CENTRE FOR
QUANTUM
TECHNOLOGIES
S I N G A P O R E

Benchmarking of NQCH's sinq20

September 30, 2025

1. Report of Changes

Platform: sinq20
Calibration-id: *fdb93a3978fe6356741e31b98c93c68837767080*
Calibration date: *19-09-2025 17:03*
Experiment date: *30-09-2025 12:10*
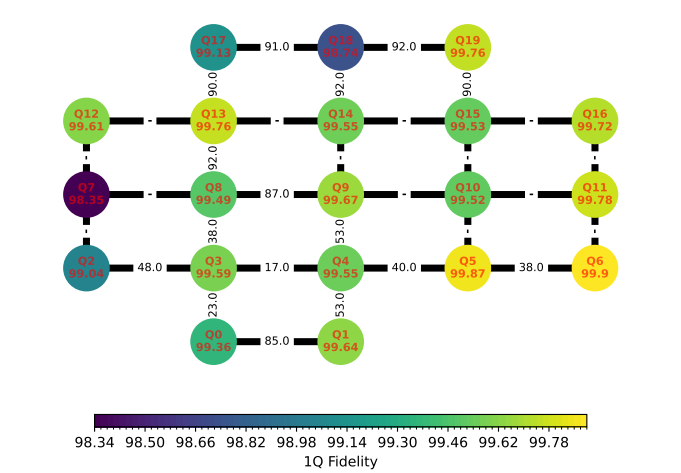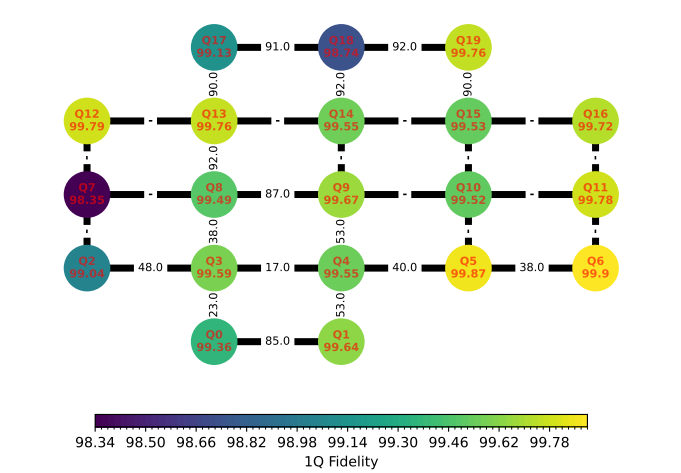**Note:** chore(sinq20): 1q tuneup, q11, q12, q18

Platform: **sinq20**
Calibration-id: *32fa7be02d2d6d5812d7cb47f8c293561b74c0b5*
Date: *2025-09-19 11:42:06*

2. Version Comparison

Library	Version	Library	Version
qibo	0.2.19	numpy	2.2.6
qibolab	0.2.9	qibocal	0.2.3
matplotlib	3.10.3	scipy	1.15.3
scikit-learn	1.6.1	pandas	2.2.3
networkx	3.4.2	sympy	1.14.0
torch	2.7.0		

Library	Version	Library	Version
qibo	0.2.19	numpy	2.2.6
qibolab	0.2.9	qibocal	0.2.3
matplotlib	3.10.3	scipy	1.15.3
scikit-learn	1.6.1	pandas	2.2.3
networkx	3.4.2	sympy	1.14.0
torch	2.7.0		

3. One and two qubit fidelities

4. Statistics

	Average	Median	Min	Max
T1 (ns)	1.28e+04	1.23e+04	646	3.65e+04
T2 (ns)	2.36e+25	4.11e+03	125	9.43e+26
Fidelity	None	None	None	None
RO fidelity	0.794	0.777	0.777	0.927
Mermin Max	3.226			

	Average	Median	Min	Max
T1 (ns)	1.28e+04	1.23e+04	646	3.65e+04
T2 (ns)	2.36e+25	4.11e+03	125	9.43e+26
Fidelity	None	None	None	None
RO Fidelity	0.794	0.777	0.777	0.927
Mermin Max	3.226			

5. Benchmark Results

Qubit n	Fidelity	Error Bars
0	0.994	± 0.000465
1	0.996	± 0.000249
2	0.99	± 0.00117
3	0.996	± 0.000322
4	0.995	± 0.000816
5	0.999	± 0.000534
6	0.999	± 0.000308
7	0.983	± 0.00219
8	0.995	± 0.000549
9	0.997	± 0.000698
10	0.995	± 0.000441
11	0.998	± 0.000246
12	0.998	± 0.000396
13	0.998	± 0.000344
14	0.996	± 0.000846
15	0.995	± 0.000647
16	0.997	± 0.000463
17	0.991	± 0.0006
18	0.987	± 0.00163
19	0.998	± 0.00042

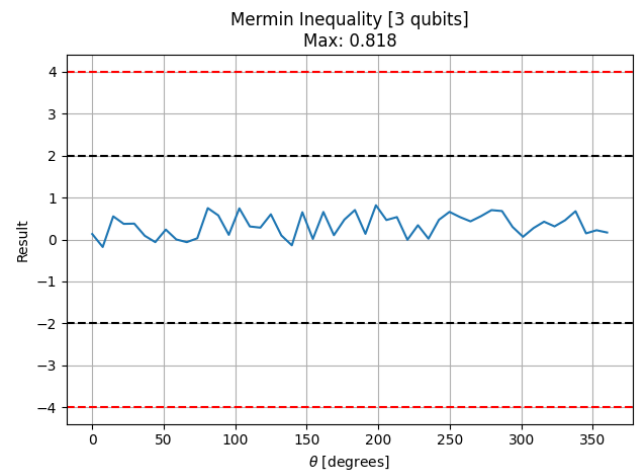| Qubit n	Fidelity	Error Bars
0	0.994	± 0.000465
1	0.996	± 0.000249
2	0.99	± 0.00117
3	0.996	± 0.000322
4	0.995	± 0.000816
5	0.999	± 0.000534
6	0.999	± 0.000308
7	0.983	± 0.00219
8	0.995	± 0.000549
9	0.997	± 0.000698
10	0.995	± 0.000441
11	0.998	± 0.000483
12	0.996	± 0.000371
13	0.998	± 0.000344
14	0.996	± 0.000846
15	0.995	± 0.000647
16	0.997	± 0.000463
17	0.991	± 0.0006
18	0.987	± 0.00163
19	0.998	± 0.00042

6. 5 Qubit Mermin

Mermin's algorithm for 3 qubits.

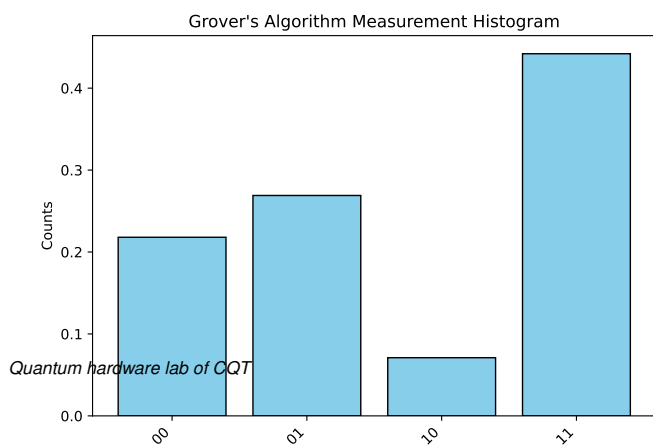- **Runtime:** 19.05328 seconds.
- **Qubits used:** [[13, 17, 18]]

- **Runtime:** 10.13292 seconds.
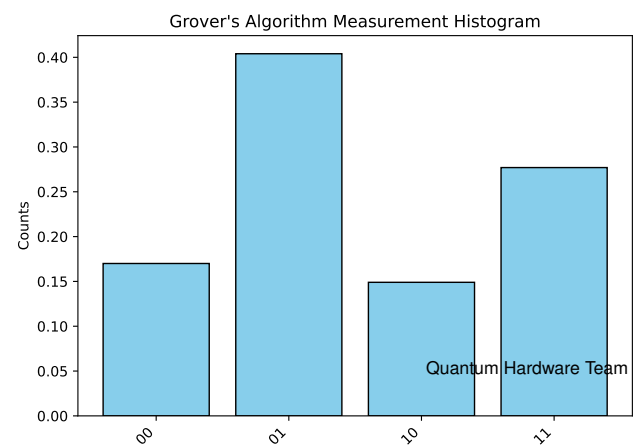- **Qubits used:** — No "qubits_used" provided. —

7. Grover - 2 qubits

Grover's algorithm for 2 qubits executed on sinq20 backend with 1000 shots per circuit. We measure the success rate of finding the target state '11' for each pair of qubits in [[13, 14]].

- **Runtime:** 11.27258 seconds.
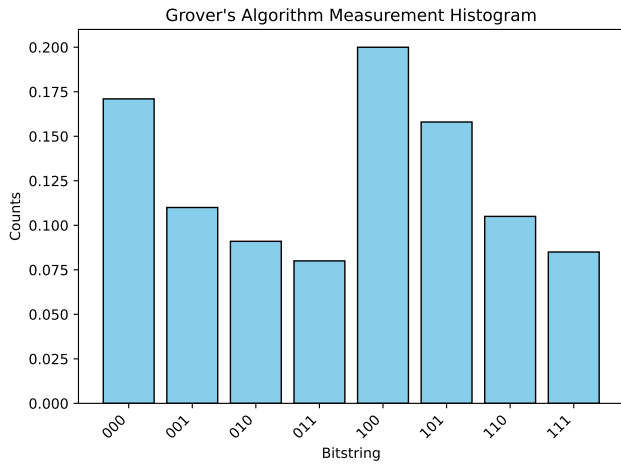- **Qubits used:** — No "qubits_used" provided. —

- **Runtime:** 8.94676 seconds.
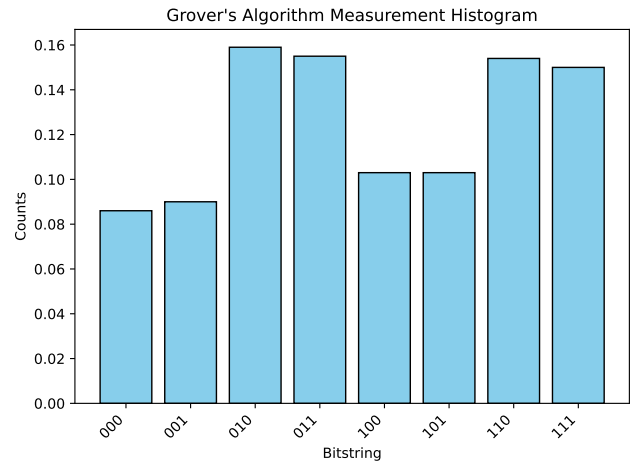- **Qubits used:** — No "qubits_used" provided. —

8. Grover - 3 qubits

Grover's algorithm for 3 qubits executed on sinq20 backend with 1000 shots per circuit. We measure the success rate of finding the target state '111' for each pair of qubits in [[17, 13, 18, 14]].

- **Runtime:** 16.51933 seconds.
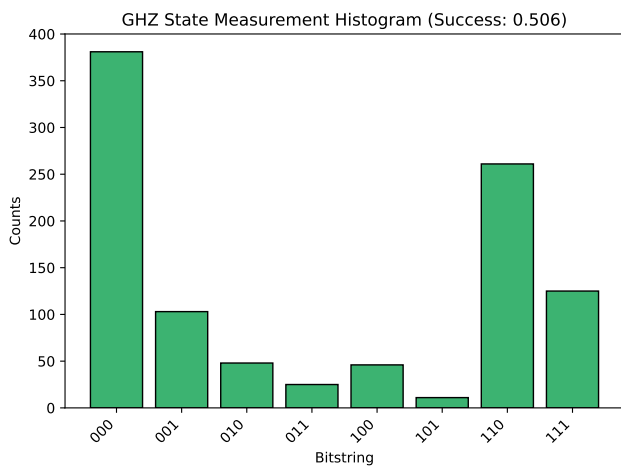- **Qubits used:** [[17, 13, 18, 14]]

- **Runtime:** 17.52389 seconds.
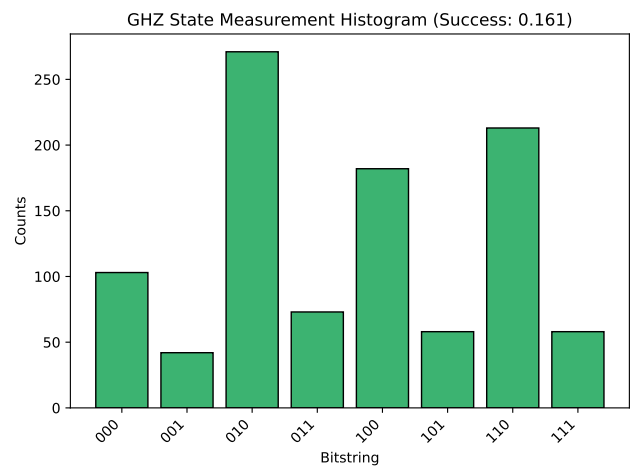- **Qubits used:** — No "qubits_used" provided. —

9. GHZ state preparation

GHZ circuit with 3 qubits executed on sinq20 backend with 1000 shots.

- **Runtime:** 22.51014 seconds.
- **Qubits used:** [0, 1, 2]

- **Runtime:** 7.23527 seconds.
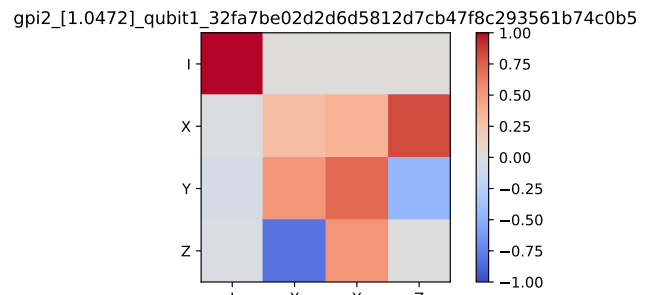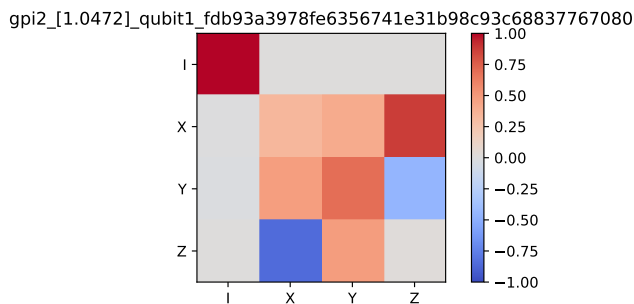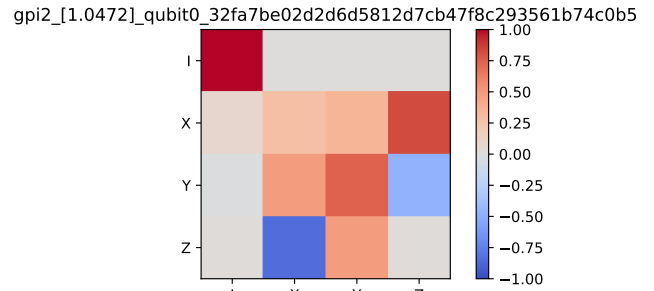- **Qubits used:** — No "qubits_used" provided. —
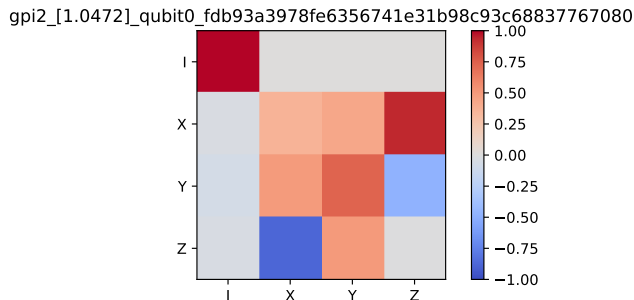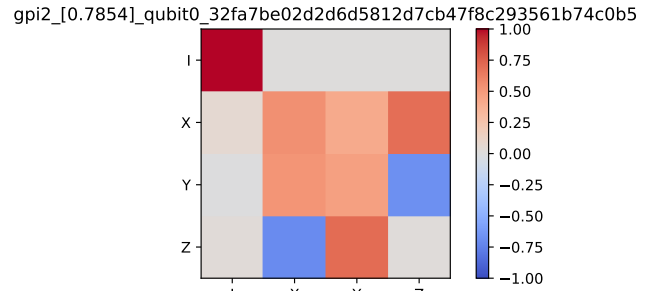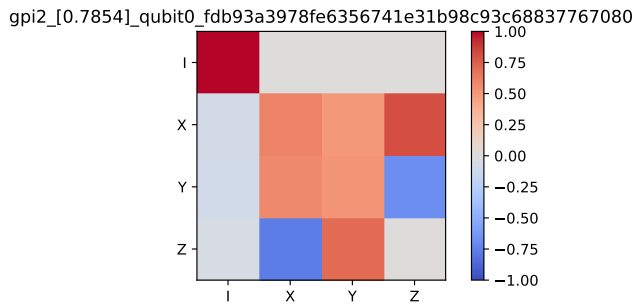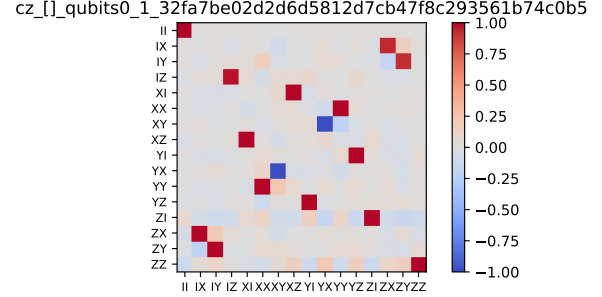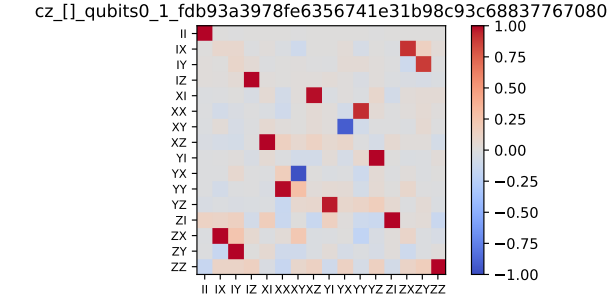
10. Process Tomography state preparation

Process tomography involves preparing a circuit particular set of states, appending a gate (process) to the circuit, and measuring the circuit in the Pauli basis. The data is processed to get the Pauli Liouville representation of a process (gate). - Single qubit process tomography executed on qubits: [0, 1] - Two qubit process tomography on coupled qubits: [[0, 1]]
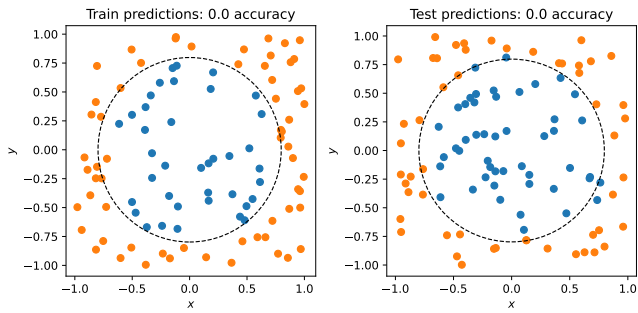
- **Runtime:** 2068.71072 seconds.
- **Qubits used:**

- **Runtime:** — No runtime provided. —
- **Qubits used:**

cz_[]_qubits0_1_fdb93a3978fe6356741e31b98c93c68837767080

cz_[]_qubits0_1_32fa7be02d2d6d5812d7cb47f8c293561b74c0b5

gpi2_[0.7854]_qubit0_fdb93a3978fe6356741e31b98c93c68837767080

gpi2_[0.7854]_qubit0_32fa7be02d2d6d5812d7cb47f8c293561b74c0b5

gpi2_[0.7854]_qubit1_fdb93a3978fe6356741e31b98c93c68837767080

gpi2_[0.7854]_qubit1_32fa7be02d2d6d5812d7cb47f8c293561b74c0b5

gpi2_[1.0472]_qubit0_fdb93a3978fe6356741e31b98c93c68837767080

gpi2_[1.0472]_qubit0_32fa7be02d2d6d5812d7cb47f8c293561b74c0b5

gpi2_[1.0472]_qubit1_fdb93a3978fe6356741e31b98c93c68837767080

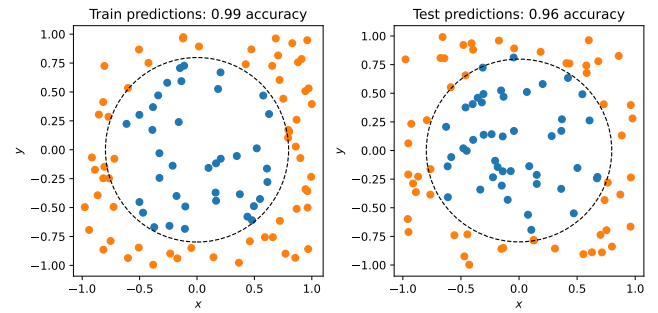gpi2_[1.0472]_qubit1_32fa7be02d2d6d5812d7cb47f8c293561b74c0b5

11. Reuploading Classifier

Reuploading classifier with 1 qubits, 10 layers, depth of 20, 500 shots.

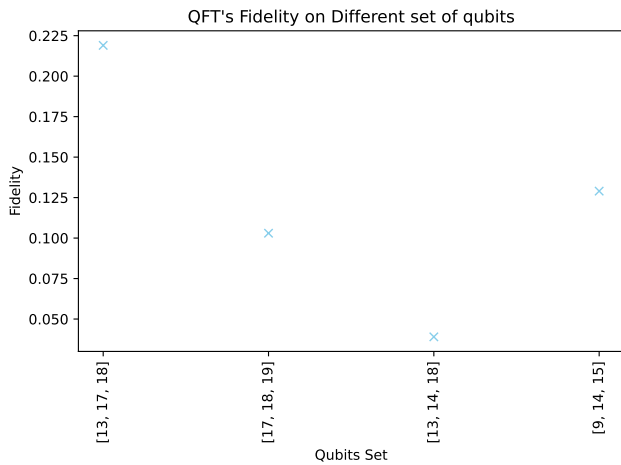- **Runtime:** 3393.40321 seconds.
- **Qubits used:** [9]

- **Runtime:** None
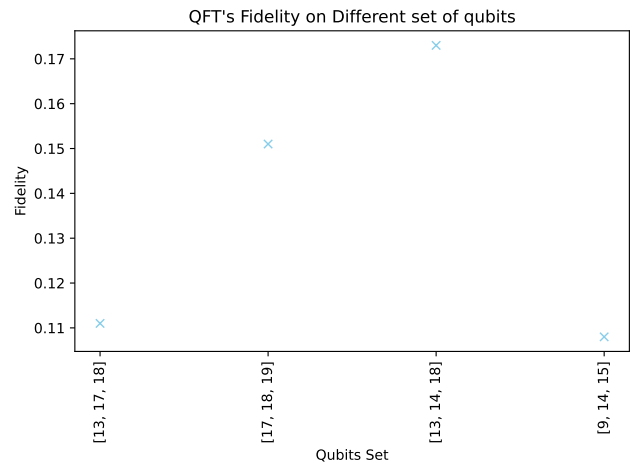- **Qubits used:** — No "qubits_used" provided. —

12. QFT Plots

Implementation of the Quantum Fourier Transform on different subsets of three qubits. The number of gates is 12, the depth of the circuit is 7

- **Runtime:** 18.82738 seconds.
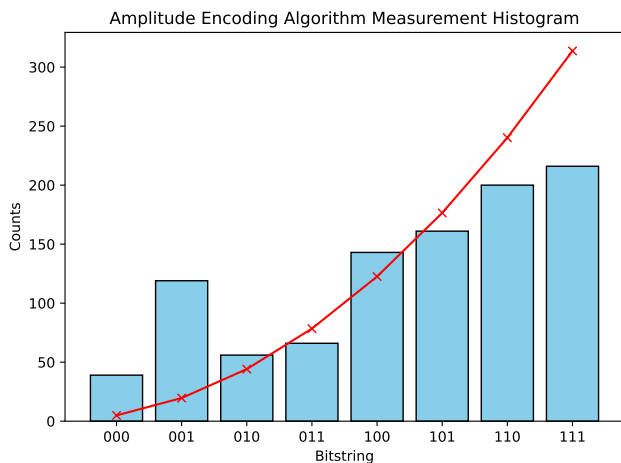- **Qubits used:** [[13, 17, 18], [17, 18, 19], [13, 14, 18], [9, 14, 15]]

- **Runtime:** 7.5941018289886415
- **Qubits used:** — No "qubits_used" provided. —

13. Amplitude Encoding

Encoding of a vector of numerical data into the amplitudes of a quantum state. The input vector is [1, 2, 3, 4, 5, 6, 7, 8]. The number of gates is 16, the depth of the circuit is 12 and the runtime execution is 16.467ms

- **Runtime:** 16.46720 seconds.
- **Qubits used:** [0, 1, 4]

- **Runtime:** 7.99663 seconds.
- **Qubits used:** — No "qubits_used" provided. —