

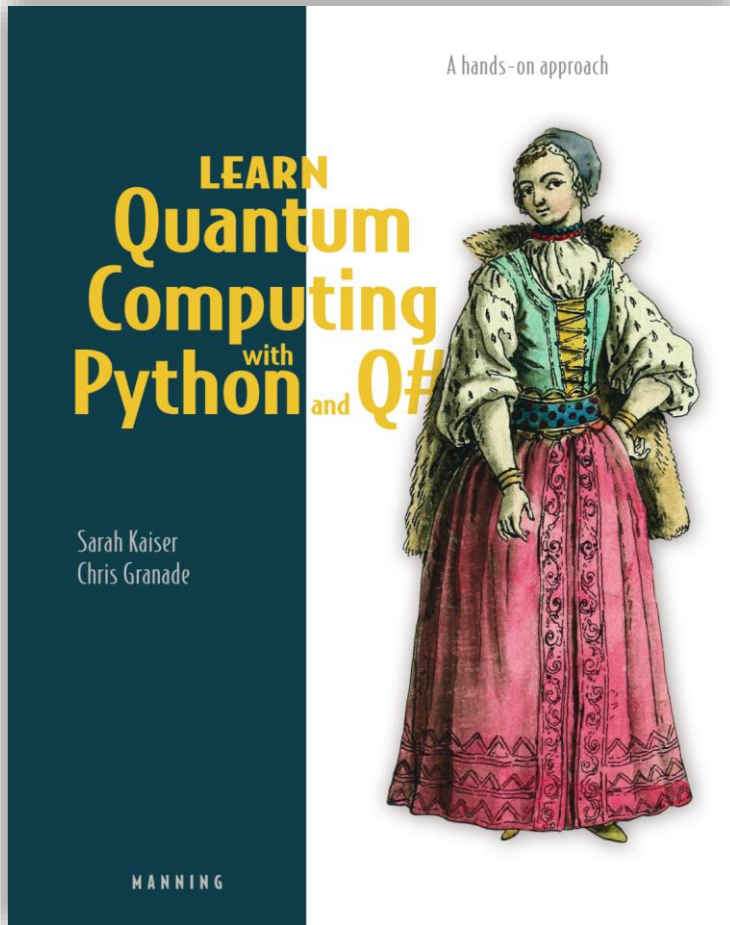


# Everyone Can Be a Quantum Open Source Developer!

Dr. Sarah Kaiser | @crazy4pi314

Technical staff and community lead at Unitary Fund

# readme.md



NEW TIP

SUBSCRIBER devopen

FOLLOWER DrAirRock

Testing notes • Untitled-1 - unita...

read.html M

# Testing notes Untitled-1

confidence high

3 Pytest:

- 4 - pytest xdist
- 5 - -n auto

6 Randomly:

- 7 - every time you run `pytest` you can randomize test order

8 How is time spent?

- 9 - Setup v. running
- 10 - Figure out why DEPENDENCIES take so long, maybe cache stuff
- 11 - docker can take more time than useful if dependencies need source built

12 Tox

- 13 - need tests at top level
- 14 - isolate the CWD for tests for source
- 15 - src at top level
- 16 -
- 17 - workflow
  - 18 - setup new working directory from src in repo
  - 19 -

20 parameterization:

- 21 - pairwise Testing process
  - 22 - reduce search space
  - 23 - <https://www.softwaretestinghelp.com/what-is-pairwise-testing/>
  - 24 - <https://github.com/thombashi/allpairspy>
  - 25

Search or jump to...

Pulls Issues Marketplace Explore

thombashi / allpairspy

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Code Issues Pull requests Discussions Actions Security

master

Go to file Add file + Code +

About

thombashi Add support for Python 3.10 23 days ago 201

github Add github/workflows 23 days ago

allpairspy Drop Python 2 support 11 months ago

examples Apply isort 9 months ago

requirements Drop Python 2 support 11 months ago

tests Drop Python 2 support 11 months ago

.gitignore Update .gitignore 2 years ago

CHANGES.txt Update CHANGES 11 months ago

LICENSE.txt Version 2.0.1 12 years ago

MANIFEST.in Fix typo in MANIFEST.in 28 days ago

Makefile Add setup target to Makefile 11 months ago

README.rst Replace badges 23 days ago

pylama.ini Update pylama.skip 15 months ago

pyproject.toml Add [build-system] table to pyproject.toml 23 days ago

setup.py Add support for Python 3.10 23 days ago

tox.ini Add support for Python 3.10 23 days ago

testing python-library

allpairs pairwise

Readme

MIT License

Releases 9

v2.5.0 Latest on May 11, 2019

8 releases

Sponsor this project

the link

CLICK THE LINK

hehehe

<https://github.com/thombashi/allpairspy>

VanuBarz No joke, last week our production broke on the single day when I had enough fever to not work at a computer

VanuBarz I think we can do a single question interview for senior engineering positions

VanuBarz Question: Why do we need tests?

VanuBarz I am stealing that "nope.gif" dialogue idea

VanuBarz Technically I am getting it from the internet

VanuBarz Rust compiler produces the most eye-pleasing error messages

VanuBarz I don't like the truth in "Your brain must be this messed up to understand..."

VanuBarz I think from now on I should just forget about any chance of reading books on Tuesday night

VanuBarz Thanks a lot for all the tips Steven

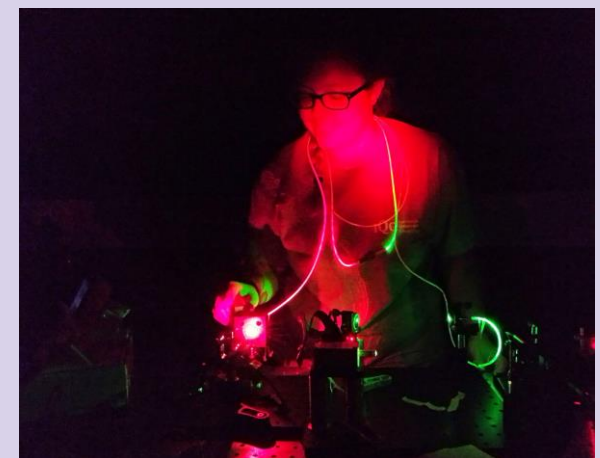
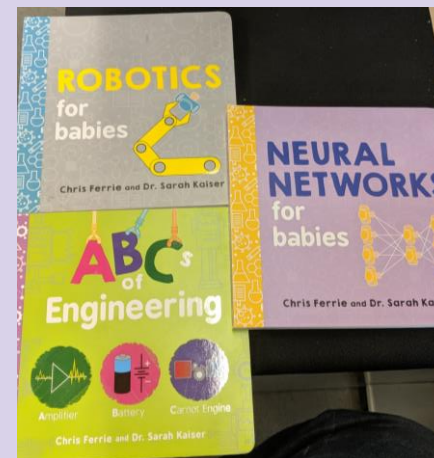
sckaiser.dev

@crazy4pi314

@crazy4pi314

bit.ly/qsharp-book

Sarah's Disord discord.gg/VMp3ycg



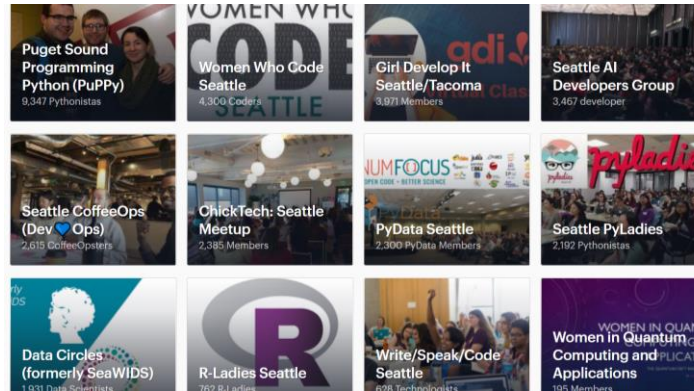
# Quantum software developer + OSS advocate

```
H(register);
CNOT(register, target);

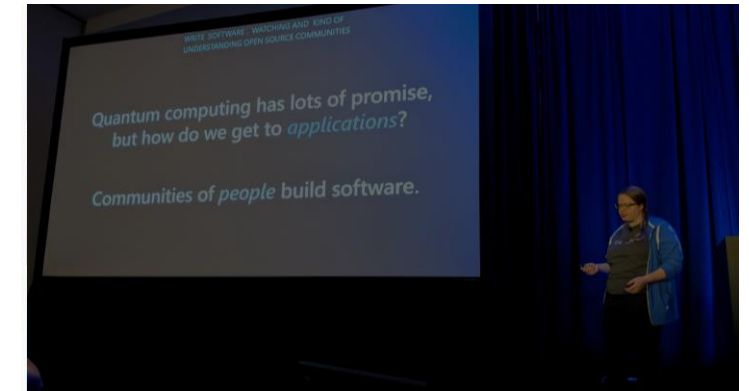
// Encode the message into the entangled pair,
// and measure the qubits to extract the classical data
// we need to correctly decode the message into the target qubit:
CNOT(msg, register);
H(msg);
let data1 = M(msg);
let data2 = M(register);

// decode the message by applying the corrections on
// the target qubit accordingly:
if (data1 == One) { Z(target); }
if (data2 == One) { X(target); }
```

💻 I wanted to learn how to be a better programmer to help teach others



🤝 Global open source meetup groups were amazing, I wanted to help build one for quantum computing.



📢 I started giving demos of quantum programming at events and on Twitch. Also wrote a book on quantum programming





**Dr. Sarah KaisEEEKer #DefundThePolice**

@crazy4pi314

That one time we sat here and talked about WINS: I got my first public PR approved on [#Qsharp](#) from [@MSFTQuantum](#) today 🇺🇸🇺🇸

Thanks again to [@azureadvocates](#) and especially [@allinison](#) for the best tech conference ever!!



4:18 PM · May 9, 2018

Twitter for Android

@crazy4pi314

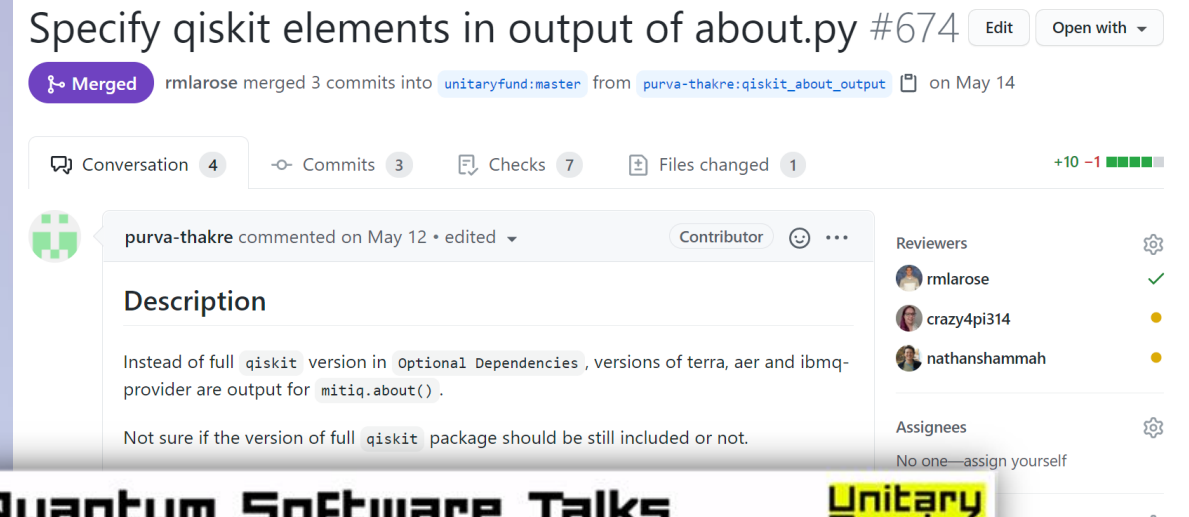
...and now I work here



because evolution is unitary

Creating a quantum  
technology ecosystem  
that benefits the most  
people.

<https://unitary.fund>



@crazy4pi314

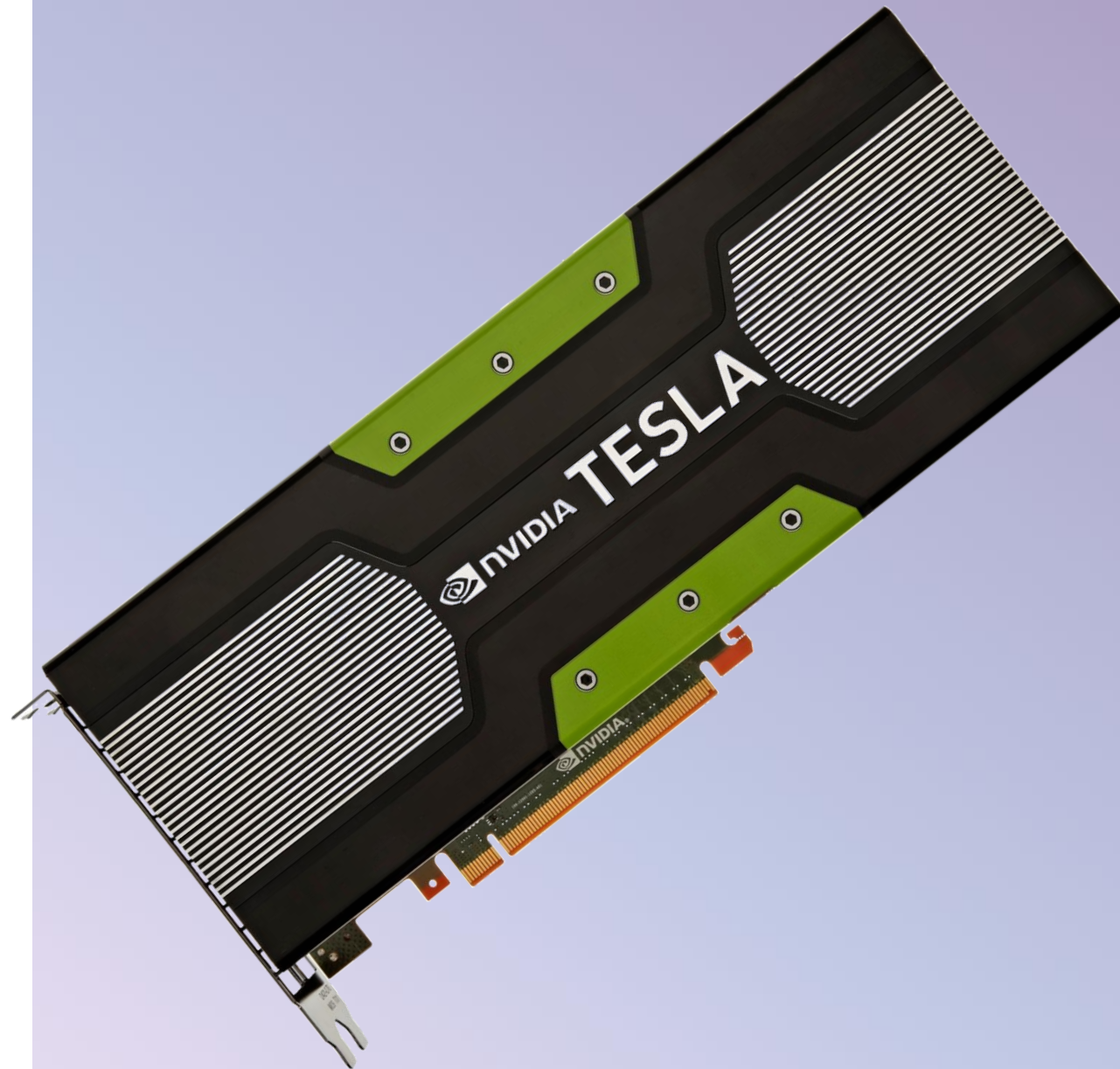
# So.... what is quantum computing?

A question I ask myself frequently 🤔

# Graphics cards are **hardware accelerators**.

GPUs are good at speeding up *some* highly parallelizable tasks:

- Rendering graphics
- Training + inferencing machine learning models
- Editing video and audio files
- Making your computer case hotter 🔥



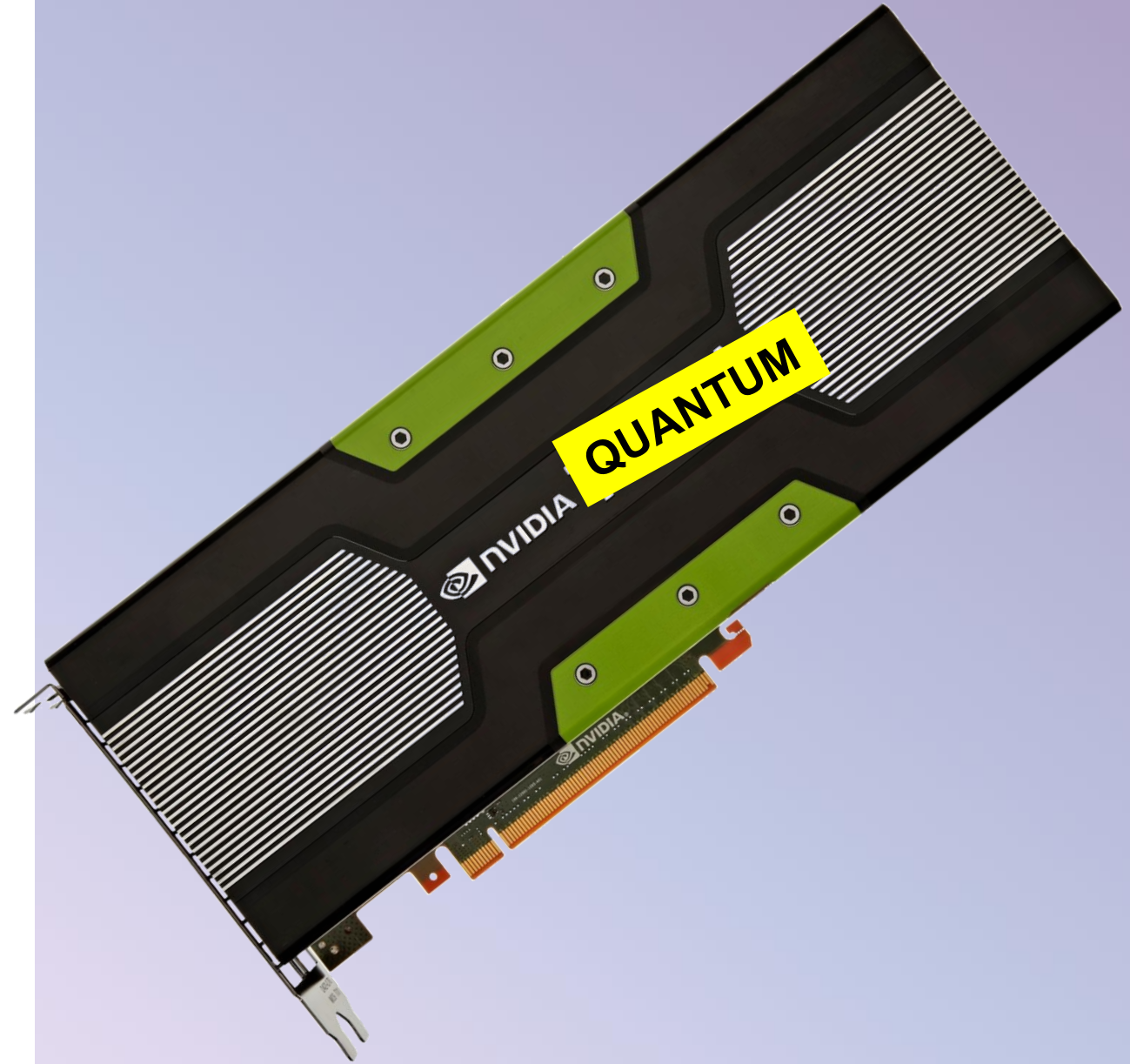


# A quantum computer is a hardware accelerator.

Quantum computers are good at speeding up **???** tasks.

We know we can:

- Factor large integers
- Search unstructured data
- Simulate quantum systems
- ...

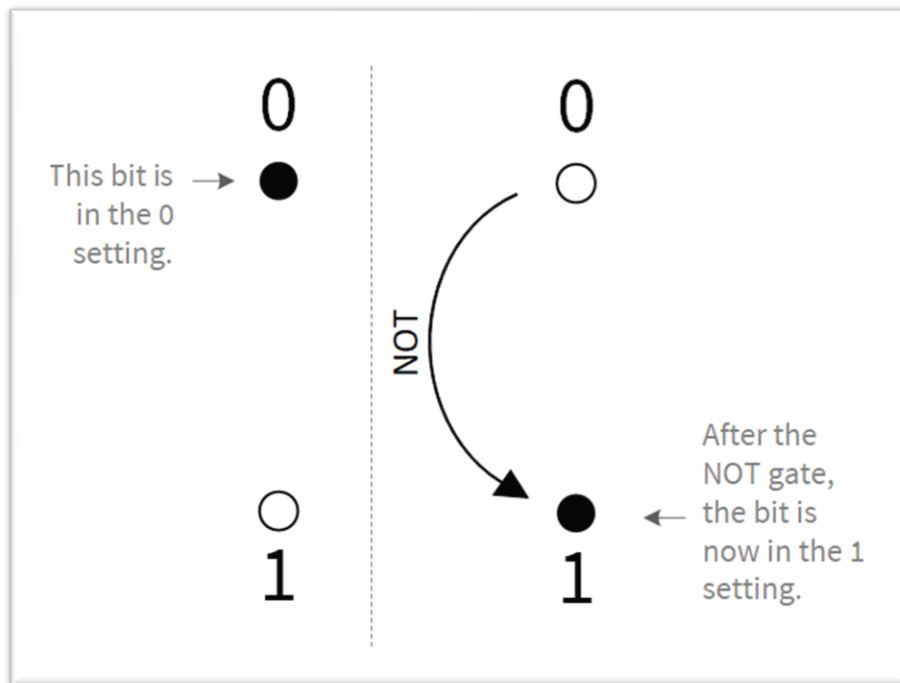




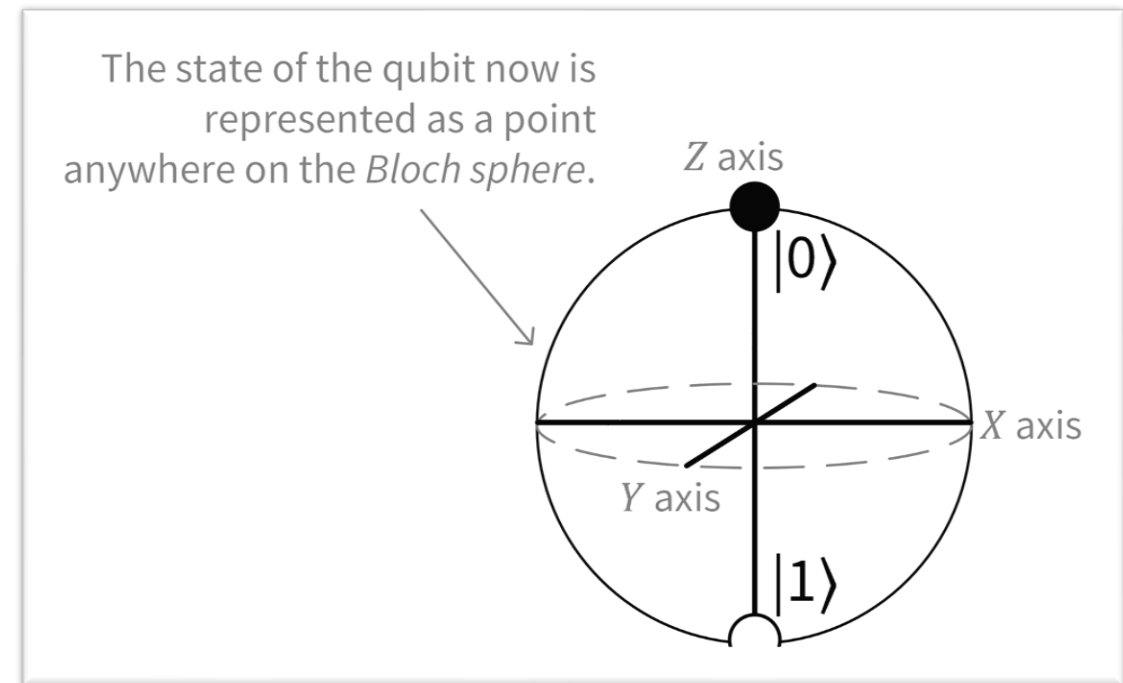
# SIDEBAR:

## Ok, but how is a quantum device different?

### Normal (classical) bits



### Quantum bits (qubits)



[cgranade/quantum-falsehoods.md](https://cgranade.github.io/quantum-falsehoods.md)

NOTE: for informational purposes only, mental model only good for one qubit ☺

We **know** how to use hardware accelerators. We program them.



**OpenCL:** a framework for writing programs that execute across heterogeneous platforms.



**CUDA:** Industry/Hardware specific solutions for parallel computing.



A quantum programming language for quantum computers??

*Spoiler: quantum programs are classical programs that address quantum hardware*

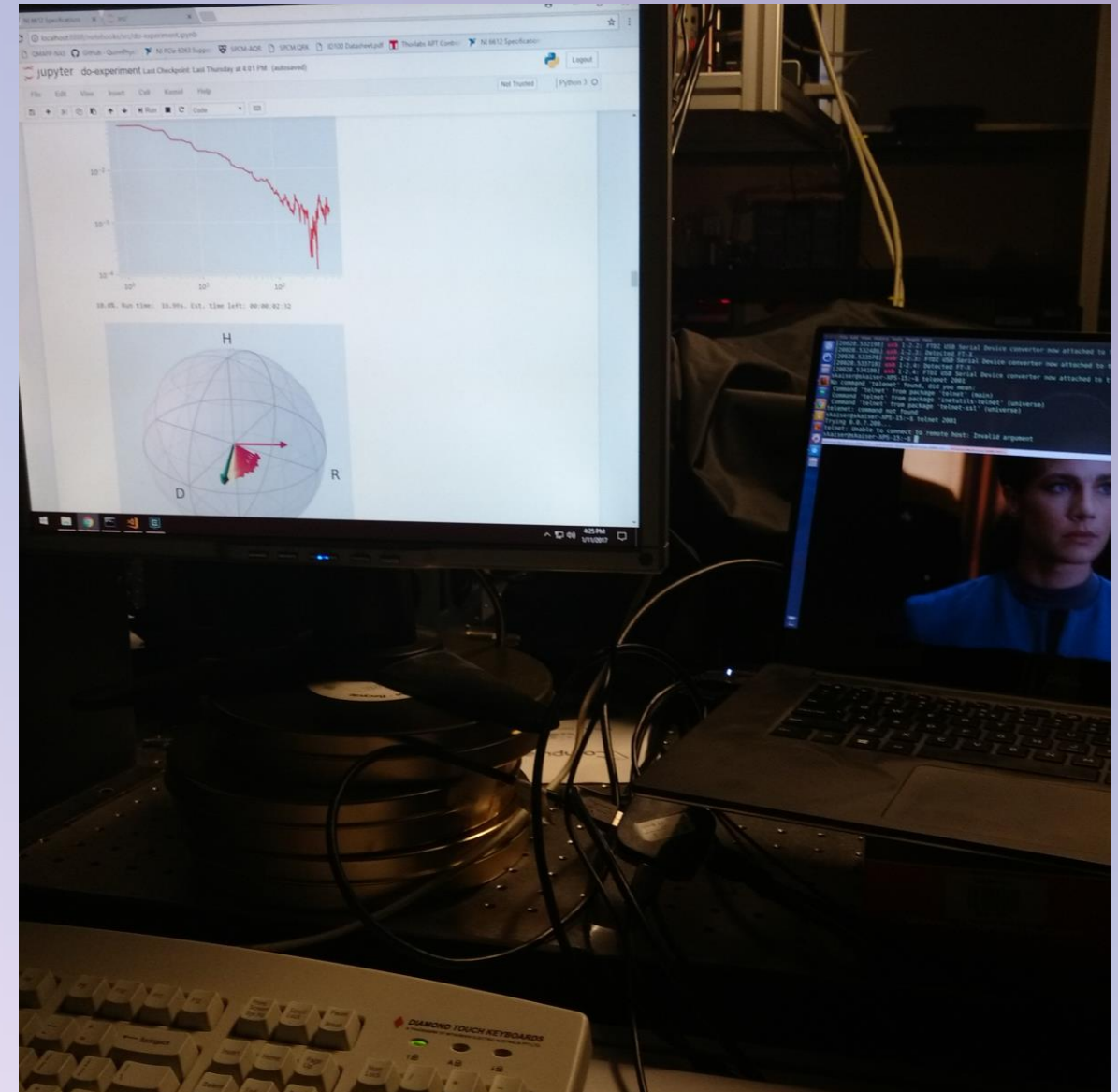
# Great, so what can we **do** with a quantum computer?

- 🧪 Chemistry / material science
- 🔑 Cryptography
- 🧠 Machine learning
- ... Help us find more!



Programming **concrete applications** helps us understand what to do next.

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





# Who can program quantum devices?

Full stack developers

Front-end developers

Machine learning scientists

Teachers

Data scientists

Dev ops

UI/UX designers

Physicists

Python developers

Chemists

Academics

Project managers

Mobile developer

**You!**

Full stack developers

Front-end developers

Machine learning scientists

Teachers

Data scientists

Dev ops

UI/UX designers

Physicists

Python developers

Chemists

Academics

Project managers

Mobile developer

Full stack developers

Front-end developers

Machine learning scientists

Teachers

Data scientists

Dev ops

# EVERYONE!

UI/UX designers

Physicists

Python developers

Chemists

Academics

Project managers

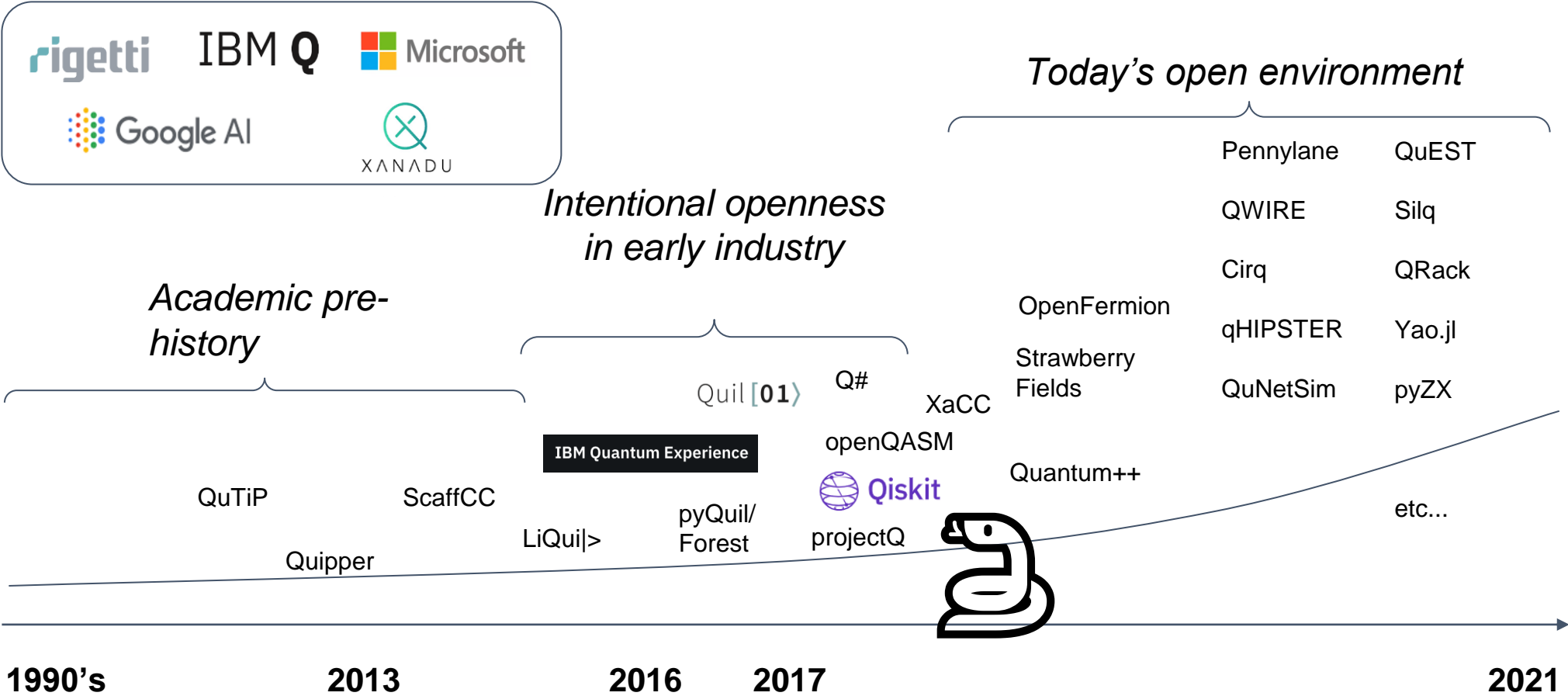
Mobile developer



# Let's program quantum computers.

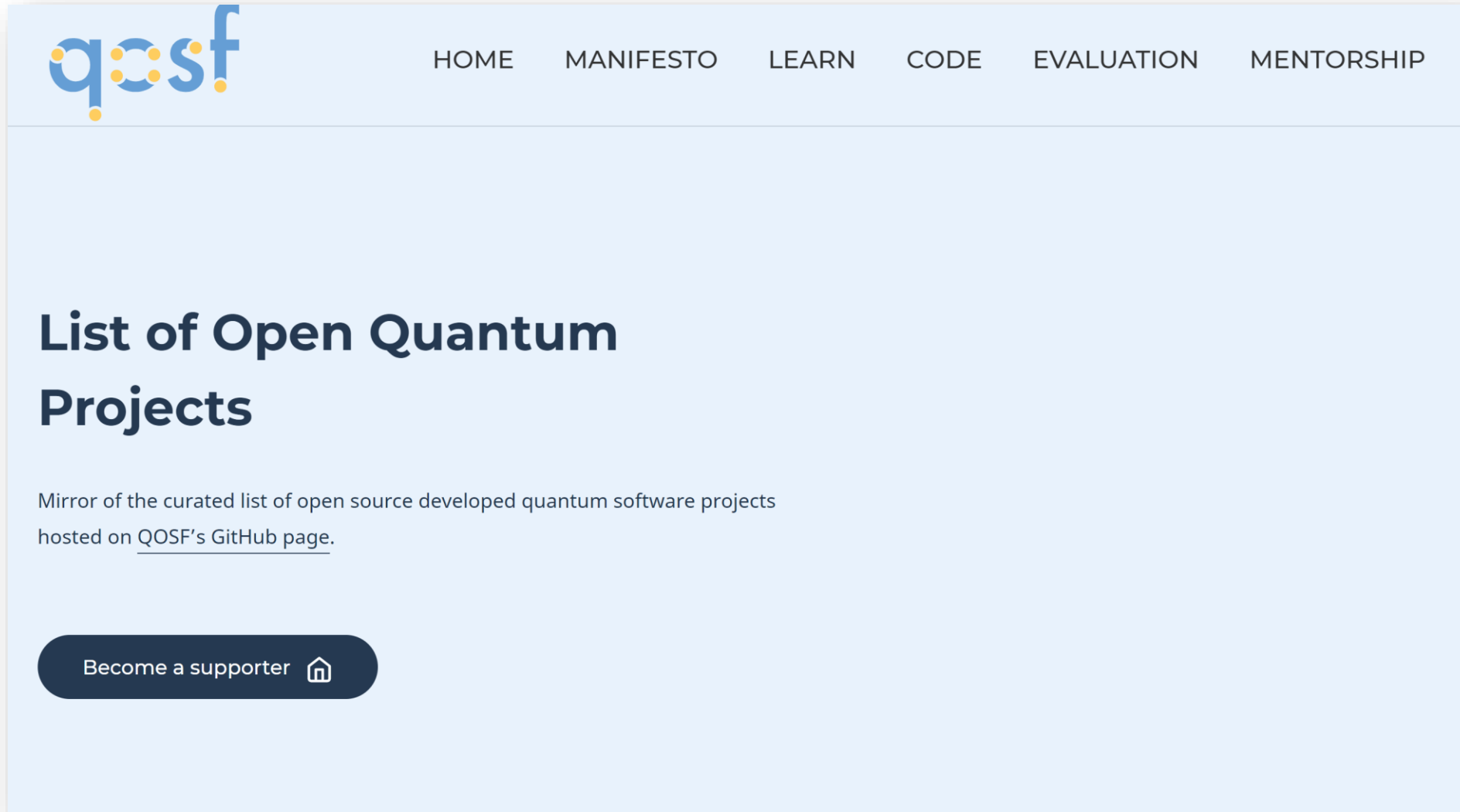
With open source tools of course! 🧪

# The quantum ecosystem is open



\* This timeline is representative, not precise

# The quantum ecosystem is **open**: qosf.org



# How can Python help?

There are **tons of Python packages** that can help you learn quantum computing, as well as write code for quantum computers.



# The quantum stack

Quantum Applications

OSS

OSS

Libraries / Techniques

Quantum Languages

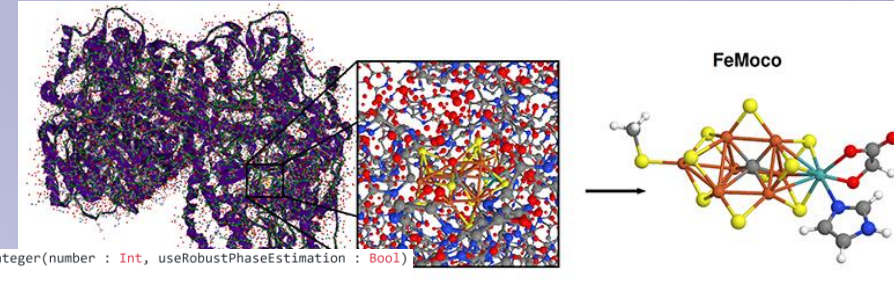
OSS

Intrinsic Operations

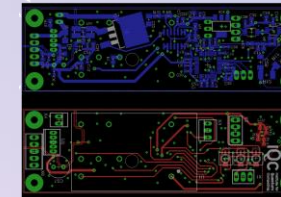
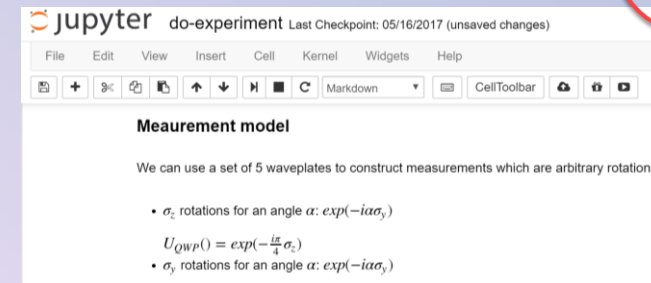
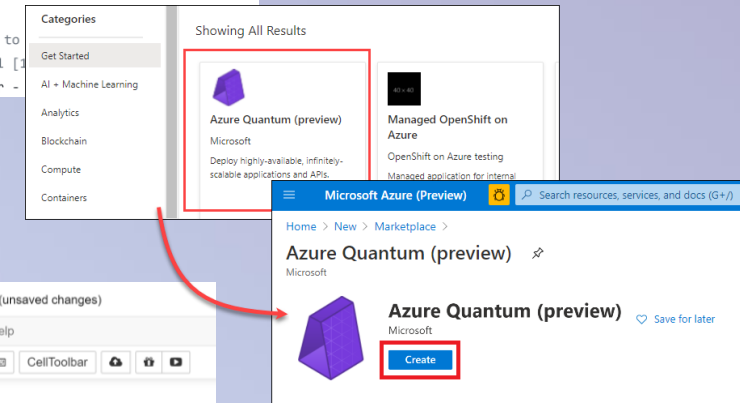
Quantum  
Hardware

Simulators

OSS



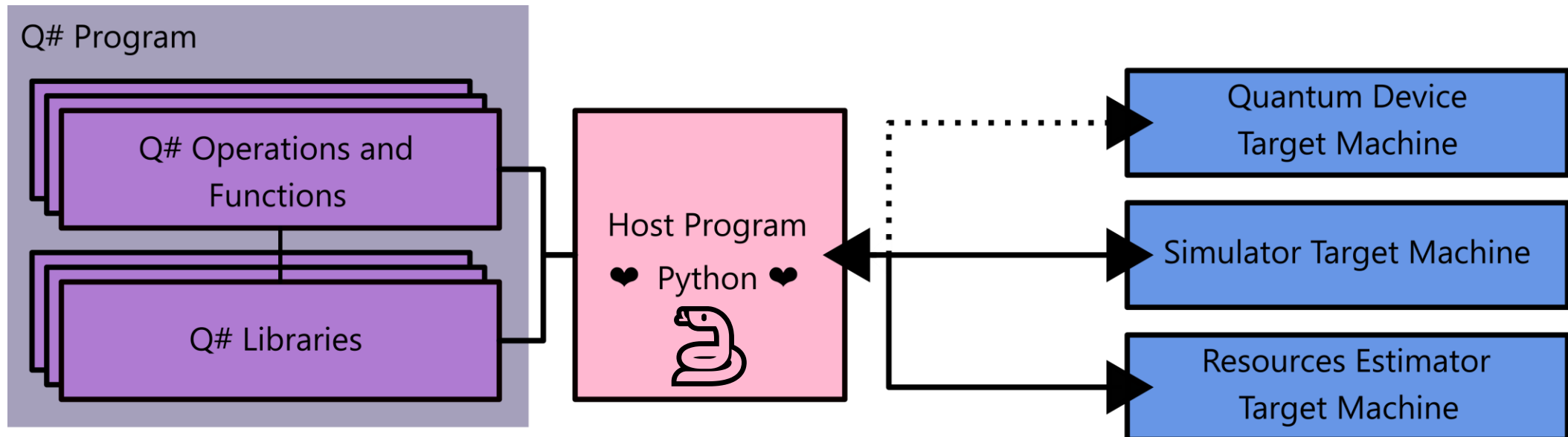
```
36 operation FactorSemiprimeInteger(number : Int, useRobustPhaseEstimation : Bool)
37 : (Int, Int) {
38     // First check the most trivial case, if the provided number is even
39     if (number % 2 == 0) {
40         Message("An even number has been given; 2 is a factor.");
41         return (number / 2, 2);
42     }
43     // These mutables will keep track of if we found the factors,
44     // and if so, what they are. The default value for the factors
45     // is (1,1).
46     mutable foundFactors = false;
47     mutable factors = (1, 1);
48
49     repeat {
50         // Next try to guess a number co-prime to
51         // Get a random integer in the interval [1, number - 1]
52         let generator = DrawRandomInt(1, number - 1);
```



# Hi Python, meet Q#!

a domain-specific language for quantum programming

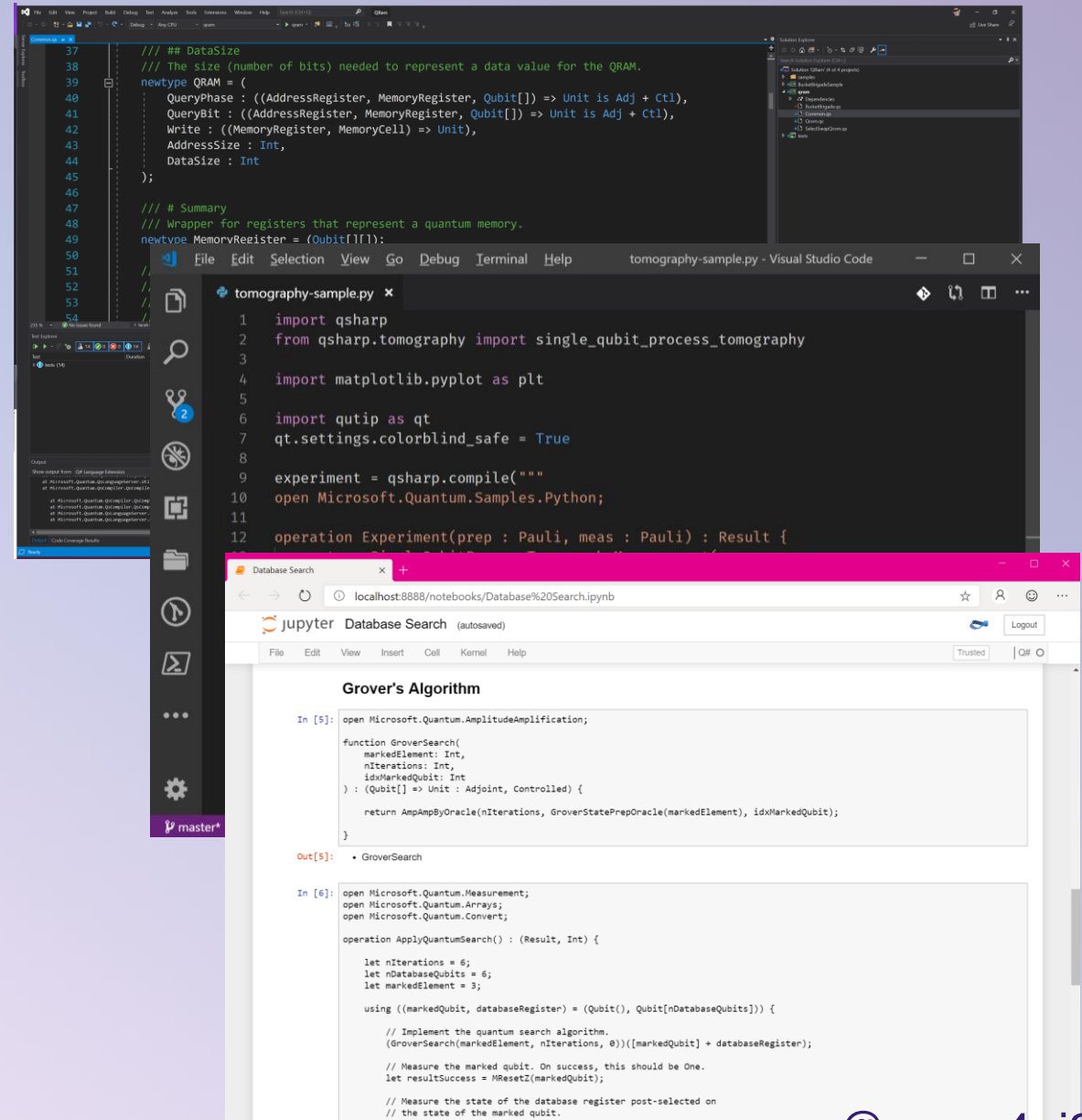
- Q# is included in the Quantum Development Kit (QDK), a development platform for expressing and executing quantum programs.
- Allows you to write code the same way you think about it (high level of abstraction)



# Tools for quantum developers

The Quantum Development Kit offers lots of great tools for working with Q#

- Editor extensions and syntax highlighting and intellisense
- Great libraries to help bootstrap your applications
- Lots of built-in simulators and tools to build your own!
- Azure Quantum service to run your programs on hardware



The image shows two development environments. The top environment is Visual Studio Code, displaying a C# file named 'tomography-sample.py'. The code defines a 'QRAM' type with fields for 'QueryPhase', 'QueryBit', 'Write', 'AddressSize', and 'DataSize'. It also defines a 'MemoryRegister' type. The bottom environment is a Jupyter Notebook titled 'Database Search', showing a 'Grover's Algorithm' implementation. The code includes a 'GroverSearch' function and an 'ApplyQuantumSearch' operation. The Jupyter Notebook interface includes a 'File' menu, a 'View' menu, and a 'Kernel' menu. The code in the Jupyter Notebook is as follows:

```
In [5]: open Microsoft.Quantum.AmplitudeAmplification;

function GroverSearch(
    markedElement: Int,
    nIterations: Int,
    idMarkedQubit: Int
) : (Qubit[] => Unit : Adjoint, Controlled) {
    return AmpAmplifyOracle(nIterations, GroverStatePrepOracle(markedElement), idMarkedQubit);
}

Out[5]: • GroverSearch

In [6]: open Microsoft.Quantum.Measurement;
open Microsoft.Quantum.Arrays;
open Microsoft.Quantum.Convert;

operation ApplyQuantumSearch() : (Result, Int) {
    let nIterations = 6;
    let nDatabaseQubits = 6;
    let markedElement = 3;

    using ((markedQubit, databaseRegister) = (Qubit(), Qubit[nDatabaseQubits])) {
        // Implement the quantum search algorithm.
        (GroverSearch(markedElement, nIterations, 0))[markedQubit + databaseRegister];

        // Measure the marked qubit. On success, this should be One.
        let resultSuccess = MReset2(markedQubit);

        // Measure the state of the database register post-selected on
        // the state of the marked qubit.
```

# To the code!

<https://bit.ly/osd-qsharp>



**Quantum computing is not magic,  
but we are ✨**

# # TODO

## Connect with me:

sckaiser.dev | @crazy4pi314

## Learn QC w/ Python and Q# Book!

[bit.ly/qsharp-book](https://bit.ly/qsharp-book)

[cgranade/quantum-falsehoods.md](https://cgranade/quantum-falsehoods.md)

<https://dev.to/cgranade>

## Q# / QDK:

[docs.microsoft.com/quantum](https://docs.microsoft.com/quantum)

**Unitary Fund:**  
[unitary.fund](https://unitary.fund)

Quantum open  
source foundation:  
[qosf.org](https://qosf.org)

