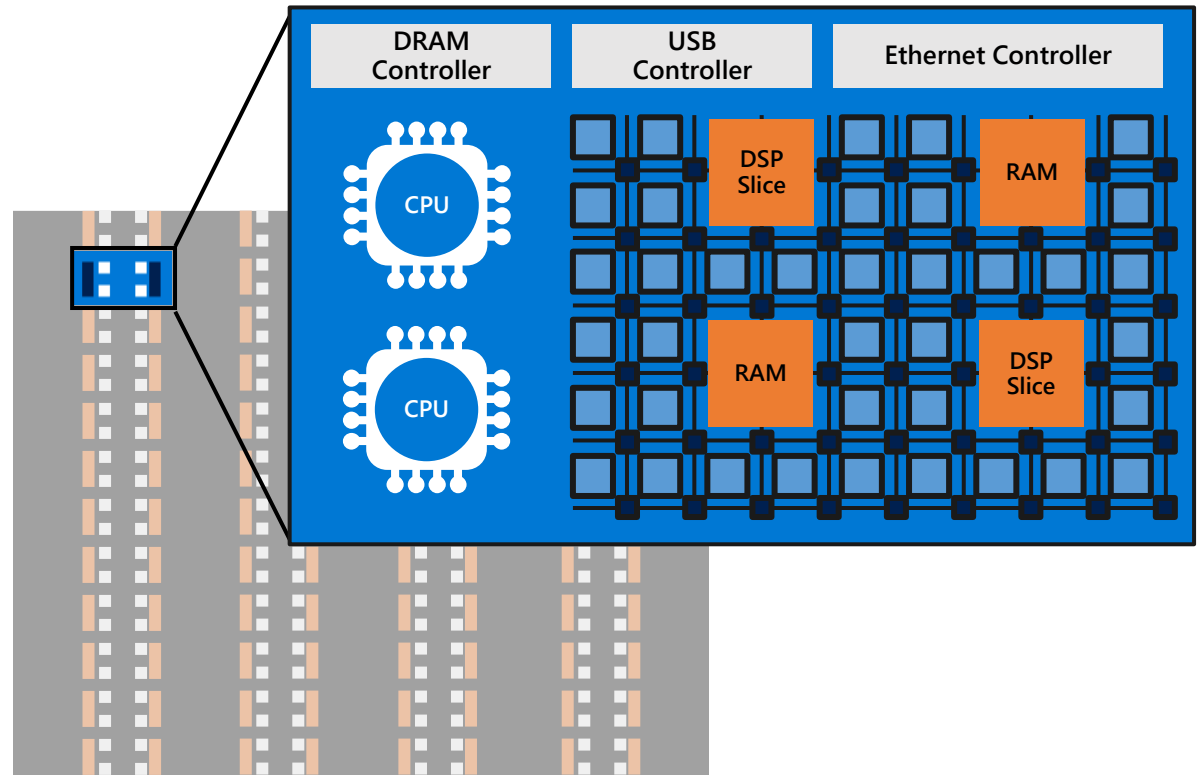
→ High throughput

Cloud-scale services
Converting data to intelligence



What is FPGA technology?

- Field Programmable Gate Array
- Reprogrammable silicon
- Specialized compute engines
- Flashed via software in <2 seconds
- Updatable as often as needed



A complete, scalable, quantum system

Room temp →

Nitrogen →

Helium →

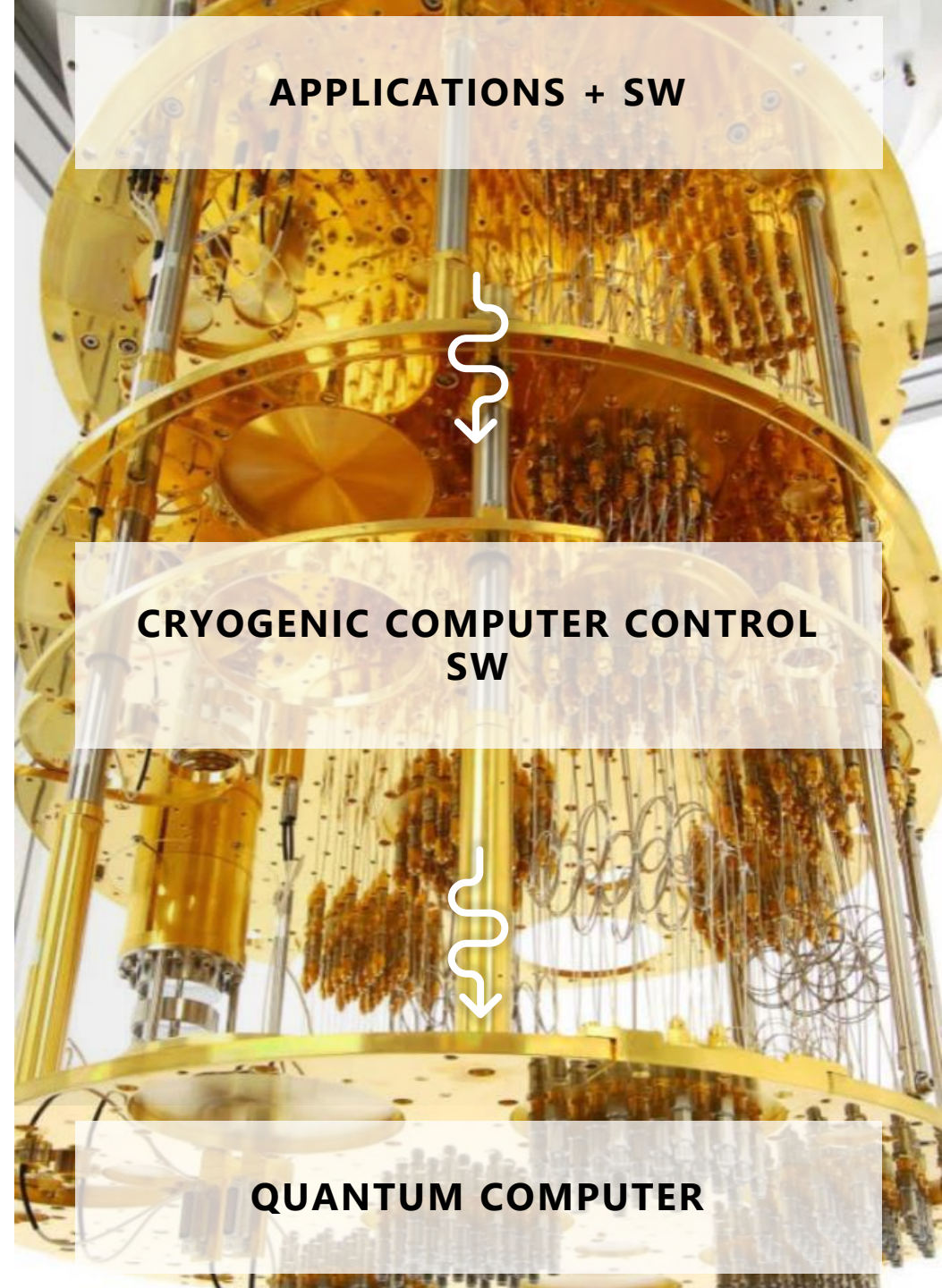
Deep Space →

Quantum World →

APPLICATIONS + SW

CRYOGENIC COMPUTER CONTROL
SW

QUANTUM COMPUTER



Case study: Domain Expertise

Case Western Reserve University advances MRI research with quantum

Objective: Optimize MRI pulse sequences for...

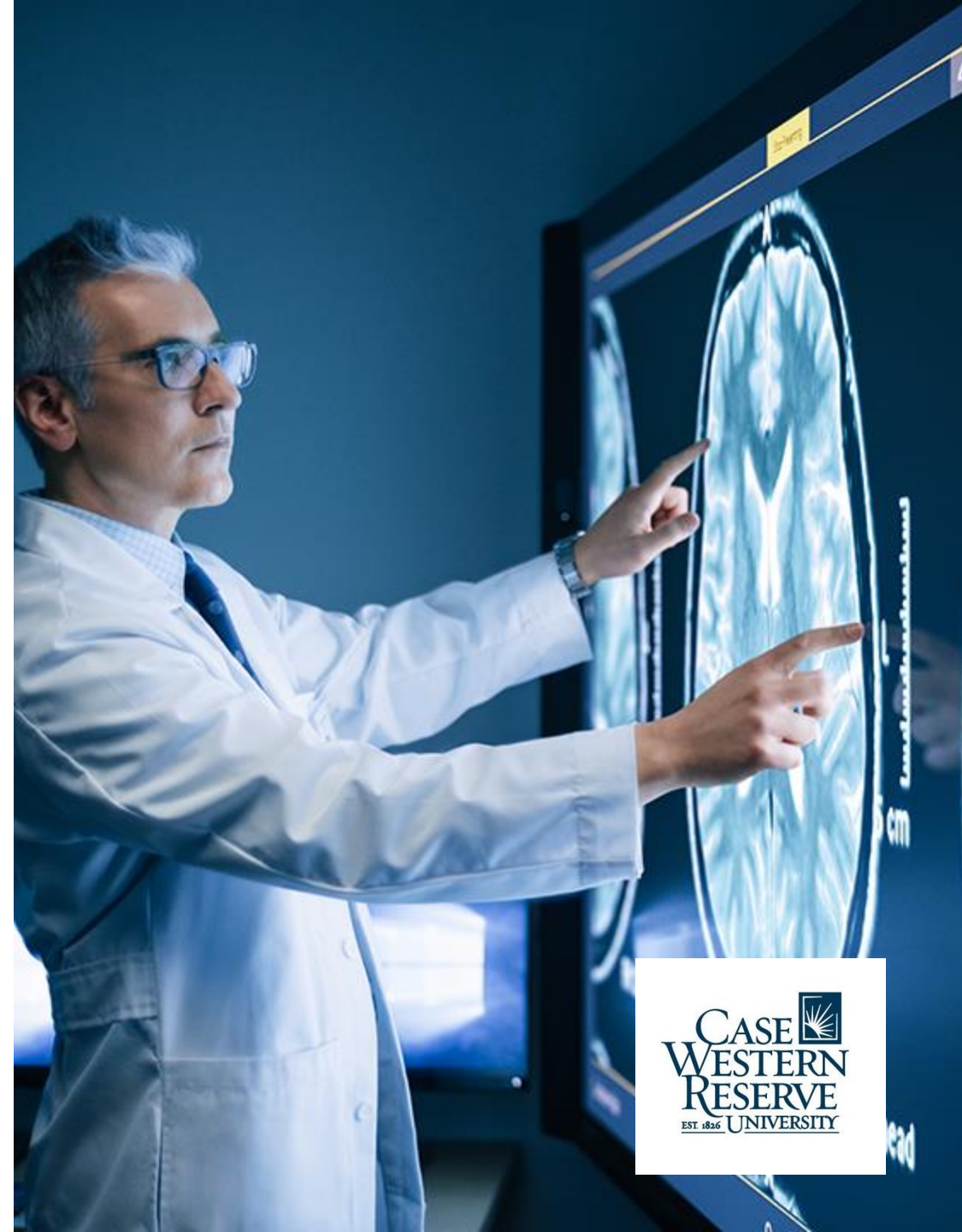
Better quality imaging

Faster diagnosis

Iterative approach:

Optimization via diffusion Monte Carlo

Weekly in vivo tests



The Microsoft Quantum Development Kit



Q#

A new language for quantum *algorithms*.



Open-source libraries/samples

Phase estimation, amplitude amplification, state preparation, and more



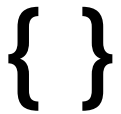
Powerful dev tools

Extensions for Visual Studio and VS Code



Docs

Comprehensive documentation



.NET Core

Enables cross-platform development on Windows, macOS, and Linux

A screenshot of the Microsoft Visual Studio IDE showing a Q# code file named 'DatabaseSearch.qs'. The code is written in a dark-themed editor with line numbers on the left. It includes comments in green and code in white. The code defines a 'QuantumSearch' operation that takes 'nIterations', 'markedQubit', and 'databaseRegister' as parameters. It performs state preparation, a loop of Grover iterations, and reflection operations.

```
224 // # Summary
225 // Prepares the start state and boosts the amplitude of the marked
226 // subspace by a sequence of reflections about the marked state and
227 // the start state.
228 //
229 // # Input
230 // ## nIterations
231 // Number of applications of the Grover iterate (RS + RM).
232 // ## markedQubit
233 // Qubit that indicates whether database element is marked.
234 // ## databaseRegister
235 // A register of n qubits initially in the |00...0> state.
236 operation QuantumSearch(
237     nIterations : Int, markedQubit : Qubit,
238     databaseRegister: Qubit[]) : ()
239 {
240     body {
241         StatePreparationOracle(markedQubit, databaseRegister);
242         // Loop over Grover iterates.
243         for(idx in 0..nIterations - 1){
244             ReflectMarked(markedQubit);
245             ReflectStart(markedQubit, databaseRegister);
246         }
247     }
248 }
```

Q# Goes Open-Source

COMING THIS YEAR

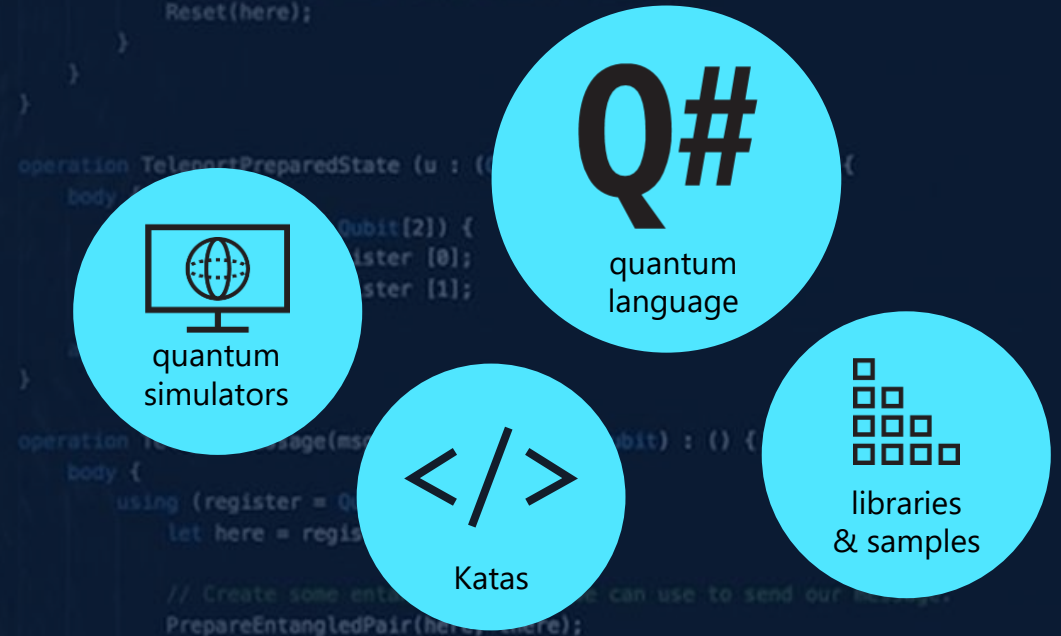
- **Open-source** Q# compiler
- **Open-source** quantum simulators
- **Open-source** libraries, samples and katas (self-paced tutorials)

SHARE your ideas!

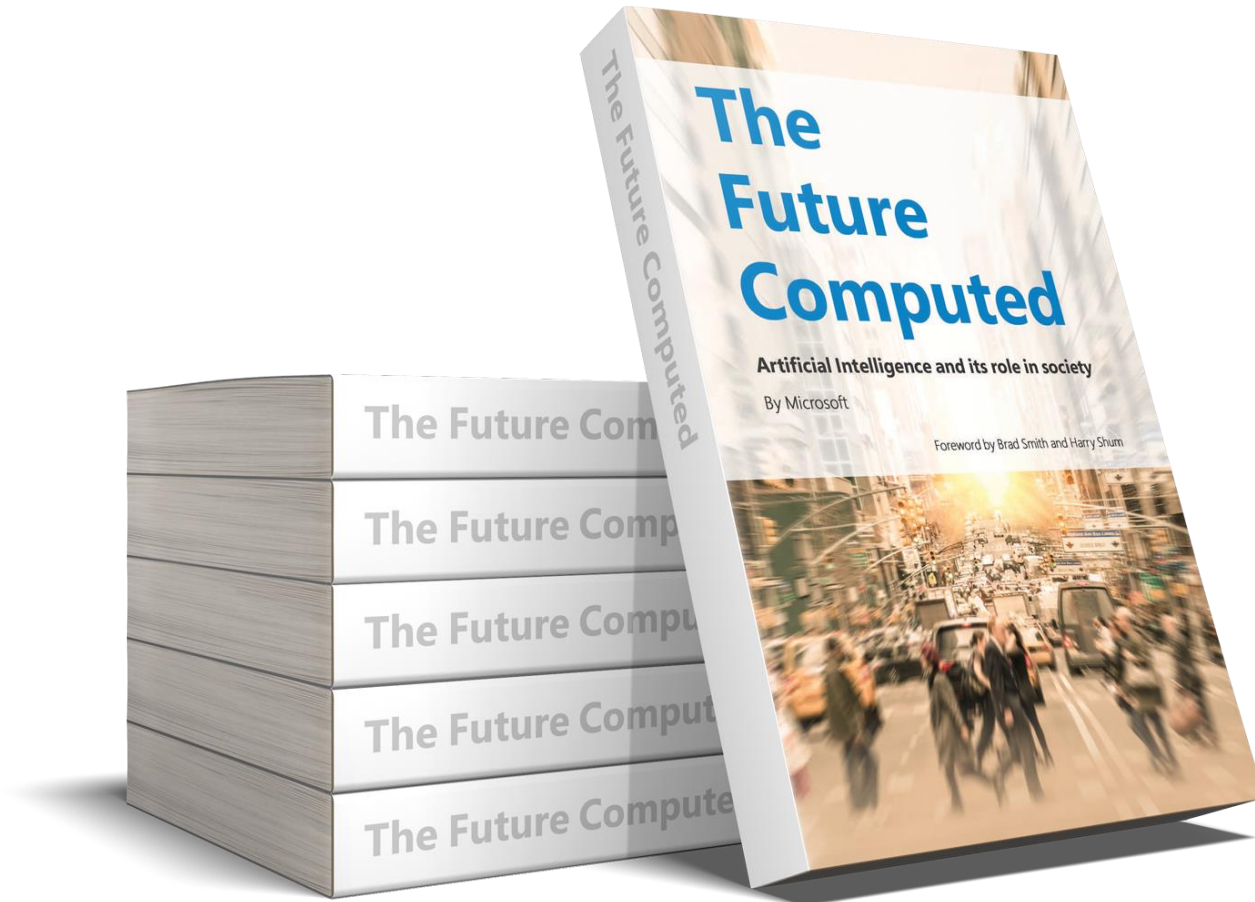
COLLABORATE with your code!

ENGAGE the Q# community!

DRIVE the quantum revolution!



Microsoft Quantum
Development Kit



“Ultimately the question is not only what computers can do. It’s what computers should do.”

– The Future Computed

Brad Smith ✓

@BradSmi

harryshum ✓

@harryshum

Learn more

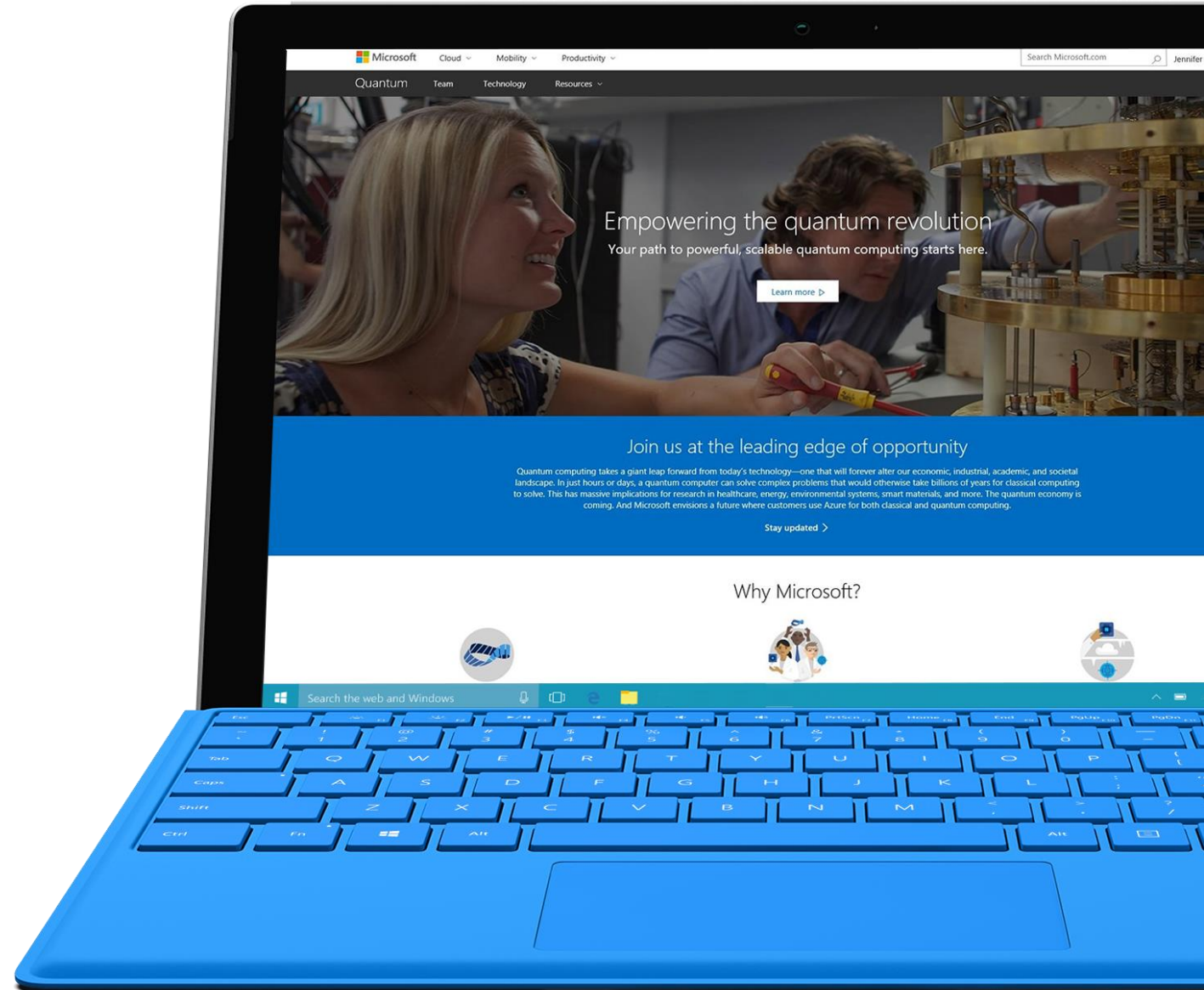
Download the
Microsoft Quantum Development Kit

github.com/microsoft/quantum/

Explore the documentation

docs.microsoft.com/quantum/

microsoft.com/quantum





THANK YOU

Sandeep.Alur @Microsoft.com

 @saalur