TensorFlow User Group Mysuru

TensorFlow

TensorFlow Quantum to build hybrid quantum-classical models

Rishit Dagli (@rishit_dagli)

10 STD, TEDX, Ted-Ed speaker|Google certified mobile site developer|Intel AI Scholar|2XGCP Champ|Mozilla Mumbai Lead

rishit.tech

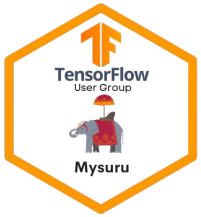
Ideal Audience

- Developers who having worked on Deep Learning Models (Keras)
- Developers eager to learn about how Quantum AI Models could work

Agenda

- A Gentle Introduction to Q computing
- Motivation behind Q computing
- Why Hybrid models?
- Why TensorFlow Quantum?
- Building models
- How does TFQ simplify things?
- Demos!!
- Quick Recap
- Q & A

TensorFlow

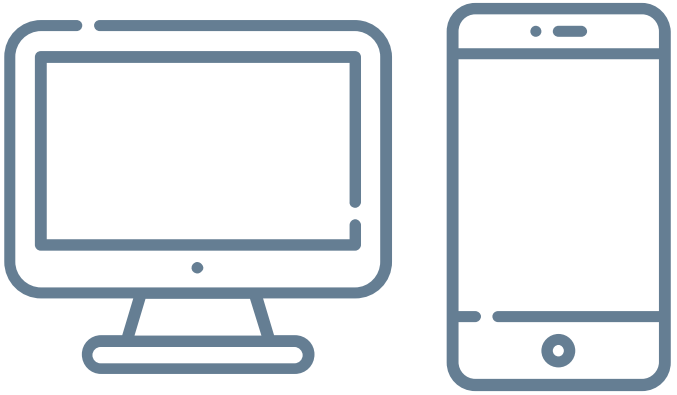


A Gentle introduction to Q Computers

rishit.tech

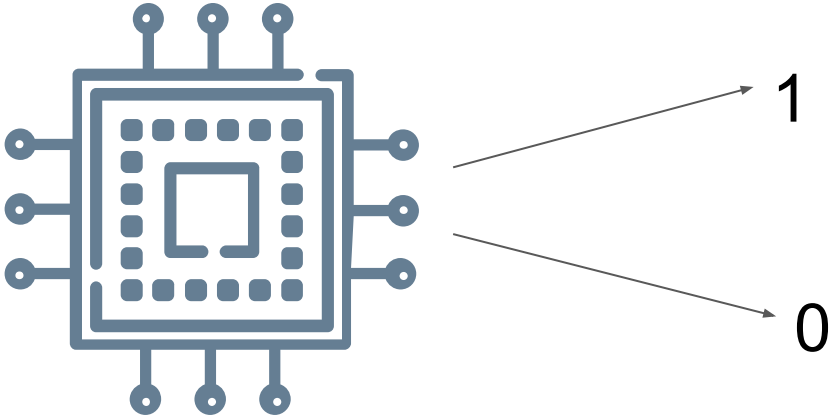
A classical machine

Works on 1 or 0

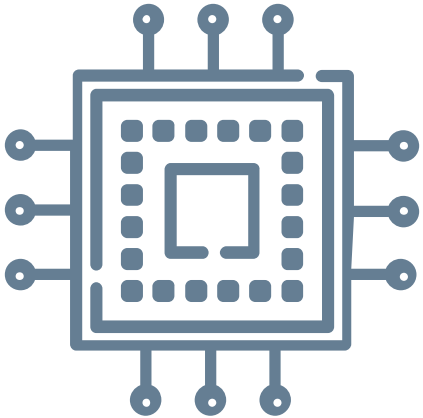


A classical machine

Works on 1 or 0



Quantum Computer

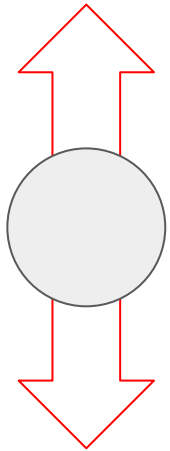


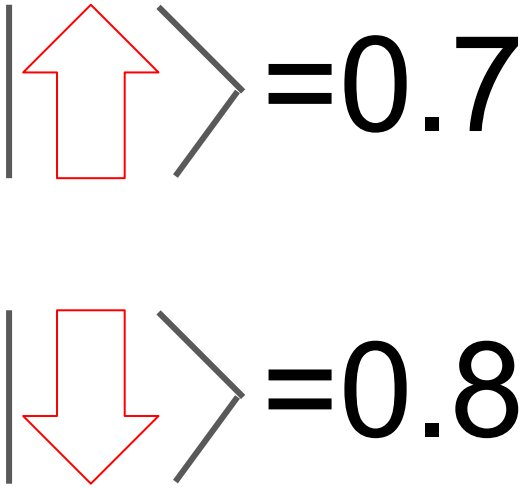
Quibit

Quantum Computer

Quibit

Quantum Computer

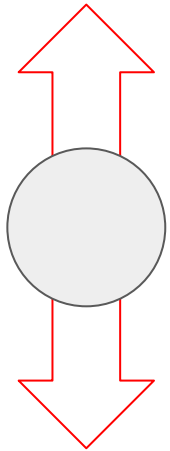




Quantum Computer

Quantum superposition

(Just a big word)



TensorFlow

TensorFlow User Group Mysuru

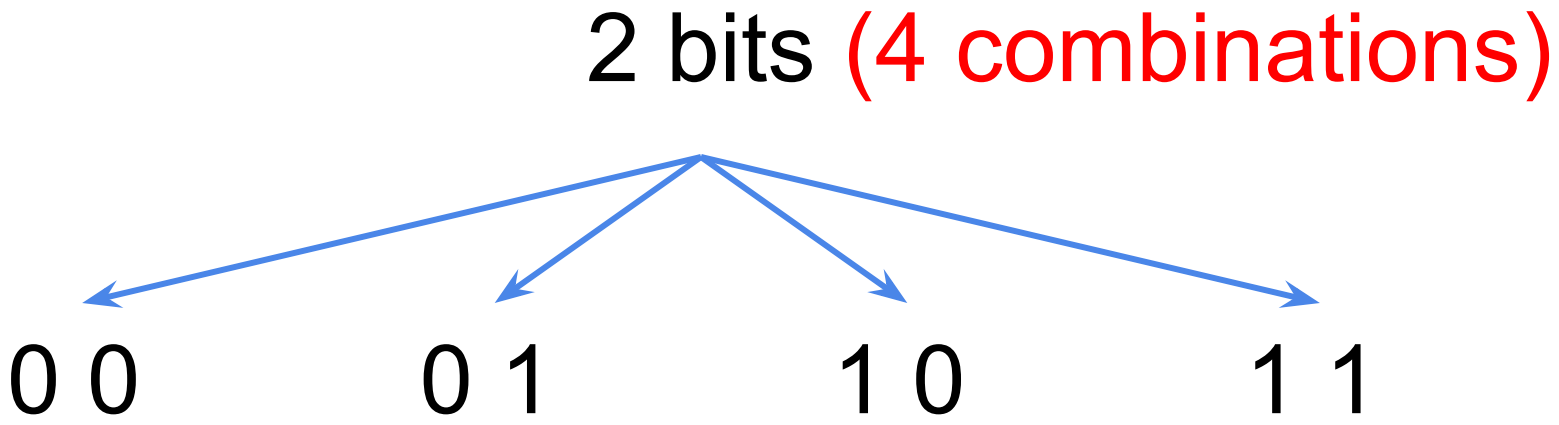
Motivation behind Q computing

Classical computer

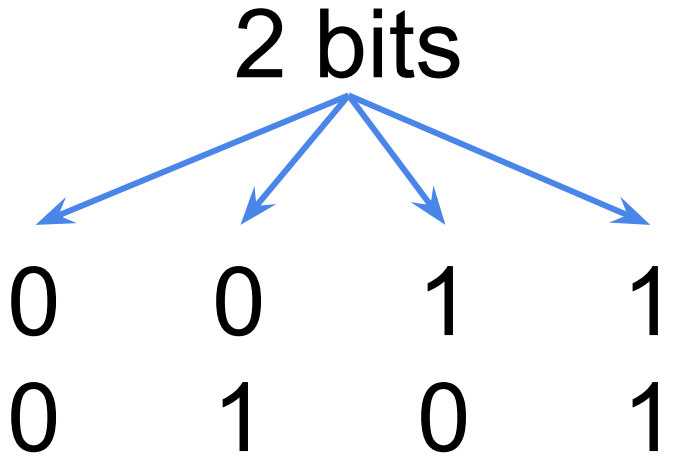
2 bits

(Remember a bit means 0 or 1)

Classical computer



Classical



Quantum

A 0 0

B 0 1

C 1 0

D 1 1

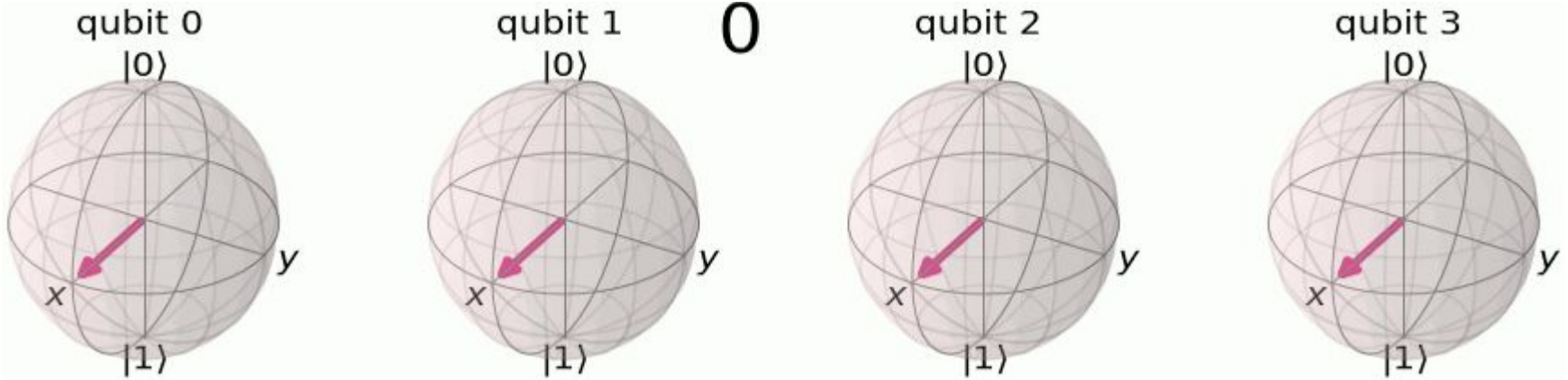
Bits	Qubits
2	4
3	8
4	16

Motivation behind Q computing

- Exponentially faster!

Motivation behind Q computing

- Exponentially faster!
- 2^n bits



risnit.tech

Motivation behind Q computing

- Exponentially faster!
- 2^n bits
- 300 bits - not enough to store even 1 image
- 300 qubits - number of particles in universe!!

Source: Derek Muller

TensorFlow

TensorFlow User Group Mysuru

Why Hybrid models?

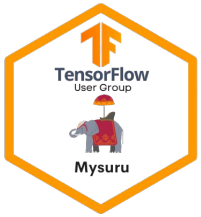
Why Hybrid models?

- Faster for ops where superposition can be used

Why Hybrid models?

- Faster for ops where superposition can be used
- Combine them :)

TensorFlow



Why TensorFlow Quantum?

Why TensorFlow Quantum?

- Easy and faster development

Why TensorFlow Quantum?

- Easy and faster development
- Training can be done using standard Keras functions

TensorFlow

Building models

The process

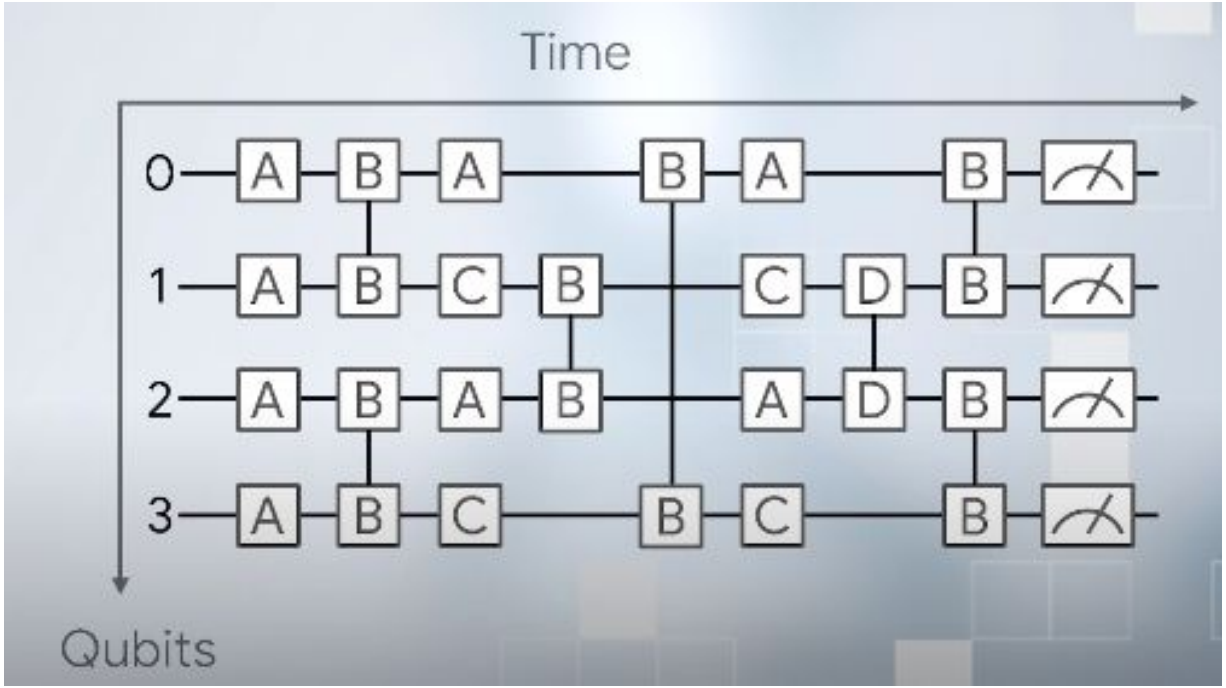
- Quantum Circuit

The process

- Quantum Circuit

PS: Not as hard as it looks

The process

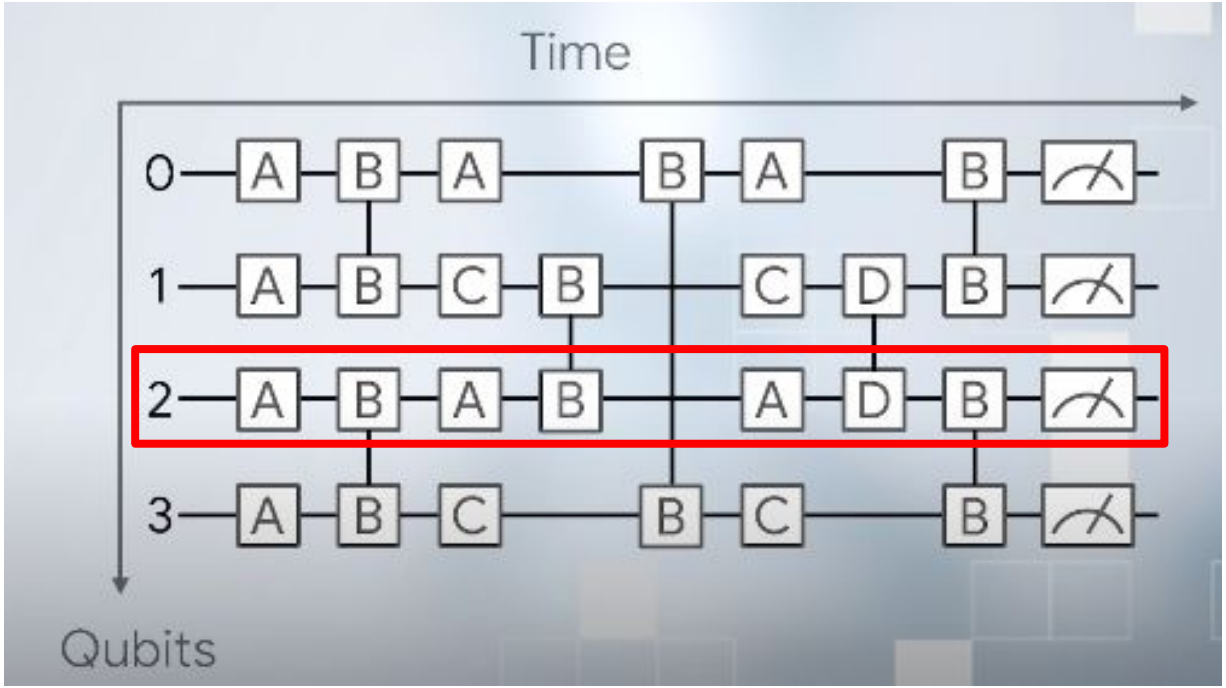


Source: Google AI

rishit.tech

PS: Not as hard as it looks

The process

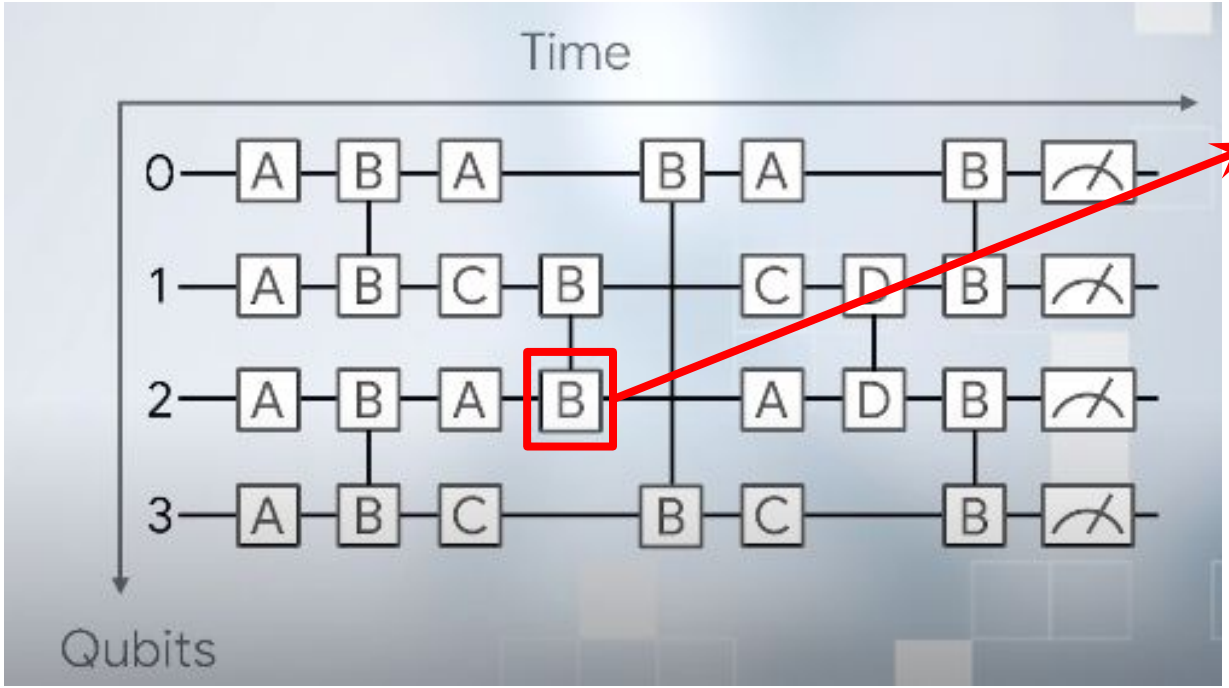


Source: Google AI

rishit.tech

PS: Not as hard as it looks

The process

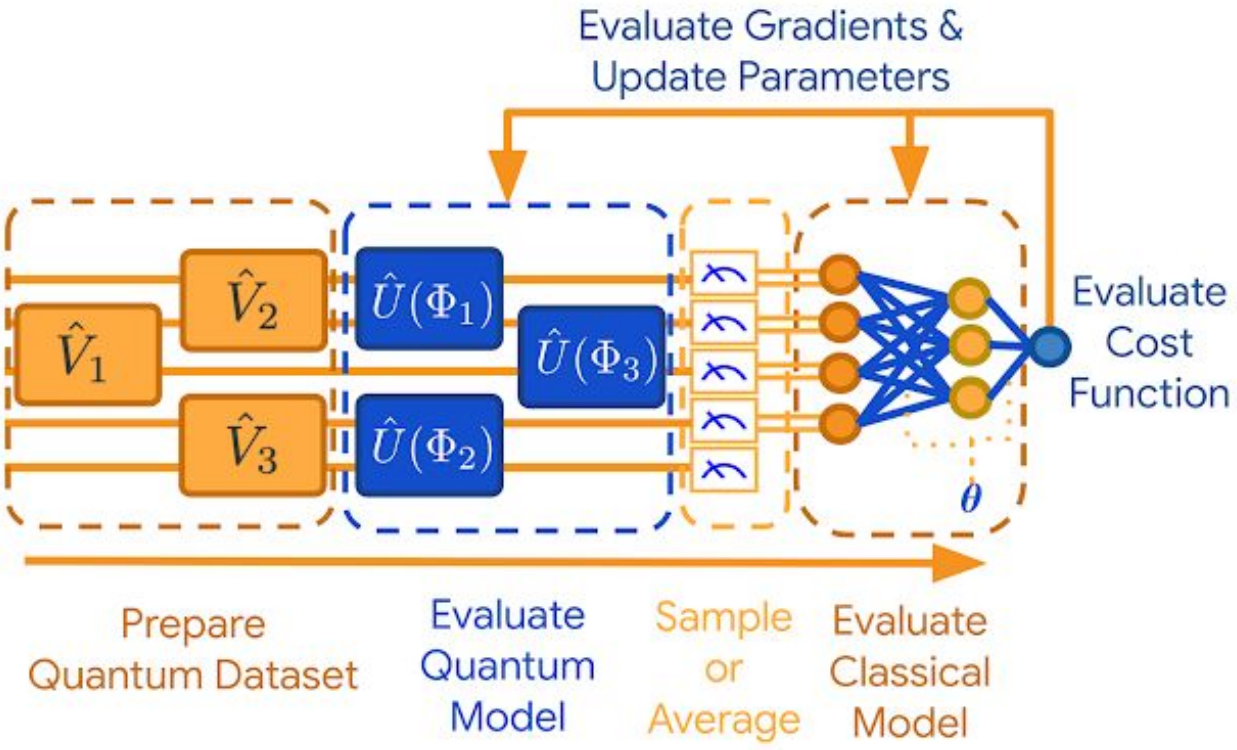


Quantum gate

Source: Google AI

rishit.tech

The process



Source: Google AI

rishit.tech

Installation

tensorflow.org/quantum/install

A simple circuit

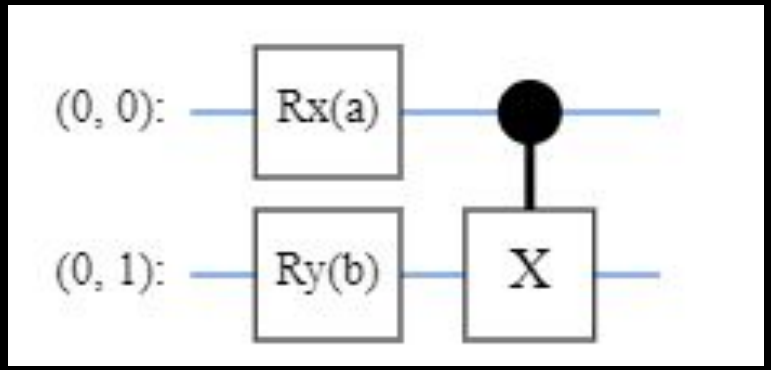
```
q0, q1 = cirq.GridQubit.rect(1, 2)
```

A simple circuit

```
q0, q1 = cirq.GridQubit.rect(1, 2)

circuit = cirq.Circuit(
  cirq.rx(a).on(q0),
  cirq.ry(b).on(q1),
  cirq.CNOT(control=q0, target=q1))
```

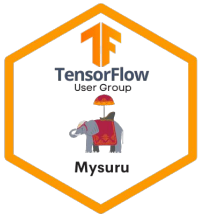
A simple circuit




```
q0, q1 = cirq.GridQubit.rect(1, 2)

circuit = cirq.Circuit(
  cirq.rx(a).on(q0),
  cirq.ry(b).on(q1),
  cirq.CNOT(control=q0, target=q1))
```

TensorFlow



Coding an AI algorithm

How does TFQ simplify things

- Differentiability

How does TFQ simplify things

- Differentiability
- Parallel circuits

How does TFQ simplify things

- Differentiability
- Parallel circuits
- Easy switching

How does TFQ simplify things

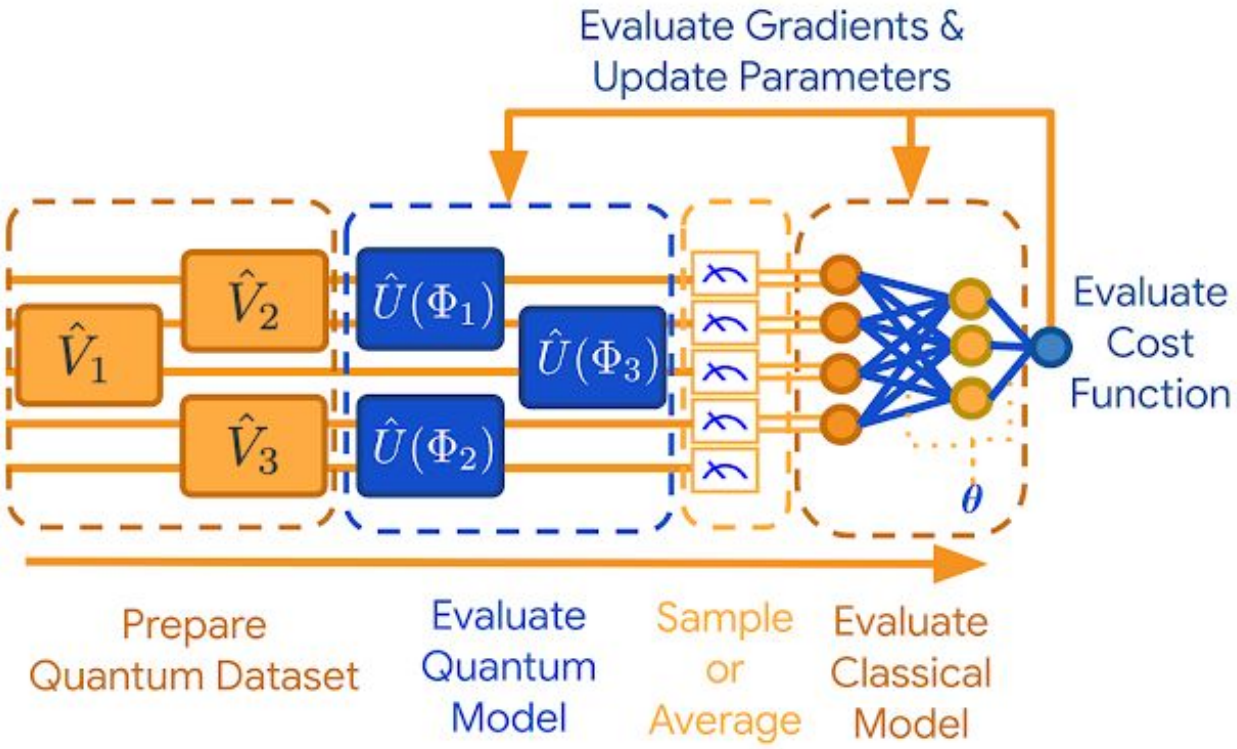
- Differentiability
- Parallel circuits
- Easy switching
- Cirq  TensorFlow

Things to keep in mind

- All circuits are Tensors

Things to keep in mind

- All circuits are Tensors
- Circuits ⟶ Classical data can be an op



Source: Google AI

TensorFlow

Demos!

tfug-mysuru.rishit.tech

Code Repo

Demos

Dummy algorithm

Image classification

TensorFlow

Key Takeaways

- Basics of quantum computing
- Motivation behind quantum computers
- Why hybrid quantum classical models?
- How can TFQ and Cirq help?
- Why use TFQ and Cirq?
- Building a hybrid classical model

About Me

Rishit Dagli

Rishit-dagli

rishit_dagli

rishit.tech

hello@rishit.tech

@rishit.dagli

tfug-mysuru.rishit.tech

Code Repo

bit.ly/tf-quantum-slides

Slides

Q & A

TensorFlow

THANK YOU