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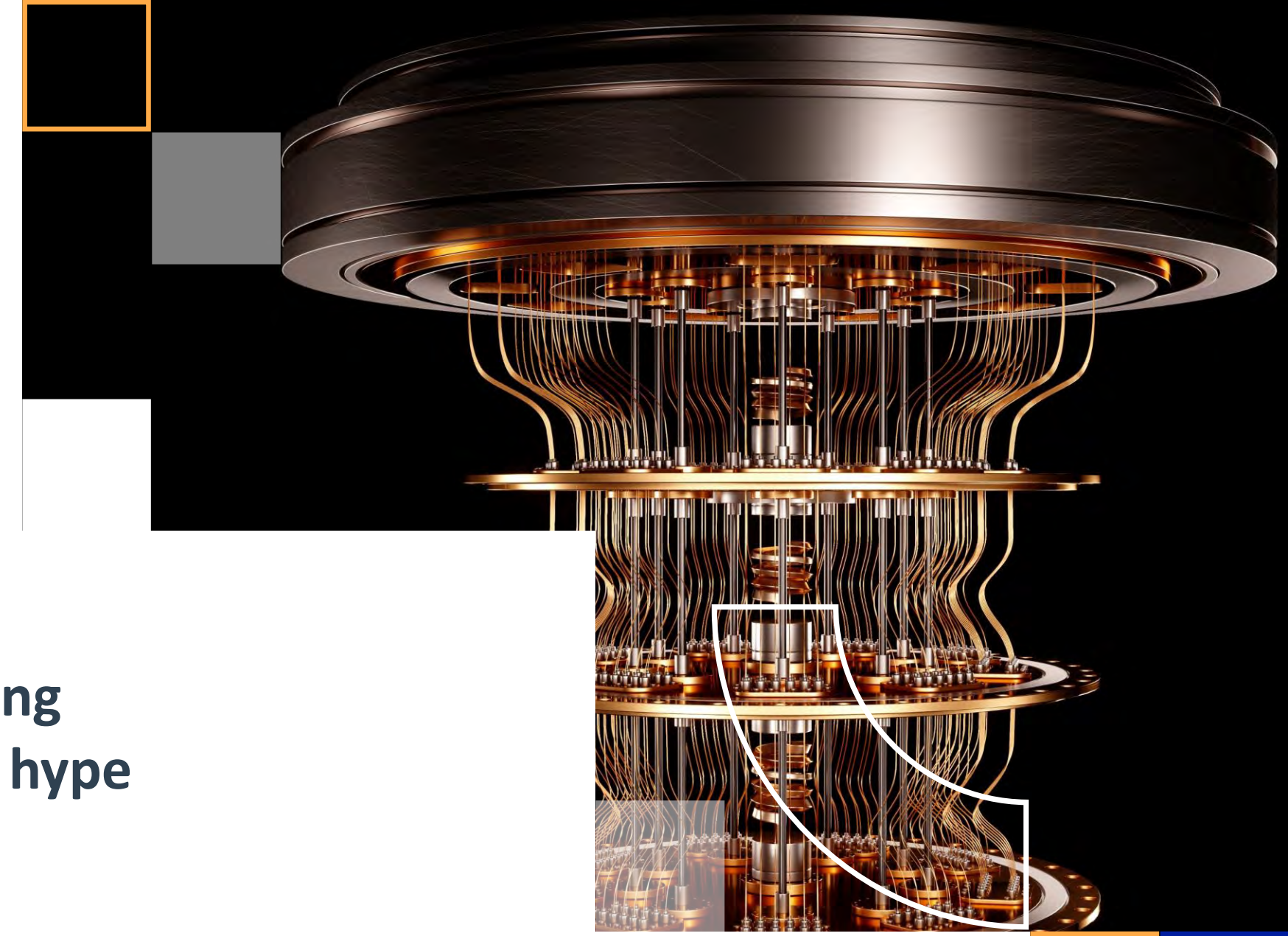

Quantum computing — is it real or just hype

Michał Jankowski

Who am I

Michał Jankowski

Head of Emerging Technologies

- I integrate cutting-edge technologies into our clients' organisations.
- My main focus is exploring and understanding the potential of quantum computing.
- I have a deep fascination for new technologies and how they can transform our everyday lives, which I express through blogging and public speaking.
- I regularly engage in conferences, sharing my insights on emerging technologies and discussing the future work landscape in the IT industry.

I’m only a message or a call away!

/ mjankowski@objectivity.co.uk

/ michalmjankowski

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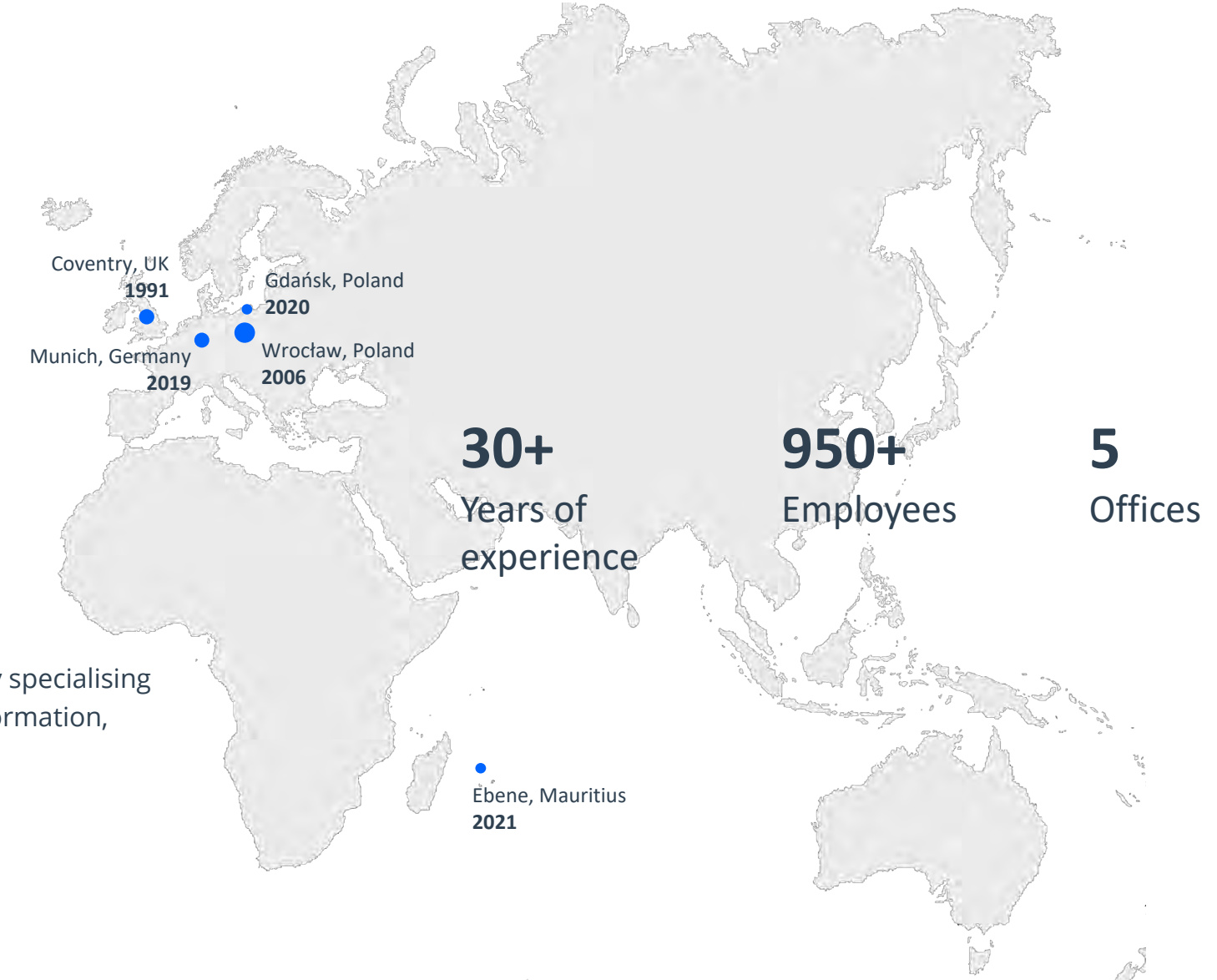


Decades of delighting clients

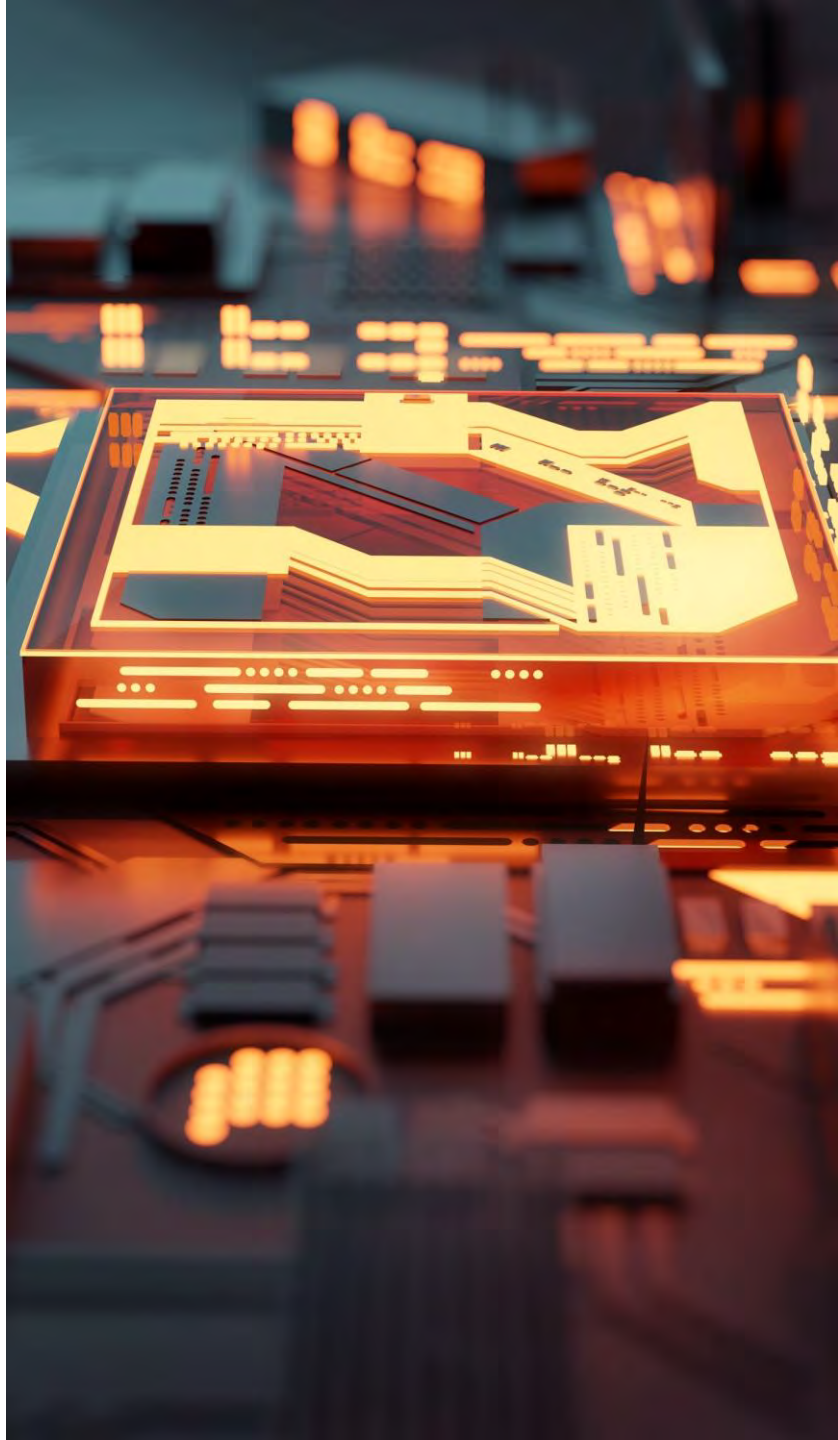
30+
Years of experience

950+
Employees

5
Offices

We're a values-driven software development company specialising in delivering custom software solutions, digital transformation, and IT consulting.

Table of Contents



Quantum computing

63% believe that commercialized quantum computing will hit the market in 5 years. 90% believe that by 2030, their company's operations will have been transformed by quantum computing

—State of Quantum 2022 IQM / Nov 2022

There is the possibility to:

- Get results faster
- Get better quality results
- Work with bigger problems
- Get multiple result scenarios

Quantum computing will not replace classical computing, it will extend and complement it.

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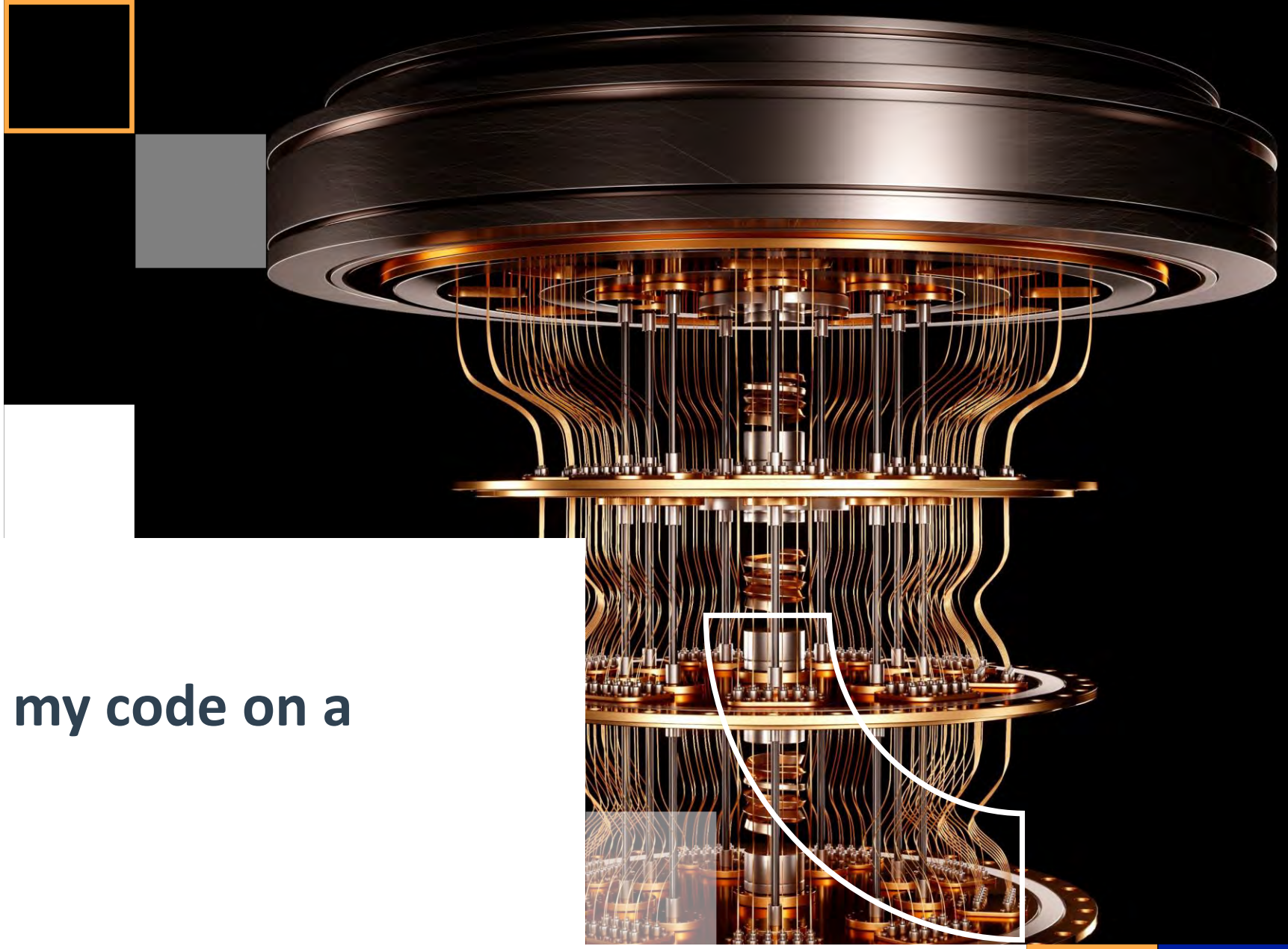
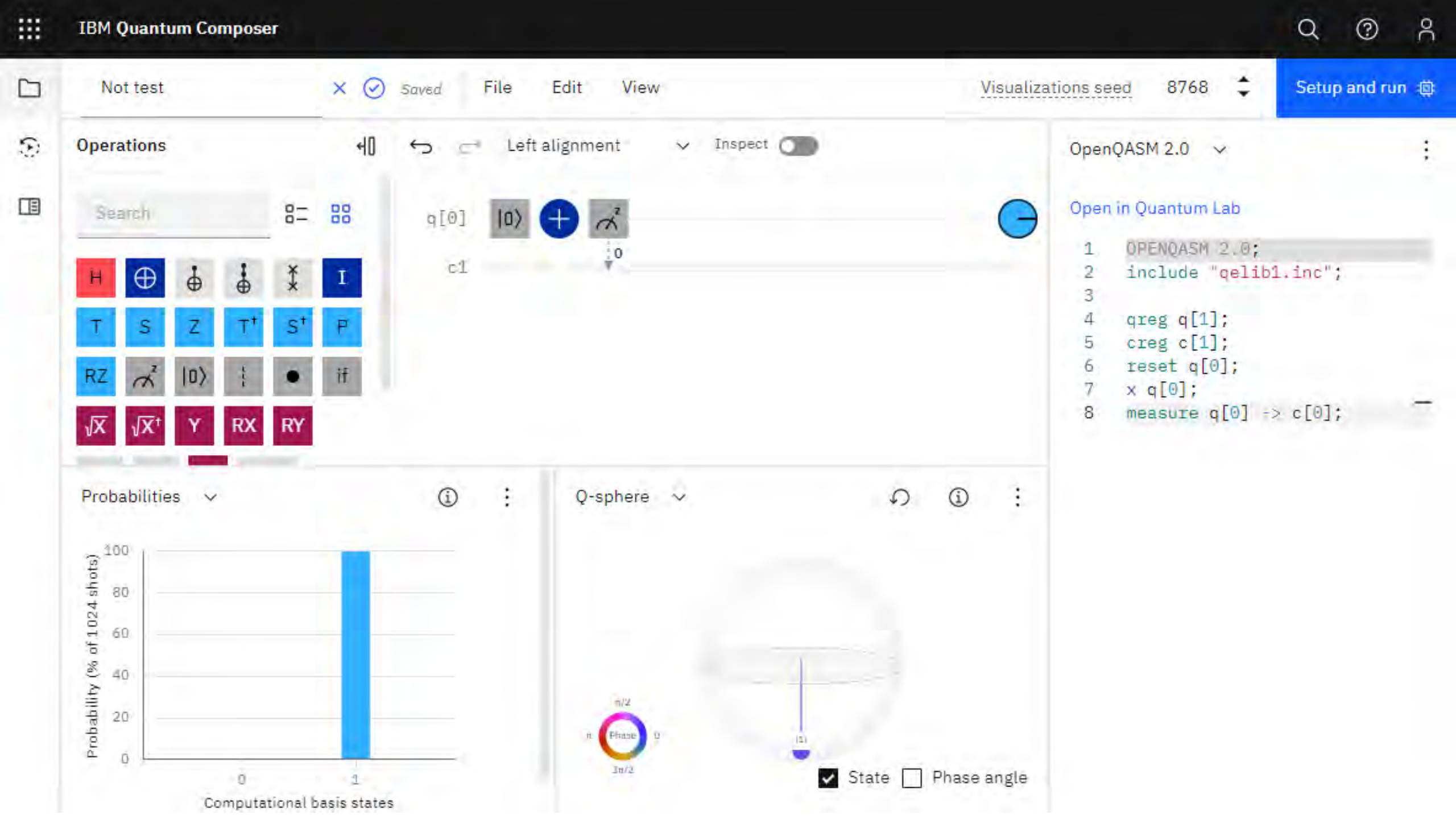


Is it possible to run my code on a quantum device?

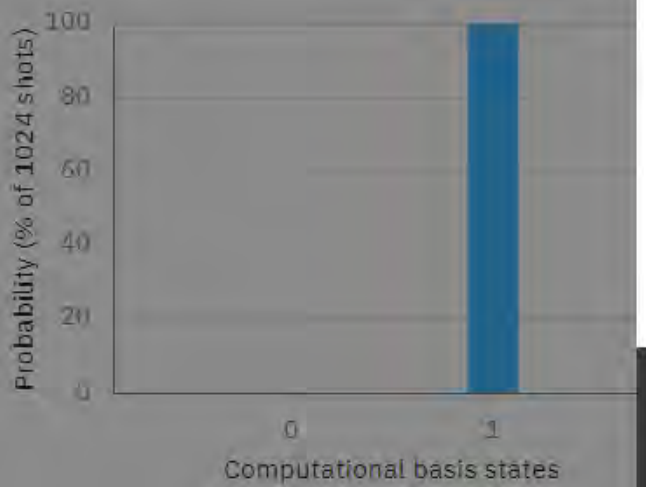

IBM Quantum Composer
Not test
Saved
File
Edit
View
Visualizations seed
8768
Setup and run
Operations
Left alignment
Inspect
Search
H
I
T
S
Z
T†
S†
P
RZ
|0⟩
if
√X
√X†
Y
RX
RY
q[0]
c1
0
OpenQASM 2.0
Open in Quantum Lab
1 OPENQASM 2.0;
2 include "qelib1.inc";
3
4 qreg q[1];
5 creg c[1];
6 reset q[0];
7 x q[0];
8 measure q[0] -> c[0];
Probabilities
Probability (% of 1024 shots)
100
80
60
40
20
0
0
1
Computational basis states
Q-sphere
π/2
π
Phase
0
3π/2
|1⟩
State
Phase angle

IBM Quantum Composer

Untitled circuit *Saved* File Edit

Operations

Probabilities



Set up and run your circuit

Step 1

Choose a system or simulator

Search by system or simulator na

7 Qubits 32 QV 2.6K CLOPS

ibm_oslo See details

System status Online

Total pending jobs 325

7 Qubits 32 QV 2.6K CLOPS

ibmq_manila See details

System status Online

Total pending jobs 124

Step 2

Choose your settings

Provider

ibm-q/open/main

Shots *

1024

Job limit: 5 remaining

Optional

Name your job

Job name

Not - example

Close

Run on ibm_oslo

ibm_washington

Exploratory

System status: Online
Processor type: Eagle r1

Qubits	QV	CLOPS
127	64	850

ibm_ithaca

Exploratory

System status: Online
Processor type: Hummingbird r3

Qubits
65

ibmq_kolkata

System status: Online
Processor type: Falcon r5.11

Qubits	QV	CLOPS
27	128	2K

ibmq_montreal

System status: Online
Processor type: Falcon r4

Qubits	QV	CLOPS
27	128	2K

ibmq_mumbai

System status: Online
Processor type: Falcon r5.10

Qubits	QV	CLOPS
27	128	1.8K

ibm_cairo

System status: Online
Processor type: Falcon r5.11

Qubits	QV	CLOPS
27	64	2.4K

Jobs /

6321d00d6b619a3da80d3d07

Rename

Edit Tags

Details

31m 47.8s
Total completion time

ibmq_lima
Backend

Sent from	Untitled circuit
Created on	Sep 14, 2022 2:58 PM
Sent to queue	Sep 14, 2022 2:58 PM
Provider	ibm-q/open/main
Run mode	fairshare
# of shots	1024
# of circuits	1

Status Timeline

- Created: Sep 14, 2022 2:58 PM
- Transpiling: 849ms
- Validating: 1.1s
- In queue: 31m 38.8s
- Running: 2s
  time in system 2s
- Completed: Sep 14, 2022 3:30 PM

Histogram

Circuit

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Why?

The quantum ecosystem

- Early adopters were highly satisfied with their most important quantum computing development activity. Almost all quantum computing early adopters surveyed indicated that progress to date was either very or somewhat successful. *—Hyperion Research / Nov 2022*

- Nearly half (48%) believe quantum computing will play a significant role in their industries by 2025. The vast majority (97%) think quantum will disrupt their industries—as well as the UK economy—to at least some extent by 2027. *—EY / Jun 2022*

- 43% organisation working on quantum technologies expect them to become available for use in at least one major commercial application with the next 3-5 years *—Capgemini / Mar 2022*

Hardware vendors

Microsoft, Google, intel, hp, Alibaba Group 阿里巴巴集团, D-Wave The Quantum Computing Company™, IBM

Early adopters

AIRBUS, Goldman Sachs, BMW, BBVA Banco, BNP PARIBAS, COMMERZBANK, Volkswagen, CRÉDIT AGRICOLE, Coca-Cola, TOYOTA, PayPal, Scotiabank, Pfizer

There is lot of fear

- What will happen if I will miss the moment?
- What about security?
- Will current security standards be safe in the future?
- Of course, there is always the question of Bitcoin

I believe that it is happening right now

From the technical perspective, we see three main reasons why this is a great time to start looking into this technology.

Key changes:

Possibility to run quantum applications on cloud

Progression in a speed improvement of quantum processors

Building interconnectivity between quantum processors

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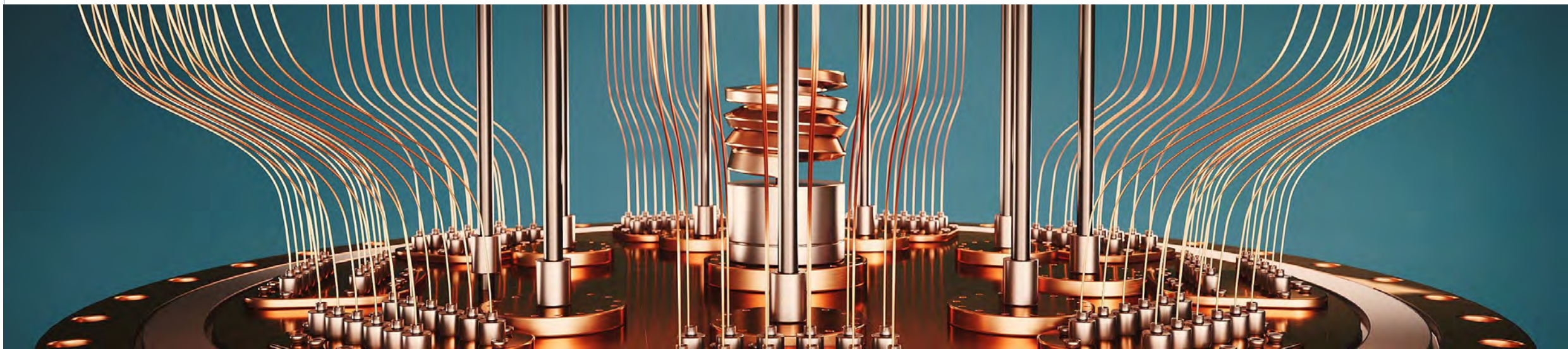
How?

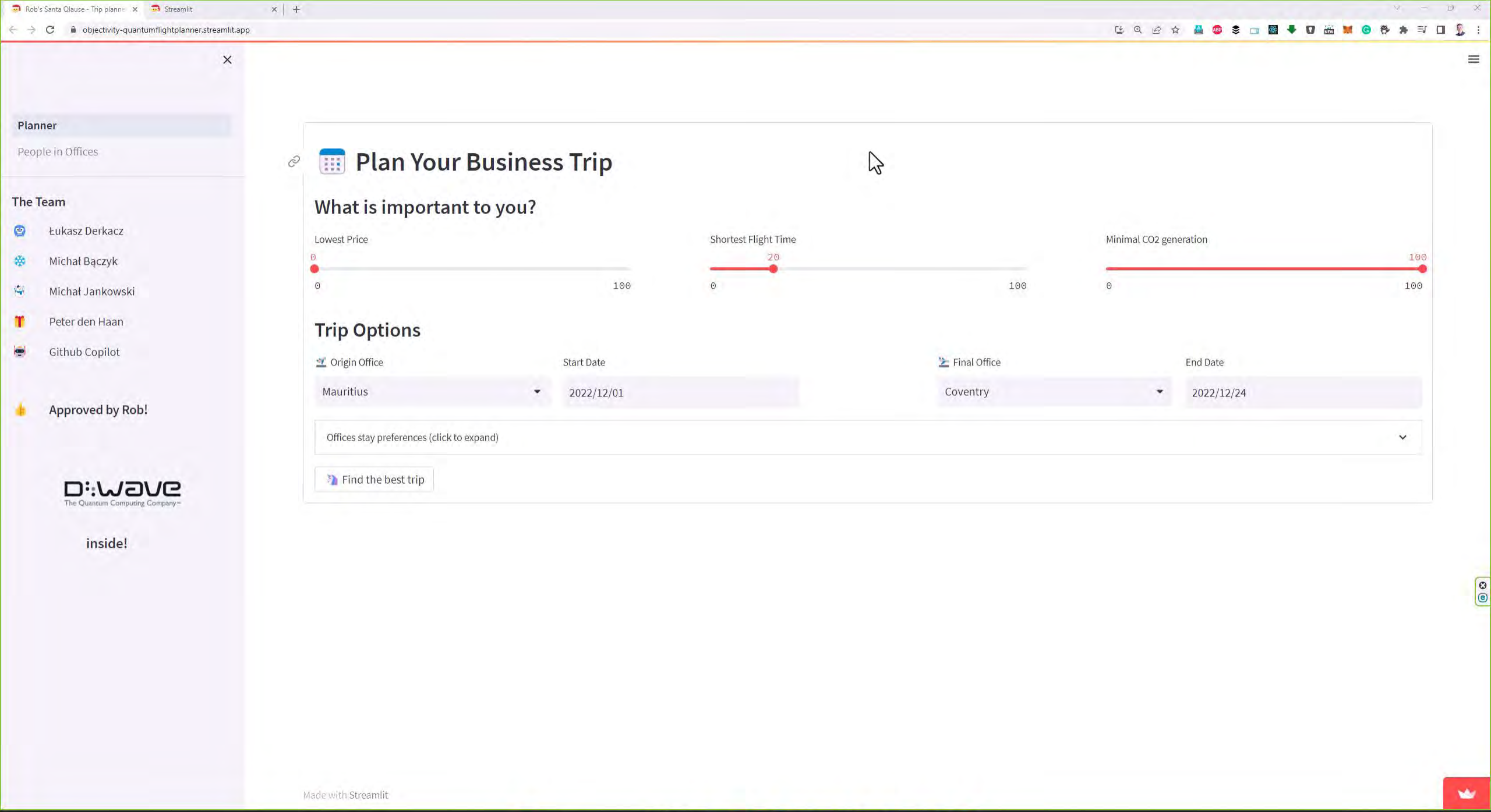
How can you check if cutting-edge technology is real?

- What has been done with quantum computing?
- Is it delivering value?
- How difficult is it to learn quantum computing?
- How long did it take to learn it?
- Are you still using it?
- How much does it cost?

Example of usages

- **Optimisation**
  - Approach complex combinatorial problems
  - Optimise scheduling and staffing
  - Improve supply chain and logistics operations
- **Modelling**
  - Anticipate customer behaviour
  - Forecast future demand and sales
  - Predict financial market trends
- **Quantum machine learning**
  - Train models with less data
  - Detect anomalies in your data
  - Improve decision making with classifiers




Rob's Santa Qlause - Trip planne
Streamlit
objectivity-quantumflightplanner.streamlit.app
Planner
People in Offices
The Team
Łukasz Derkacz
Michał Bączyk
Michał Jankowski
Peter den Haan
Github Copilot
Approved by Rob!
D:wave
The Quantum Computing Company™
inside!
Plan Your Business Trip
What is important to you?
Lowest Price
0
0
100
Shortest Flight Time
20
0
100
Minimal CO2 generation
100
0
100
Trip Options
Origin Office
Mauritius
Start Date
2022/12/01
Final Office
Coventry
End Date
2022/12/24
Offices stay preferences (click to expand)
Find the best trip
Made with Streamlit
Search
22:57
11/06/2023

Production planning

From 4 hours to 90 seconds with additional flexibility

Objectivity manufacturing customer

Challenge

The customer was struggling with production planning optimisation. Calculation using classical approaches took 4 hours and blocked them from extending the model.

Solution

We conduct proof of concept to verify if we can speed up calculations using the quantum computing approach.

Benefit

Using quantum computing, we reduced calculation time to 90 seconds for the largest models and generated multiple scenarios supporting customer constraints. Results allow rapid “what if” scenario planning and extending the current model by new dimensions.

The code

The code looks very similar to any other code.

```
# Initialize the DQM object
dqm = DiscreteQuadraticModel()

# Build the DQM starting by adding variables
for name in range(num_employees):
    dqm.add_variable(num_shifts, label=name)

# Distribute employees equally across shifts according to preferences
num_per_shift = int(num_employees/num_shifts)
gamma = num_employees

for i in range(num_shifts):
    for j in range(num_employees):
        dqm.set_linear_case(j, i, preferences[j, i] - gamma*(2*num_per_shift-1))
        for k in range(j+1, num_employees):
            dqm.set_quadratic_case(j, i, k, i, gamma*2)

# Initialize the DQM solver
sampler = LeapHybridDQMSampler()

# Solve the problem using the DQM solver
sampleset = sampler.sample_dqm(dqm, label='Example - Employee Scheduling')

# Get the first solution, and print it
sample = sampleset.first.sample
energy = sampleset.first.energy
```

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How to prepare your organization for the quantum revolution?

How to prepare your organization for the quantum revolution?

Awareness

Help you to understand the technology and its potential

Discovery

Identify your potential quantum use cases and build your proof-of-concept roadmap

PoC

Verification of the idea by building a prototype that will use real data

Production

Delivery of application ready for work at production scale

Summary

- Right now we can observe huge hype related to quantum technology. Still, this hype has a strong justification due to technology growth and its adoption.
- Numerous businesses are exploring the potential of quantum technology.
- We can anticipate a waiting period of roughly 2 – 5 years before this technology matures for universal purposes.
- Multiple successful proof-of-concept instances highlight the advantages of quantum computing.

- It is recommended to include quantum computing technology in your strategic focus, examining its potential to generate significant benefits for your organization.

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I’m only a message or a call away!

Together, let's unlock the potential of quantum technology in your business operations.

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LinkedIn: michalmjankowski

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Thank you for your attention

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