

Menu Export Clear Circuit Clear ALL Undo Redo Make Gate

Probes Displays Half Turns Quarter Turns Eighth Turns Spinning Formulaic Parametrized Sampling Parity

Toolbox

$|0\rangle\langle 0|$ $|1\rangle\langle 1|$
 Density Bloch
 Chance Amps

Z Swap
 Y
 \oplus H

S S^{-1}
 $Y^{1/2}$ $Y^{-1/2}$
 $X^{1/2}$ $X^{-1/2}$

T T^{-1}
 $Y^{1/4}$ $Y^{-1/4}$
 $X^{1/4}$ $X^{-1/4}$

Z^t Z^{-t}
 Y^t Y^{-t}
 X^t X^{-t}

$Z^{f(t)}$ $R_z(f(t))$
 $Y^{f(t)}$ $R_y(f(t))$
 $X^{f(t)}$ $R_x(f(t))$

$Z^{A/2^n}$ $Z^{-A/2^n}$
 $Y^{A/2^n}$ $Y^{-A/2^n}$
 $X^{A/2^n}$ $X^{-A/2^n}$

Z $Z \otimes I_0$
 Y $Y \otimes I_0$
 X $X \otimes I_0$

$[Z_{par}]$
 $[Y_{par}]$
 $[X_{par}]$

On
 On
 On
 On
 On

000
 001
 010
 011
 100
 101
 110
 111

Local wire states (Chance-Bloch) 00 01 10 11 Final

Welcome!

Quantum Computing devroom

FOSDEM 2025

\ominus \oplus
 \otimes \otimes
 $|+\rangle\langle +|$ $|-\rangle\langle -|$
 $|i\rangle\langle i|$ $|-i\rangle\langle -i|$

X/Y Probes

$+rt$ $-rt$
 Reverse

Order

QFT QFT^\dagger
 $Grad^{1/2}$ $Grad^{-1/2}$
 $Grad^t$ $Grad^{-t}$

Frequency

input A A=# default
 input B B=# default
 input R R=# default

Inputs

$+1$ $<B \otimes A > B$
 $+AB$ $<B \otimes A > B$
 $+A$ $<B \otimes A > B$
 $+B$ $<B \otimes A > B$

Arithmetic

$+1$ -1
 mod R mod R
 $+A$ $-A$
 mod R mod R
 $\times A$ $\times A^{-1}$
 mod R mod R
 $\times B^A$ $\times B^{-A}$
 mod R mod R

Compare

\dots 0
 Oracle

Modular

\dots 0
 Oracle

Scalar

\sqrt{i} $\sqrt{-i}$

Custom Gates

\ominus \oplus
 \otimes \otimes
 $|+\rangle\langle +|$ $|-\rangle\langle -|$
 $|i\rangle\langle i|$ $|-i\rangle\langle -i|$

$+rt$ $-rt$
 Reverse

QFT QFT^\dagger
 $Grad^{1/2}$ $Grad^{-1/2}$
 $Grad^t$ $Grad^{-t}$

input A A=# default
 input B B=# default
 input R R=# default

$+1$ $<B \otimes A > B$
 $+AB$ $<B \otimes A > B$
 $+A$ $<B \otimes A > B$
 $+B$ $<B \otimes A > B$

$+1$ -1
 mod R mod R
 $+A$ $-A$
 mod R mod R
 $\times A$ $\times A^{-1}$
 mod R mod R
 $\times B^A$ $\times B^{-A}$
 mod R mod R

\dots 0
 Oracle

\sqrt{i} $\sqrt{-i}$

|organizers>

Alessandro Cosentino



nate stemen



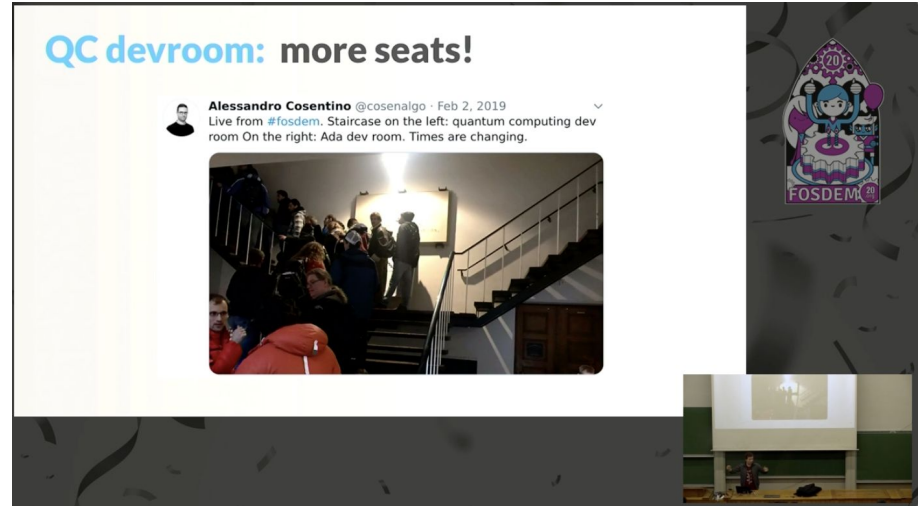
Purva Thakre



quantum-devroom-manager
@fosdem.org

|devroom history>

- ❖ 2 editions in the past: 2019 and 2020
- ❖ Organized by the Quantum Open Source Foundation (QOSF)
- ❖ Tomas Babej and Mark Fingerhuth
- ❖ 4 years hiatus since then



|outline⟩

- ❖ |quantum computing⟩
- ❖ |quantum computing *software*⟩
- ❖ |quantum computing **open source** *software*⟩
- ❖ |quantum computing **open source** *software*⟩ at FOSDEM

|quantum computing⟩

A paradigm that harnesses properties of quantum mechanics – such as superposition, entanglement, and interference – to fundamentally improve the speed and/or security of computers

 An area of research for 20 years; feasibility in the coming 20 years 🙌

 In the NISQ (noisy intermediate-scale quantum) era – up to 1,000 qubits

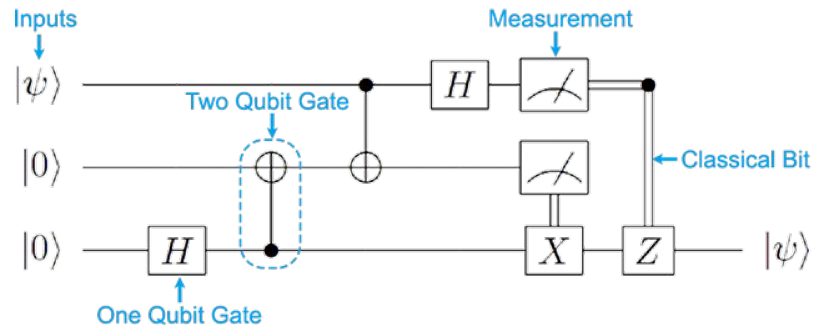
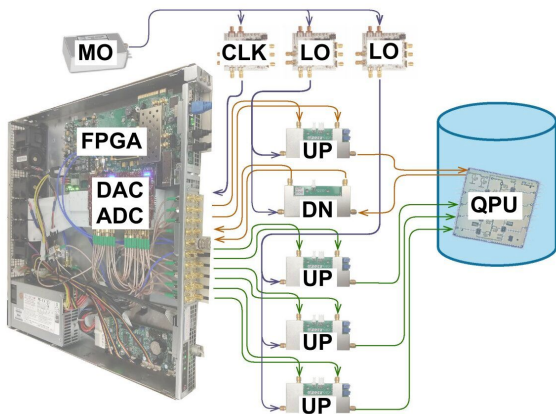
 Applications:

- **Cryptography:** compute the secret key from the public key of the RSA scheme
- **Simulation of quantum systems:** design new materials, more efficient fertilizers, new drugs
- **Optimization:** routing, scheduling, etc...

|quantum computing software⟩

the job

1. Comes up with an algorithm/protocol
2. Writes it in a formal language
3. Compiles
4. Simulates on classical devices
5. Runs on real hardware devices



tools for the job

1. Hybrid approach (error mitigation, variational quantum algorithms)
2. Domain-specific languages
3. Compilers
4. Simulators
5. Control toolkits

|quantum computing **open source software**⟩

- ❖ R&D phase
- ❖ No single “correct” approach yet
- ❖ Transparency: benchmark and verify claims
- ❖ Truly full-stack

The Economics of an Open-Source Quantum Computer

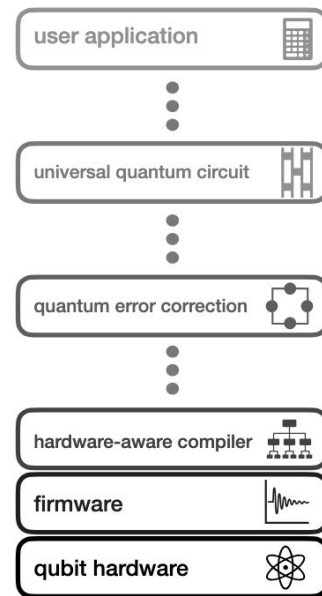
Francesco Bova^{1,2,5*} and Roger G. Melko^{2,3,4,5}

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Abstract

Open-source projects that aim to make their offerings public have competed against for-profit, proprietary companies in a number of domains. These open-source projects often arise in response to the offerings of proprietary companies in markets where products have already been commer-

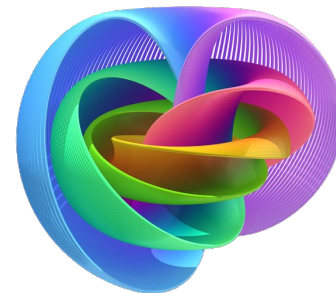


<https://arxiv.org/abs/2501.13315v1>

|QOSS: landscape>

github.com/qosf/awesome-quantum-software (400+ project)

unitaryfund.github.io/survey-2024/ (800+ participants)

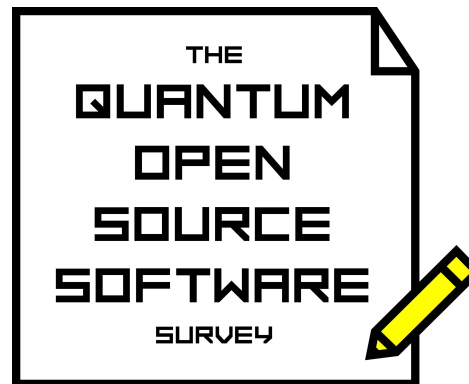
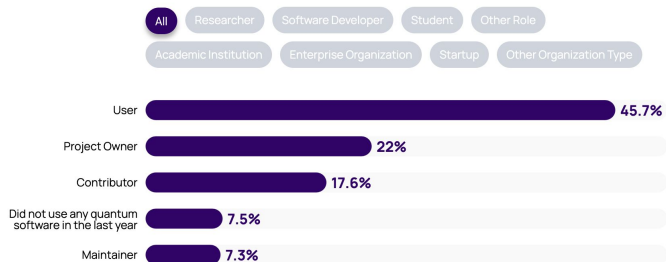


Experience

16) Primary Role in Quantum Software

+ show full text

Total answers: 797



|schedule⟩

Welcome to the Quantum Computing devroom	Alessandro Cosentino	13:10	13:20
Qlafoutea: Baby steps towards compiling a programming language to analog quantum computer	David "Yoric" Teller	13:25	13:45
No-one used my software: a tale of quantum software engineering	Aleksander Wennersteen	13:50	14:10
Bridging the Gap: Quantum Computing for Classical Software Engineers	Veronica Lopez	14:15	14:35
Quantum type system in H-hat quantum programming language	Eduardo Maschio (Dooms)	14:40	15:00
Quantum Distance Bounding: Unlocking Secure Proximity	Kevin Bogner	15:05	15:25
Introducing Qumat! (An Apache Mahout Joint)	Trevor Grant, Andrew Musselman	15:30	15:50
Opensource Tools for Platform Agnostic Quantum Computing	Harshit Gupta	15:55	16:15
On-Chip Verified Quantum Computation with an Ion-Trap Quantum Processing Unit	Cica Gustiani	16:20	16:40
Unitary Compiler Collection	nate stemen	16:45	17:00

|thanks!>



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