Get started developing for quantum computers today!

Dr. Sarah Kaiser | Azure Community Live!

→ sckaiser.dev | @crazy4pi314

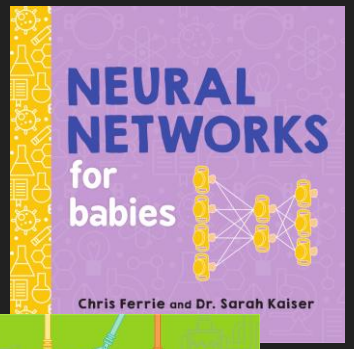
How is Azure involved here?

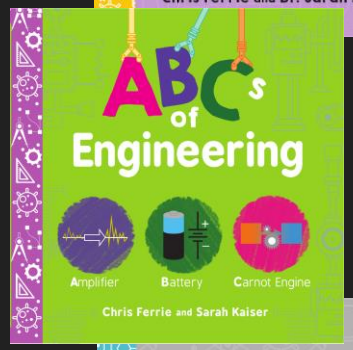
Azure Quantum PREVIEW

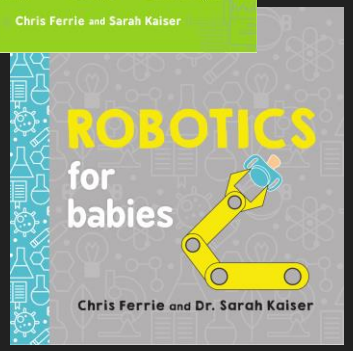
Azure Quantum is a new service coming soon to Azure that will offer a number of different ways to explore quantum impact to your applications.

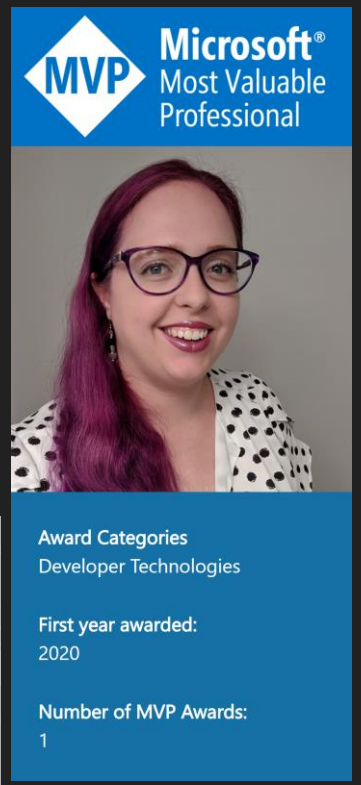
The Quantum Development Kit and Q# is the entry point!

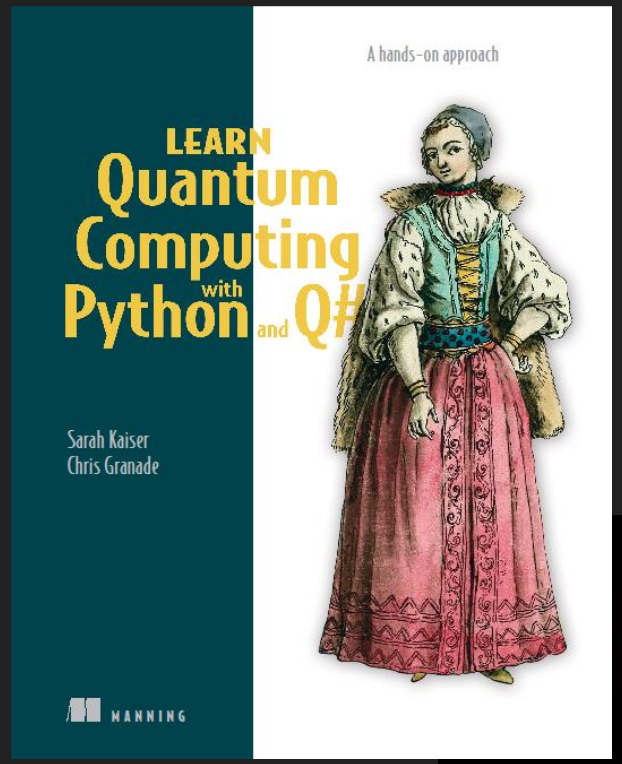
about_me.md



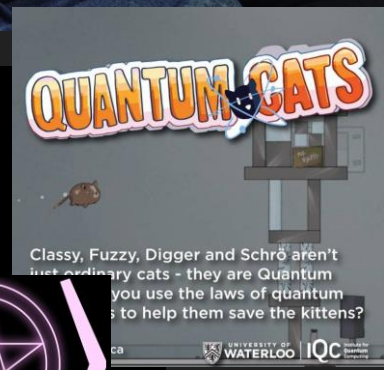








qsharp.community



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What have you heard about Quantum Computing?

Put it in the chat!

Antimatter seen in two places at once thanks to quantum experiment

The double-slit experiment is a classic demonstration that all particles of light and matter are also waves - and now...

NS New Scientist · 23 hours ago

Physics

Which came first, the chicken or the egg? Both, quantum physics says

New research from University of Queensland physicists shows events aren't always as orderly as one might ima...

USA TODAY · 16 hours ago

Quantum

This Mad New Quantum Experiment Breaks The Idea of 'Before' And 'After'

For around a century it's been thought that particles don't have defined properties until we nail them down with a ...

ScienceAlert · 9 hours ago

spooky. At least that's what Albert Einstein said when de...

Phys.org · 6 hours ago

Quantum

Can a New Blockchain Counter the Quantum Computing Threat

There has been a strong focus on the effects of quantum computing on blockch...

NewsBTC · 57 mins ago

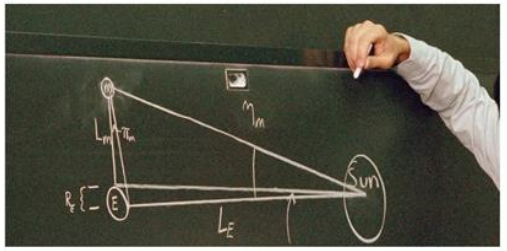
Quantum mechanics

There Are Two Kinds of Water in Every Glass, Thanks to Quantum Physics

In every glass of water you drink, there are two kinds of H2O. And scientists have shown that they have significa...

Live Science · 17 hours ago

Quantum mechanics



Quantum physics can help explain much of the world's suffering

Quantum physics is the science that describes nature at its smallest atomic levels. But tiny subatomic happening...

Quartz · 13 hours ago

Could Quantum Computing Be the End of Free Will?

Faster, more powerful computing has the potential to revolutionize fields from drug delivery to freight transpor...

The Atlantic · 9 hours ago

Quantum mechanics

Revised Schrödinger's cat experiment challenges reality

Quantum mechanics has produced its share of weird

The promise of quantum computing supremacy is bunk

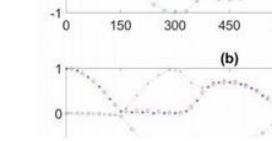
Google recently announced that the first demonstration of quantum supremacy could be just a few months away. I ...

The Next Web · 8 hours ago

Quantum

We might only see time because we can't think in quantum physics

Humans need much more information to study a problem



Braiding may be key to usir quantum computing

Over the past few years, physicists new form of matter called time cry

Phys.org · 11 hours ago

Quantum mechanics

Closed Loophole Confirms Unreality of the Quantum W

A quickly closed loophole has prov the "great smoky dragon" of quantu

Quanta Magazine · 4 hours ago

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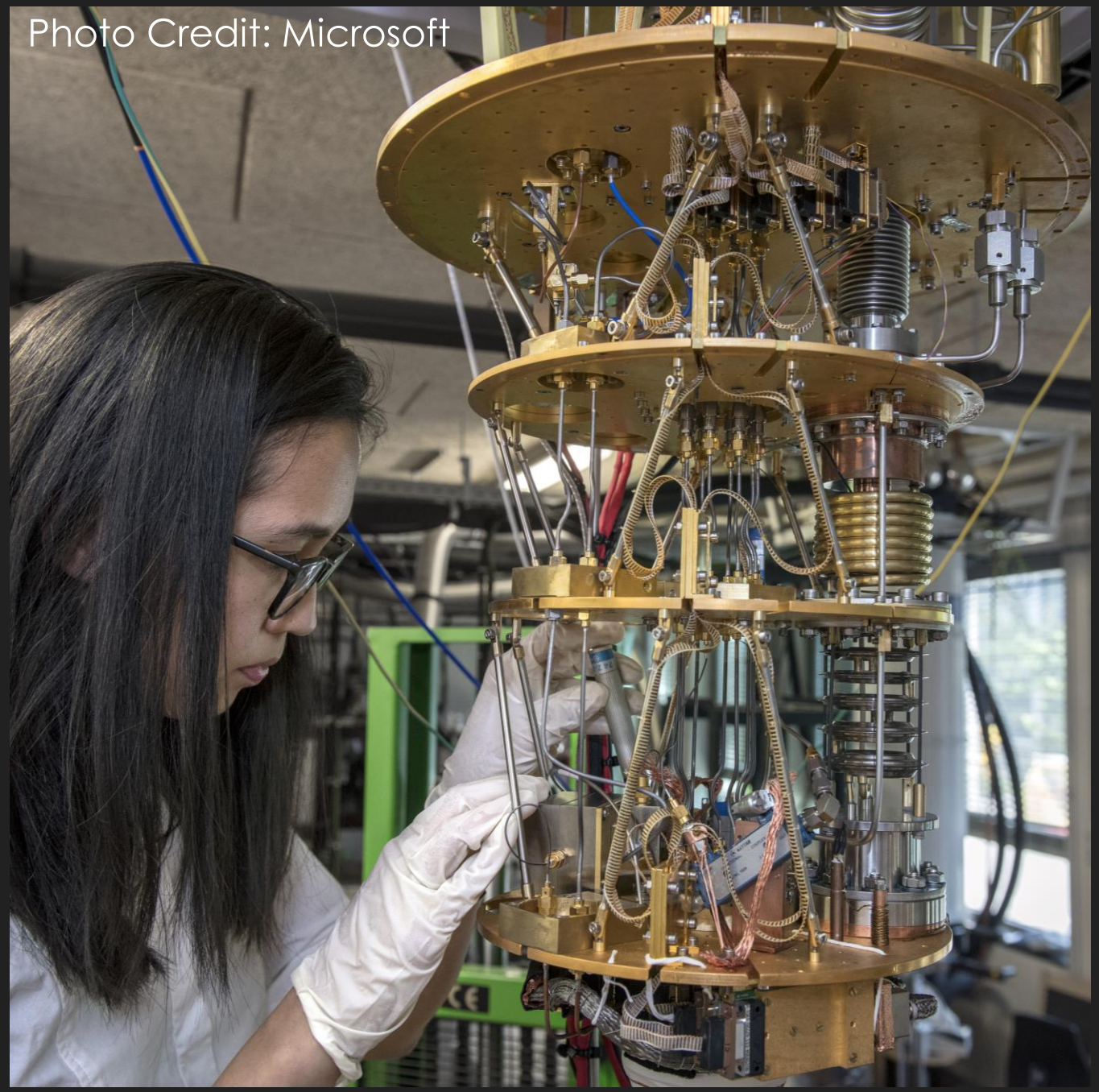
Quantum mechanics can't handle know quantum mechanics.

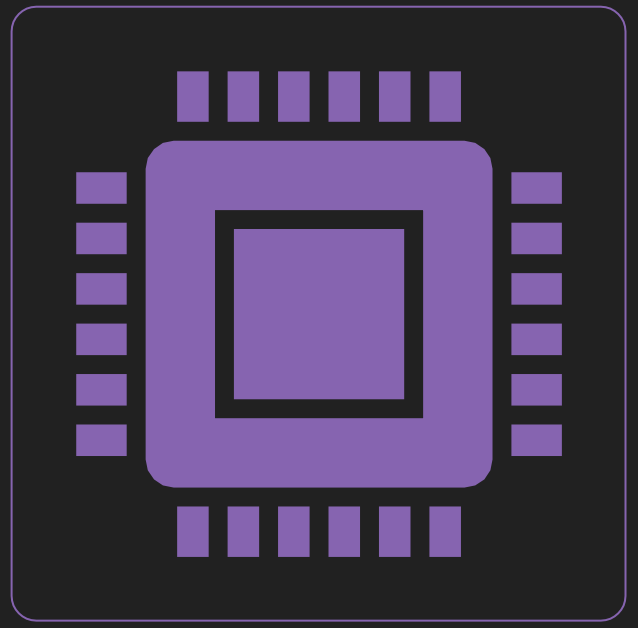
Ars Technica · 3 hours ago

There is a *lot* of info out there

What in the heck is a quantum computer then?



A new model of computing



- **Computer:**

  A device for storing and manipulating information in the form of binary bits. The instructions for how to manipulate the information is given by a *program*.

- **Quantum Computer:**

  A device for storing and manipulating information in the form of quantum systems. The instructions for how to manipulate the information is given by a *program*.

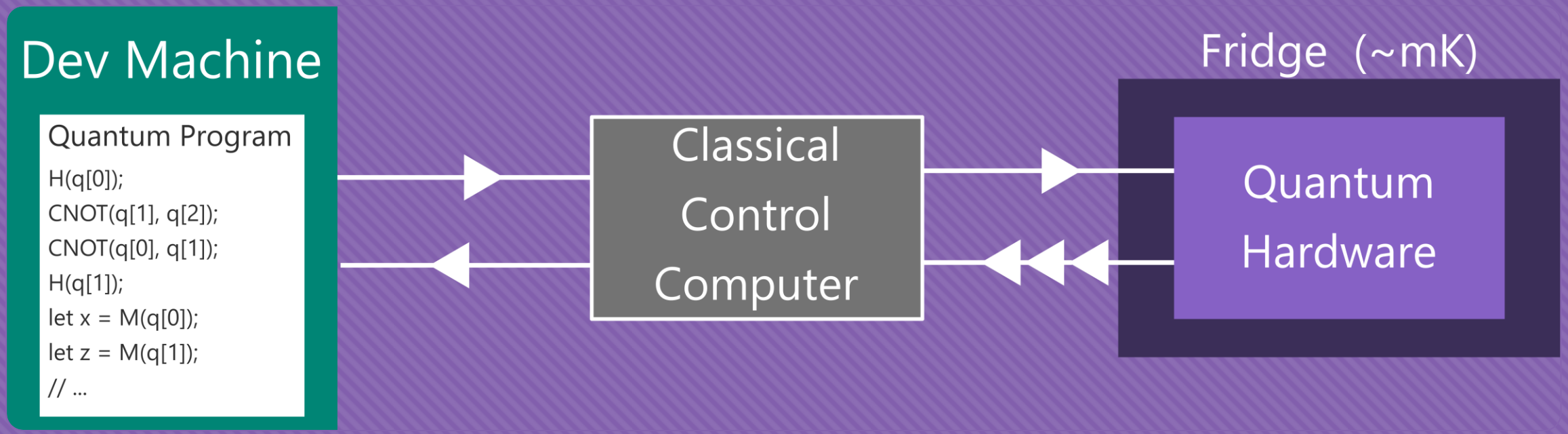
A new model for information

We can simulate a computer using n bits.

0100010101000101001111111011101…

We can simulate a **quantum computer** using 2^n complex numbers.

$$\begin{bmatrix} x_0 \\ x_1 \\ \vdots \\ x_{2^n-1} \end{bmatrix}$$



Think specific hardware accelerator (GPU)

What might quantum computers be good for?

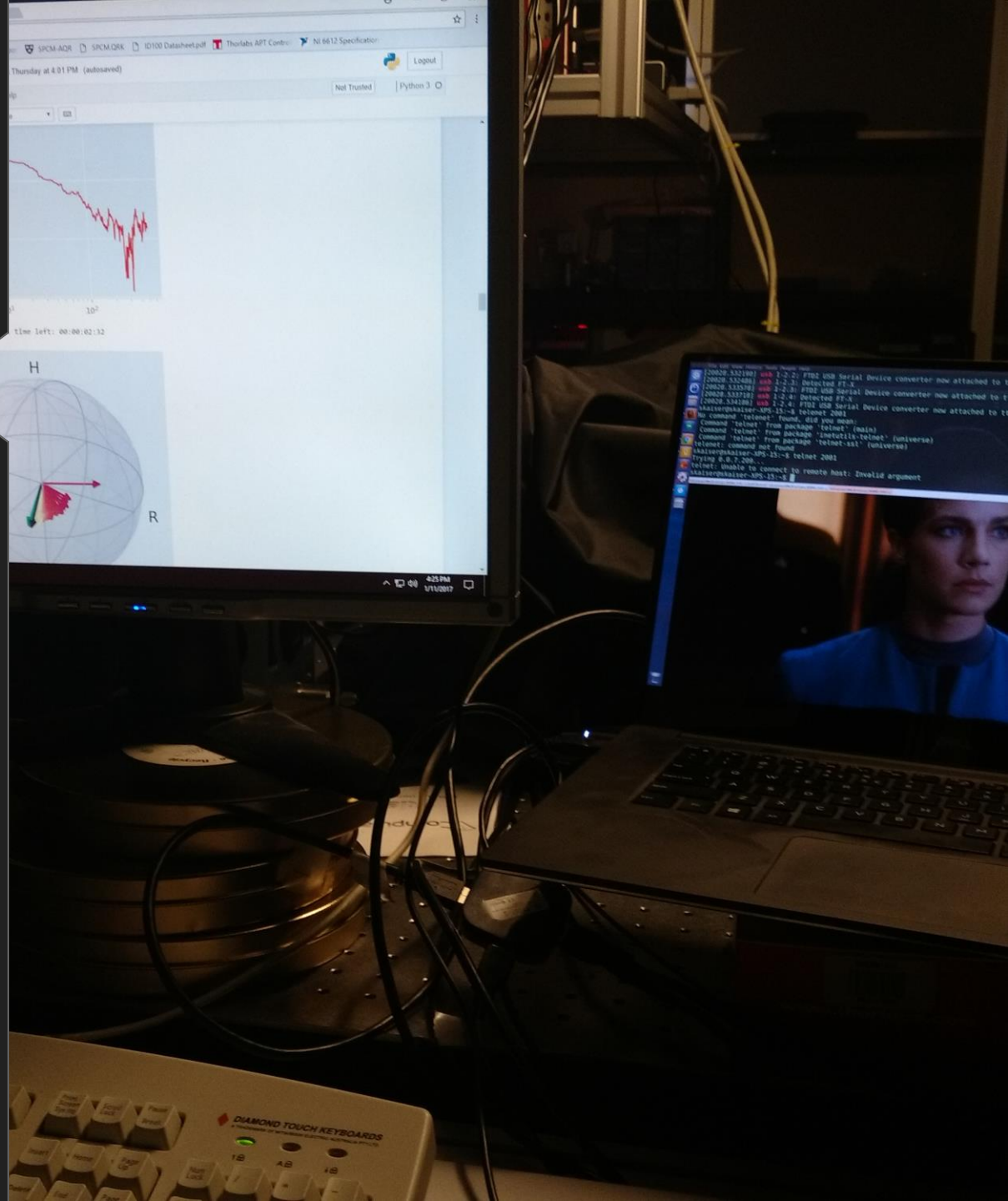
Are these long-term or short-term applications?

Quantum computing offers a lot of promise, including:

- Cryptography
- Machine learning
- Chemistry and materials science

We can understand timelines by building concrete **applications**.

- How many qubits will we need?
- What are the right quantum algorithms?
- Who is going to develop it?



Who can program a quantum computer?

Front-end developers

Full stack developers

Teachers

Machine learning scientists

Data scientists

Dev ops

UI/UX designers

Physicists

Python developers

Chemists

Academics

Project managers

Mobile developer

Front-end developers

Full stack developers

Teachers

Machine learning scientists

Data scientists

Dev ops

You!

UI/UX designers

Physicists

Python developers

Chemists

Academics

Project managers

Mobile developer

Front-end developers

Full stack developers

Teachers

Machine learning scientists

Data scientists

Dev ops

EVERYONE!

UI/UX designers

Physicists

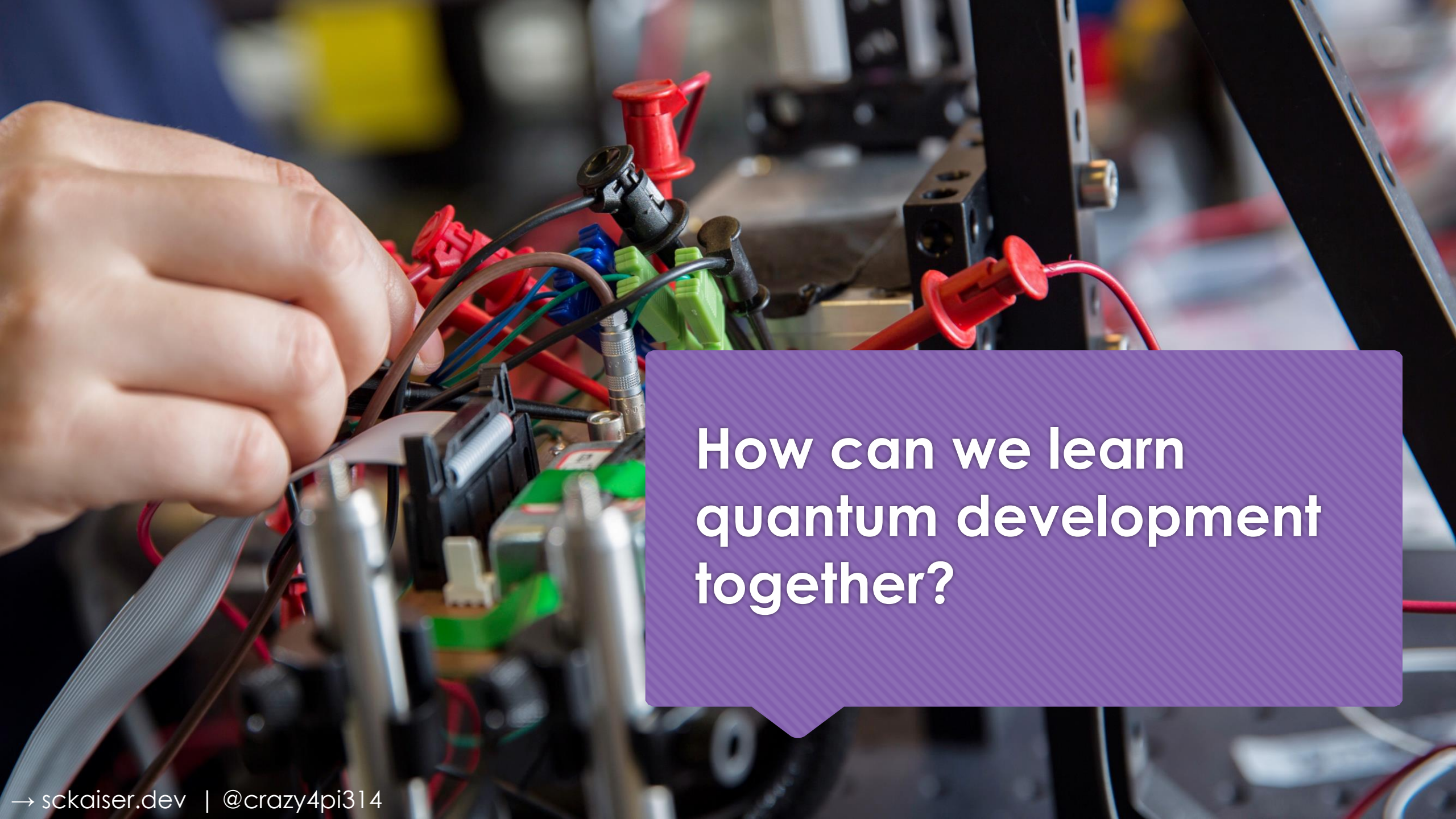
Python developers

Chemists

Academics

Project managers

Mobile developer


How can we learn quantum development together?

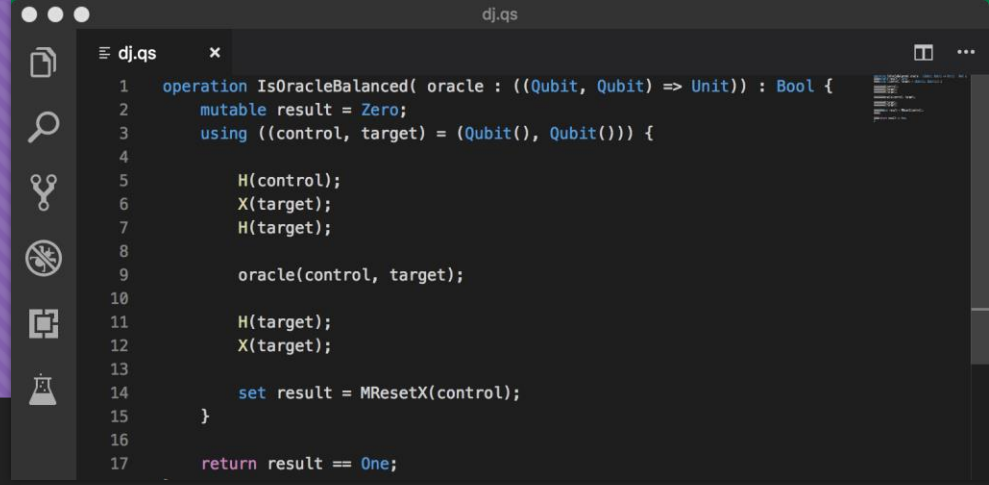
Meet Q# and the Microsoft Quantum Development Kit

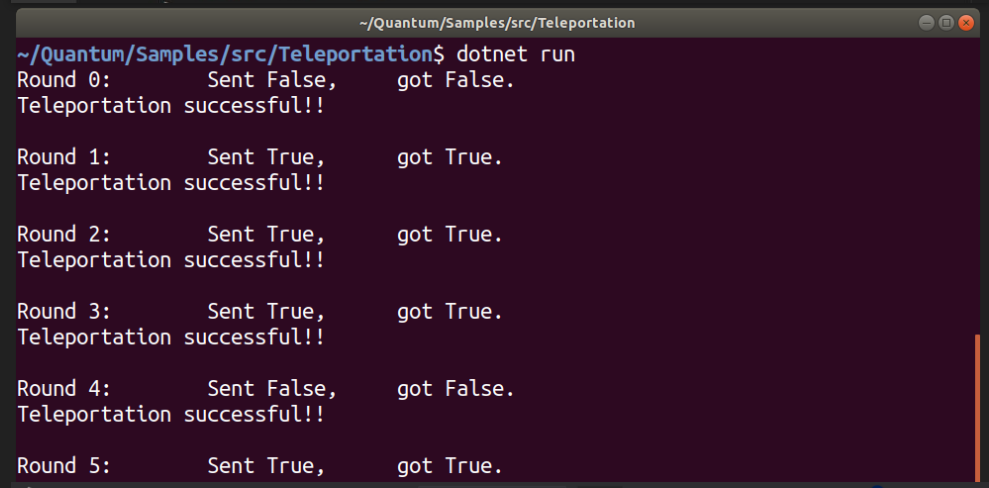
- Q# is a **domain-specific** programming language used for expressing quantum algorithms.

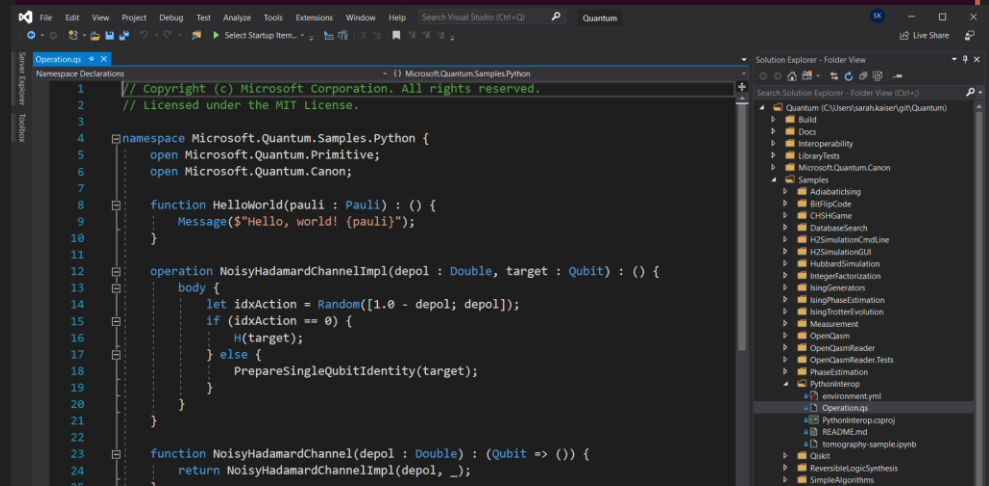
- The quantum development kit is **open source**!

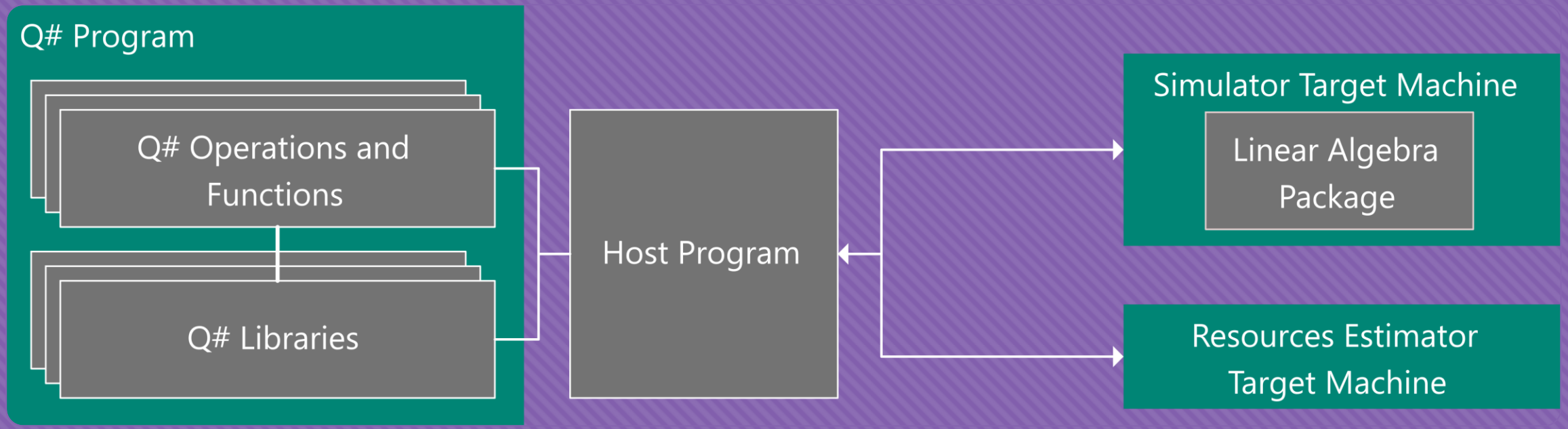
Q# is built on .NET Core

The .NET Core SDK is **cross-platform** so you can use Q# on your favorite operating system!

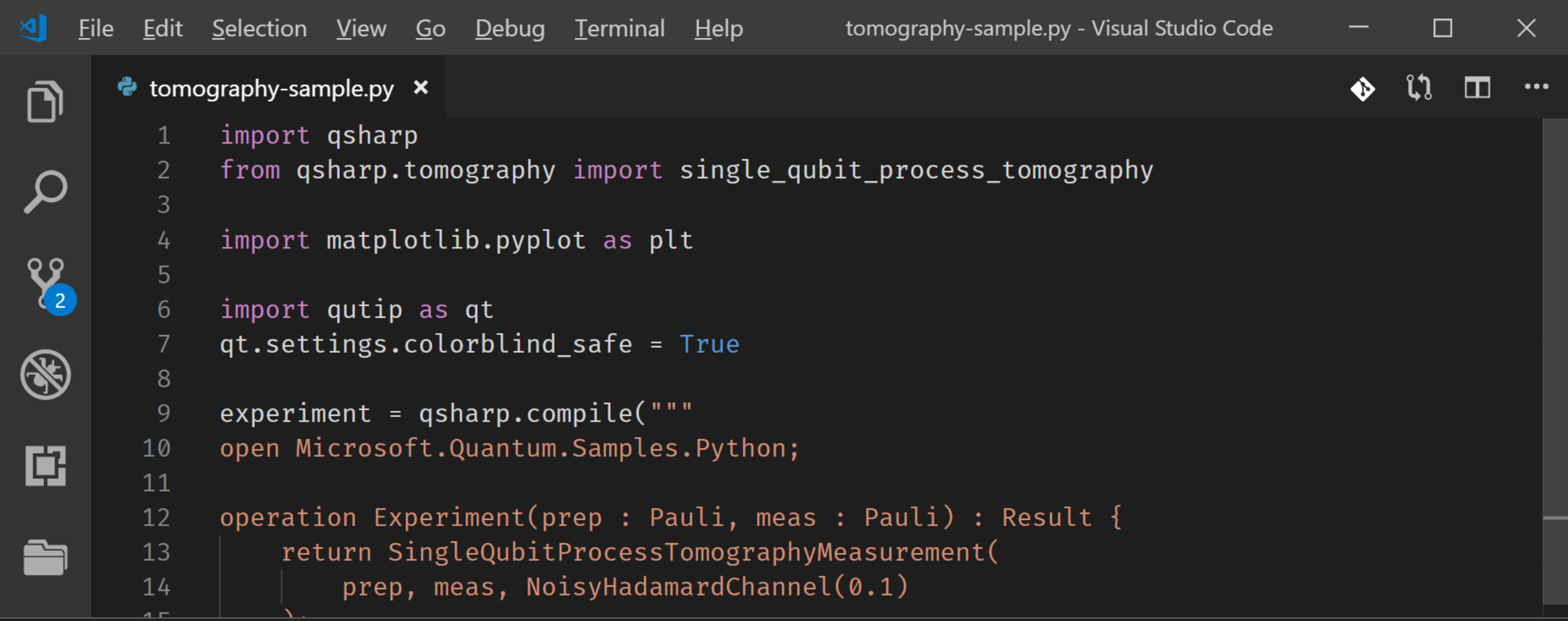








Q# Architecture



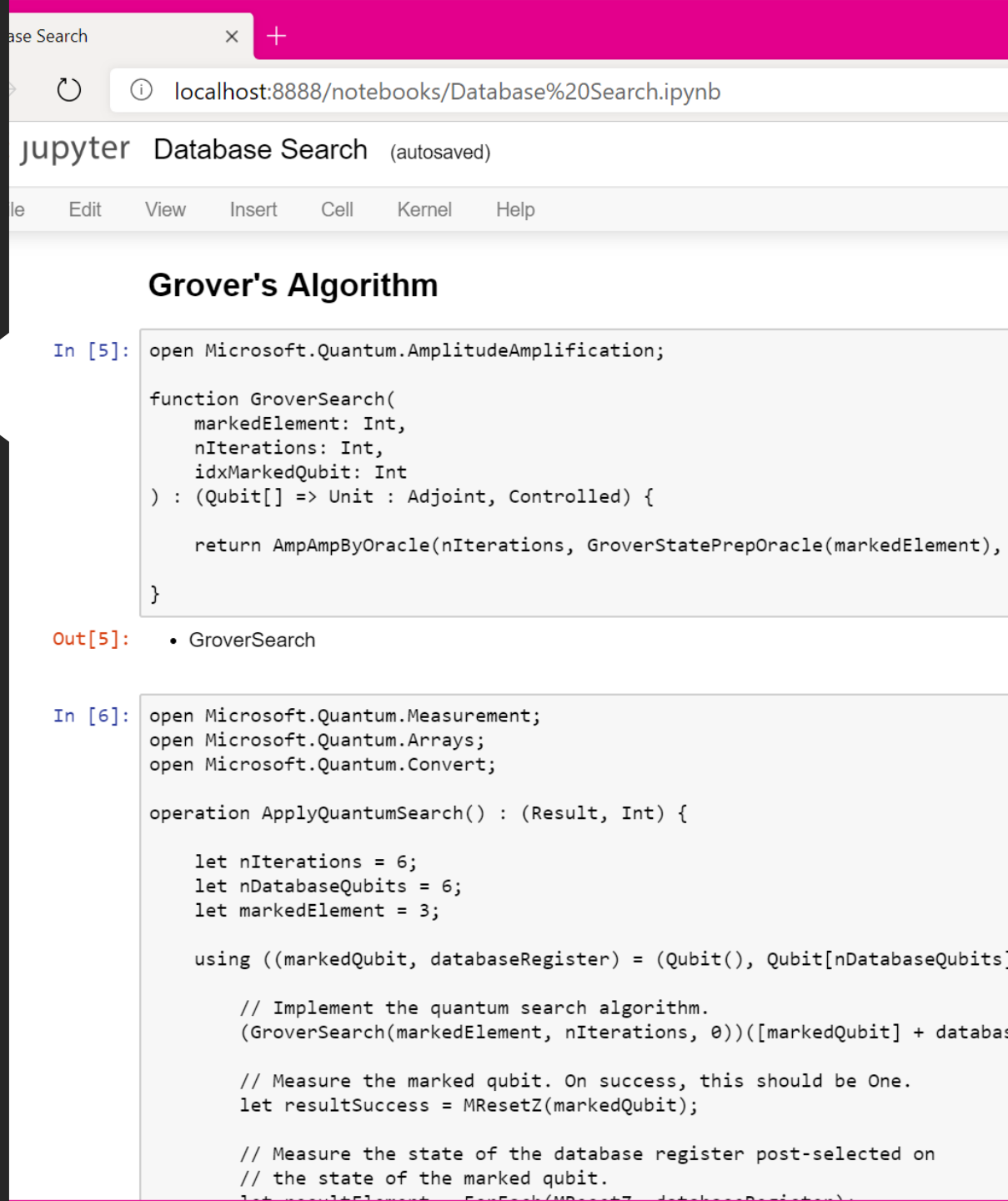
Q# 💖 Python

Q# and the QDK is **interoperable** with Python 3.6+!

Jupyter Notebooks for Q#

- Jupyter Notebook support for Q# is provided by IQ# kernel.

- Exploring Q# with Jupyter allows users to focus on learning the new language instead of the rest of the stack.



Azure Quantum PREVIEW

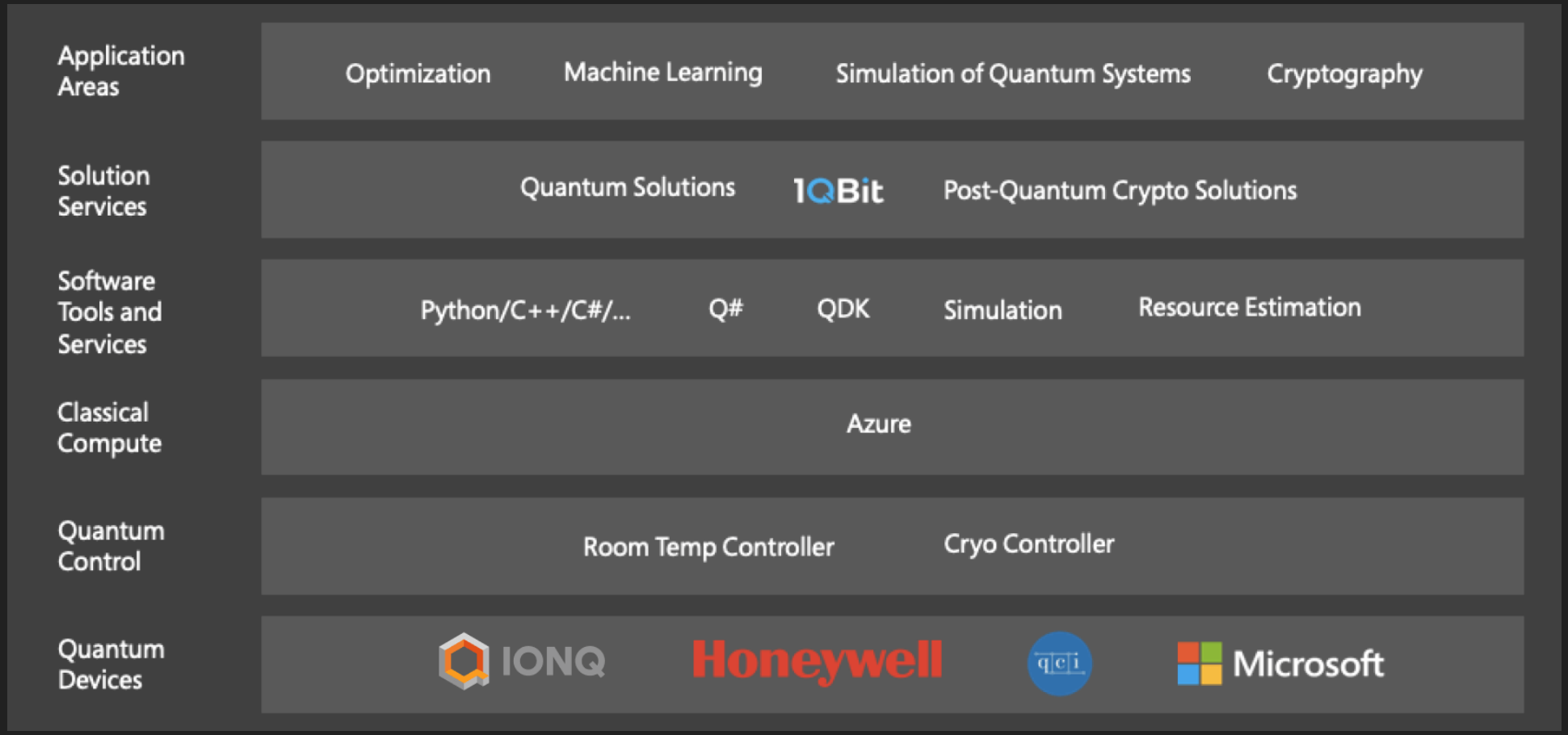
azure.com/quantum

Quantum Impact on Azure

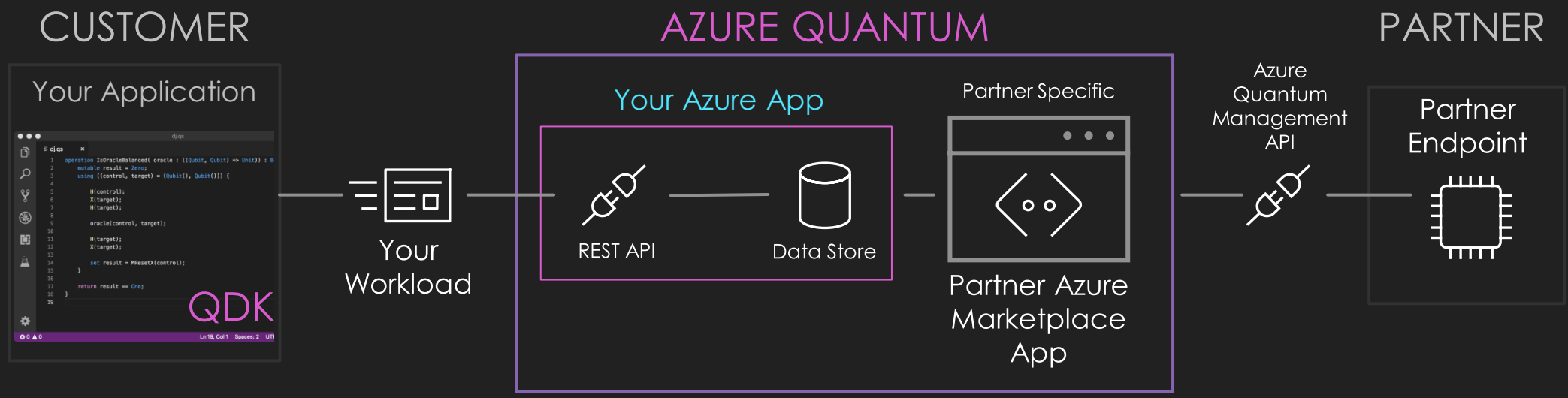
What services will be offered?

- **Quantum solutions** like pre-built solvers and algorithms that run at industrial scale
- **Quantum software**, including simulators and resource estimation tools, scaled by Azure compute
- **Quantum hardware** system options with a variety of different qubit architectures
- **Scale, security, and support** from Azure and trusted partners

Azure Quantum Stack



Azure Quantum Workflow



https://bit.ly/azurequantum-ignite

Quantum Programming:

Let’s do it!

Demo

OK, but what can *sqrt{-1}* do?

- Try Q# for yourself!
- Join a meetup!
- Learn by teaching
  - Write blogposts
  - Make tutorials
- Make the community better than you found it!
  - Contribute to docs
  - Fix bugs
  - Act intentionally to include everyone and expand the community

Quantum programming resources

- Community projects:
  - qsharp.community
  - wiqca.dev
- Documentation:
  - docs.microsoft.com/quantum
- Books:
  - Learn Quantum Computing with Python and Q#

Connect with me!

@crazy4pi314

sckaiser.dev

- Twitch streaming quantum development Wed/Sat 12pm PDT
- WIQCA talk on quantum RAM and quantum machine learning this 13 May, 5 pm PDT : wiqca.dev