

## Benchmark Report

# Benchmarking of NQCH's sinq20

September 29, 2025

## 1. Report of Changes

This report presents a benchmarking study of a quantum computer based on superconducting qubits, procured from IQM Machines and integrated with Keysight Technologies measurement solutions. Our objective is to evaluate device performance across key metrics (T1, T2, fidelity, ...) but also showcasing the performances of simple applications of quantum computers.

Platform: **sinq20**

Calibration-id: *fdb93a3978fe6356741e31b98c93c68837767080*

Date: 2025-09-26 14:56:23

Platform: **sinq20**

Calibration-id: *32fa7be02d2d6d5812d7cb47f8c293561b74c0b5*

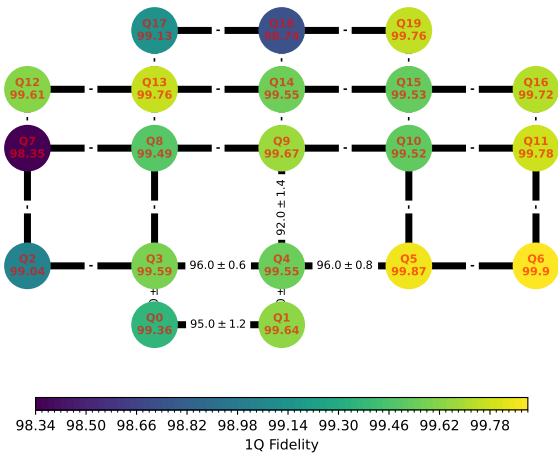
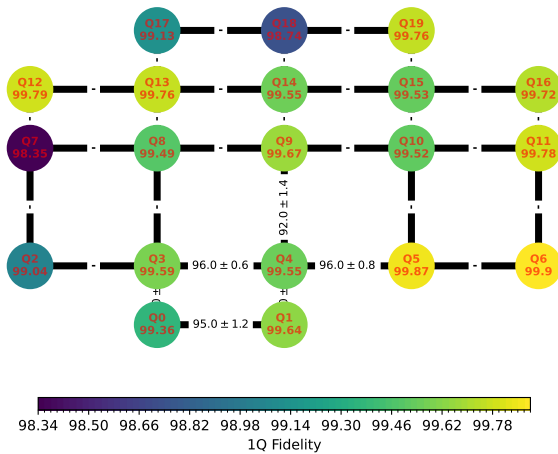
Date: 2025-09-19 11:42:06

## 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		

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## 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	3.182			

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## 5. Benchmark Results

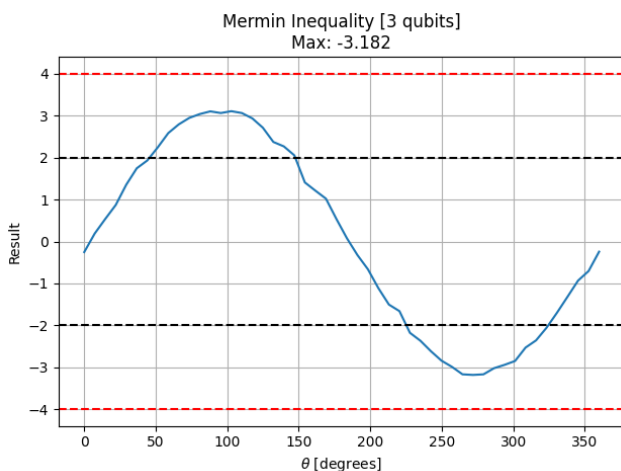
Qubit n	Fidelity	Error Bars
0	0.994	$\pm 0.000465$
1	0.996	$\pm 0.000249$
2	0.99	$\pm 0.00117$
3	0.996	$\pm 0.000322$
4	0.995	$\pm 0.000816$
5	0.999	$\pm 0.000534$
6	0.999	$\pm 0.000308$
7	0.983	$\pm 0.00219$
8	0.995	$\pm 0.000549$
9	0.997	$\pm 0.000698$
10	0.995	$\pm 0.000441$
11	0.998	$\pm 0.000246$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

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10	0.995	$\pm 0.000441$
11	0.998	$\pm 0.000483$
12	0.996	$\pm 0.000371$
13	0.998	$\pm 0.000344$
14	0.996	$\pm 0.000846$
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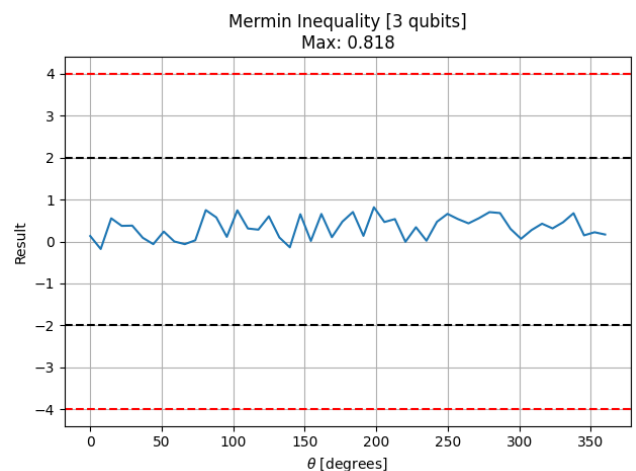
## 6. 5 Qubit Mermin

Mermin's algorithm for 3 qubits.

- **Runtime:** 0.83776 seconds.
- **Qubits used:** [[13, 17, 18]]



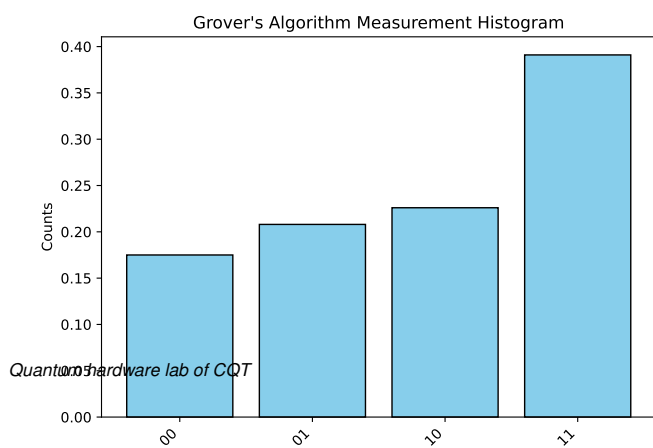
- **Runtime:** 10.13292 seconds.
- **Qubits used:** — No qubits\_used provided. —



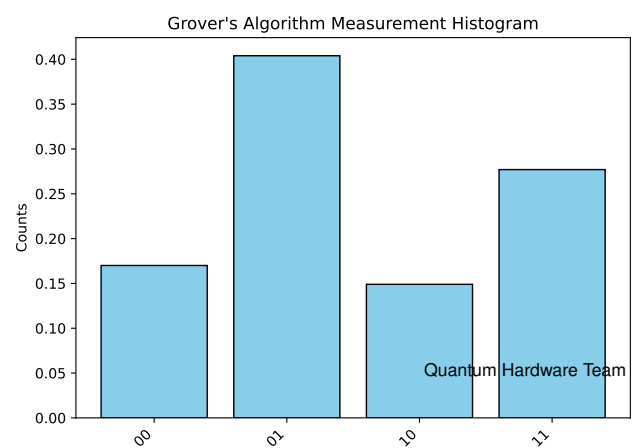
## 7. Grover - 2 qubits

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:** 14.16246 seconds.
- **Qubits used:** [[13, 14]]



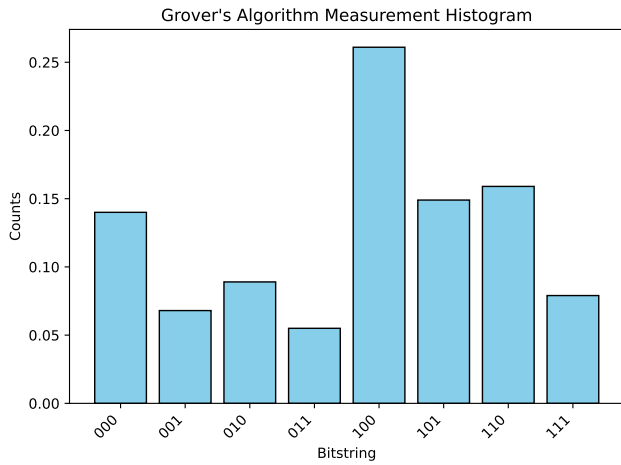
- **Runtime:** 8.94676 seconds.
- **Qubits used:** — No qubits\_used provided. —



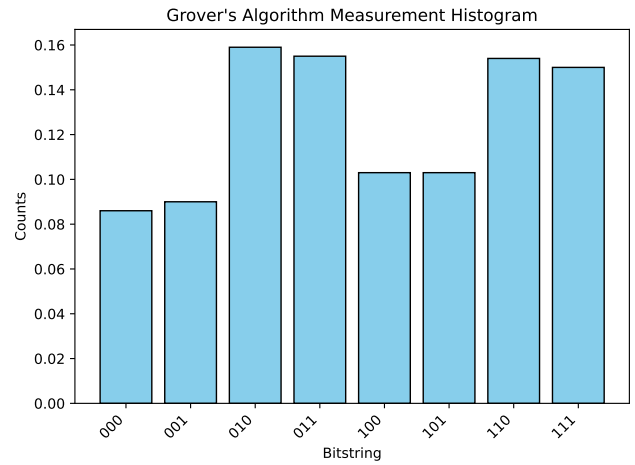
## 8. Grover - 3 qubits

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:** 17.65365 seconds.
- **Qubits used:** [[17, 13, 18, 14]]



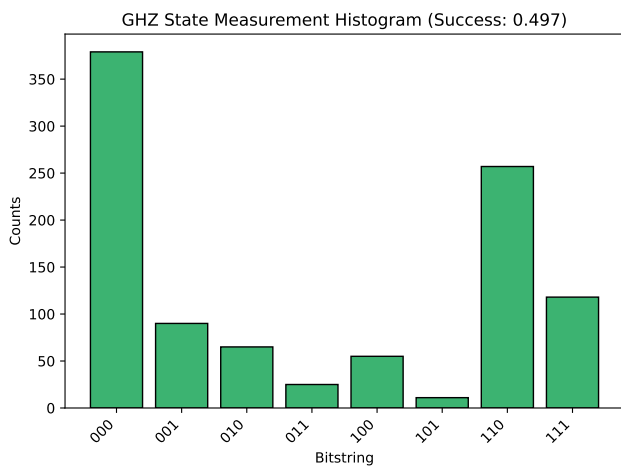
- **Runtime:** 17.52389 seconds.
- **Qubits used:** — No qubits\_used provided. —



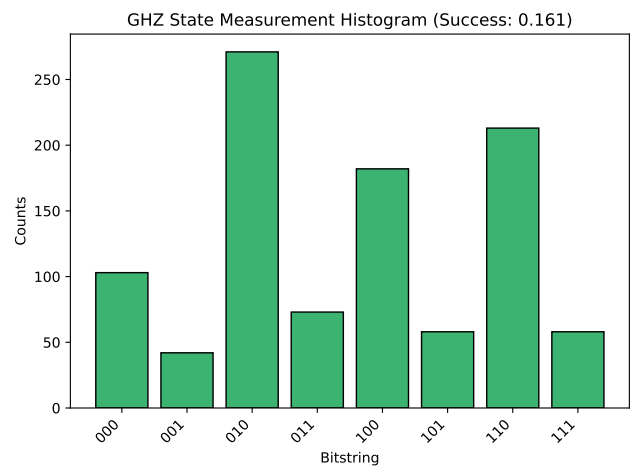
## 9. GHZ state preparation

GHZ circuit with 3 qubits executed on sinq20 backend with 1000 shots. We measure the success rate of obtaining the GHZ state (all 0s or all 1s).

- **Runtime:** 11.21520 seconds.
- **Qubits used:** [0, 1, 2]



- **Runtime:** 7.23527 seconds.
- **Qubits used:** — No qubits\_used provided. —

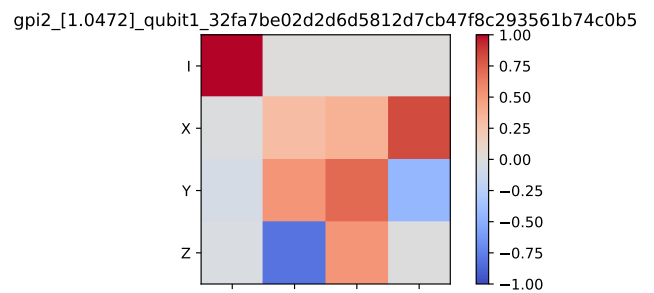
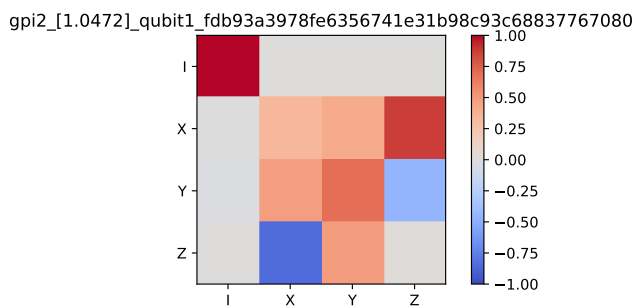
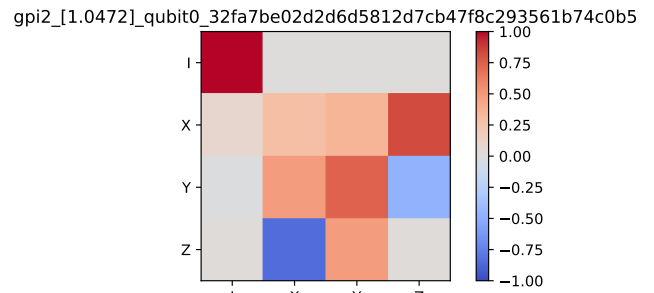
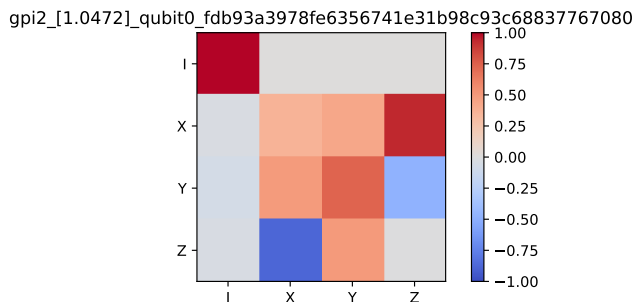
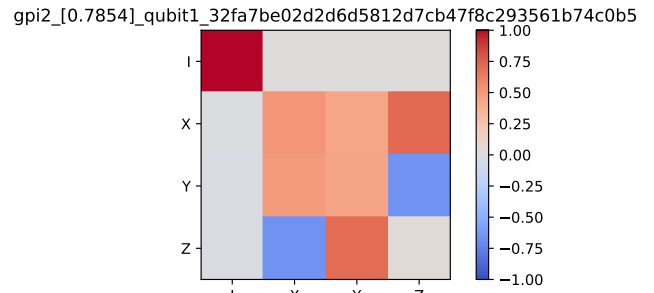
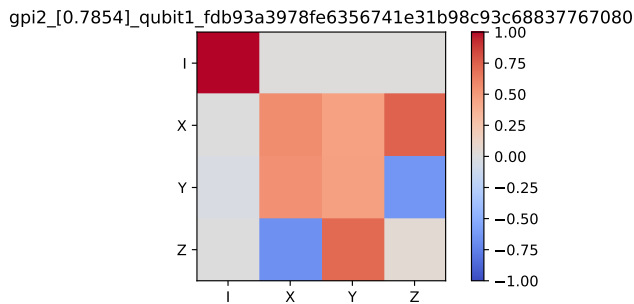
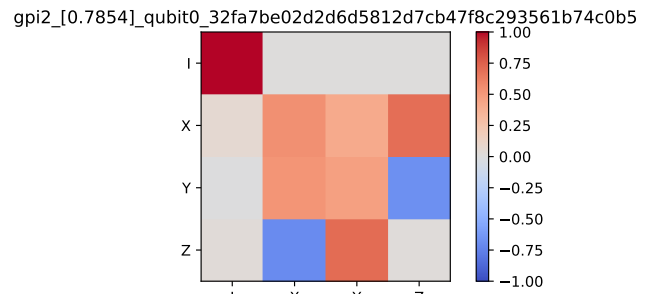
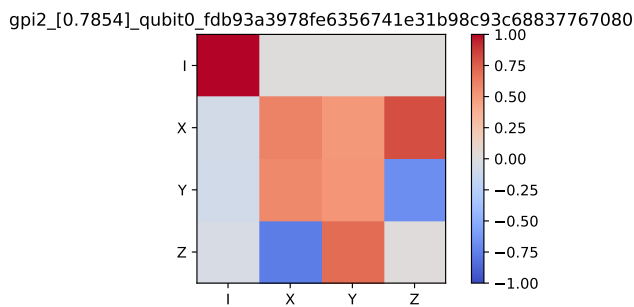
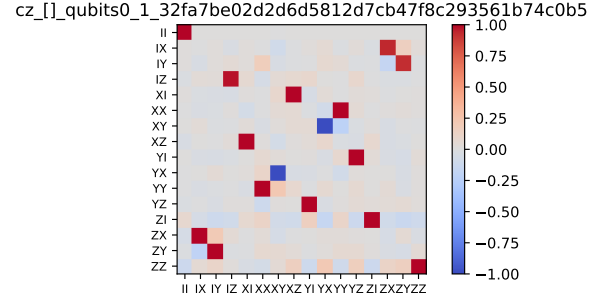
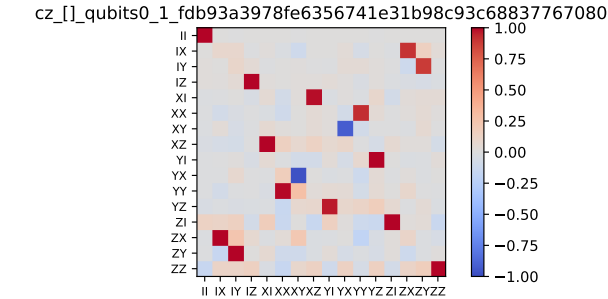


## 10. Process Tomography state preparation

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:**

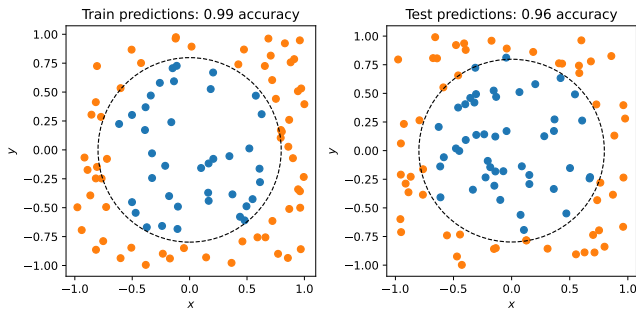
- **Runtime:** — No runtime provided. —
- **Qubits used:**



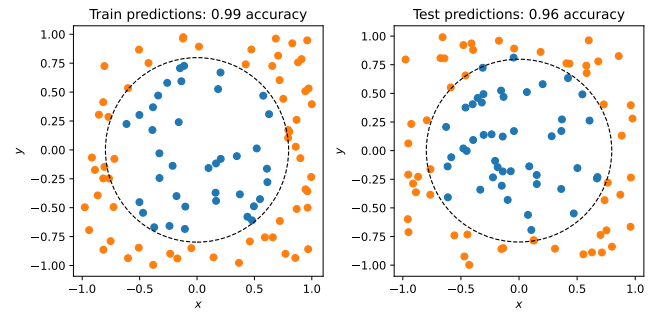
## 11. Reuploading Classifier

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

- **Runtime:** 158.69748 seconds.
- **Qubits used:**



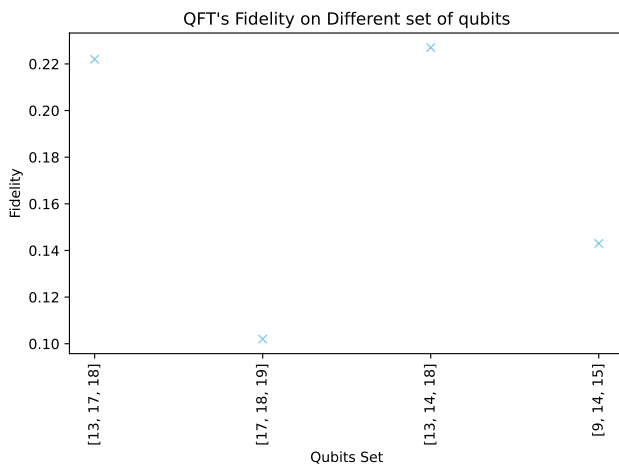
- **Runtime:** None
- **Qubits used:**



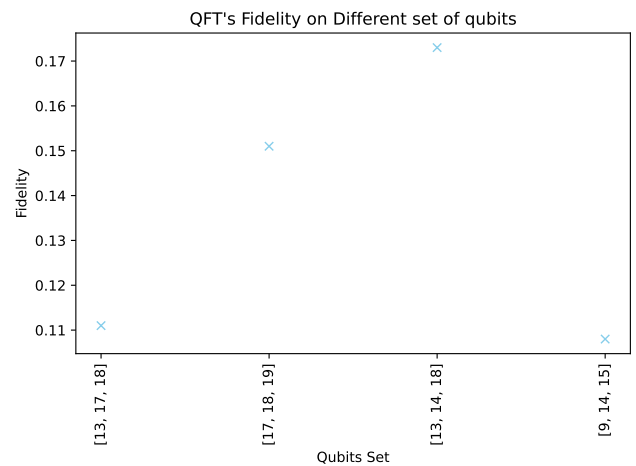
## 12. QFT Plots

Implementation of the Quantum Fourier Transform on different subsets of three qubits  $[[13, 17, 18], [17, 18, 19], [13, 14, 18], [9, 14, 15]]$ . The number of gates is 12, the depth of the circuit is 7

- **Runtime:** 13.19245 seconds.
- **Qubits used:**  $[[13, 17, 18], [17, 18, 19], [13, 14, 18], [9, 14, 15]]$



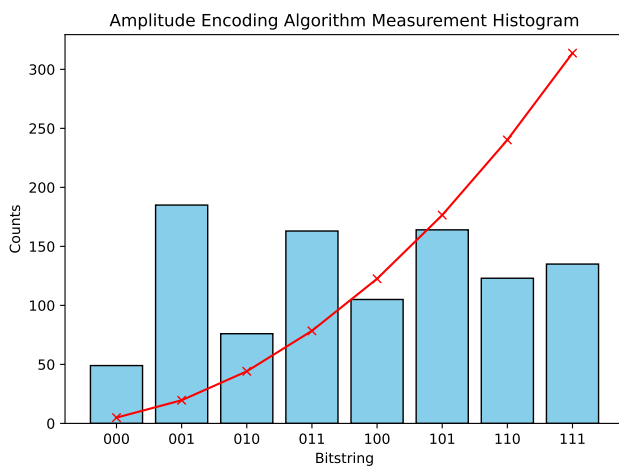
- **Runtime:** 7.5941018289886415
- **Qubits used:** — No qubits\_used provided. —



## 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 11.754ms

- **Runtime:** 11.75428 seconds.
- **Qubits used:**  $[0, 1, 4]$



- **Runtime:** 7.99663 seconds.
- **Qubits used:** — No qubits\_used provided. —

