Performance Survey of Current Gate-Model Quantum Processors
現在のゲート型量子プロセッサの性能調査

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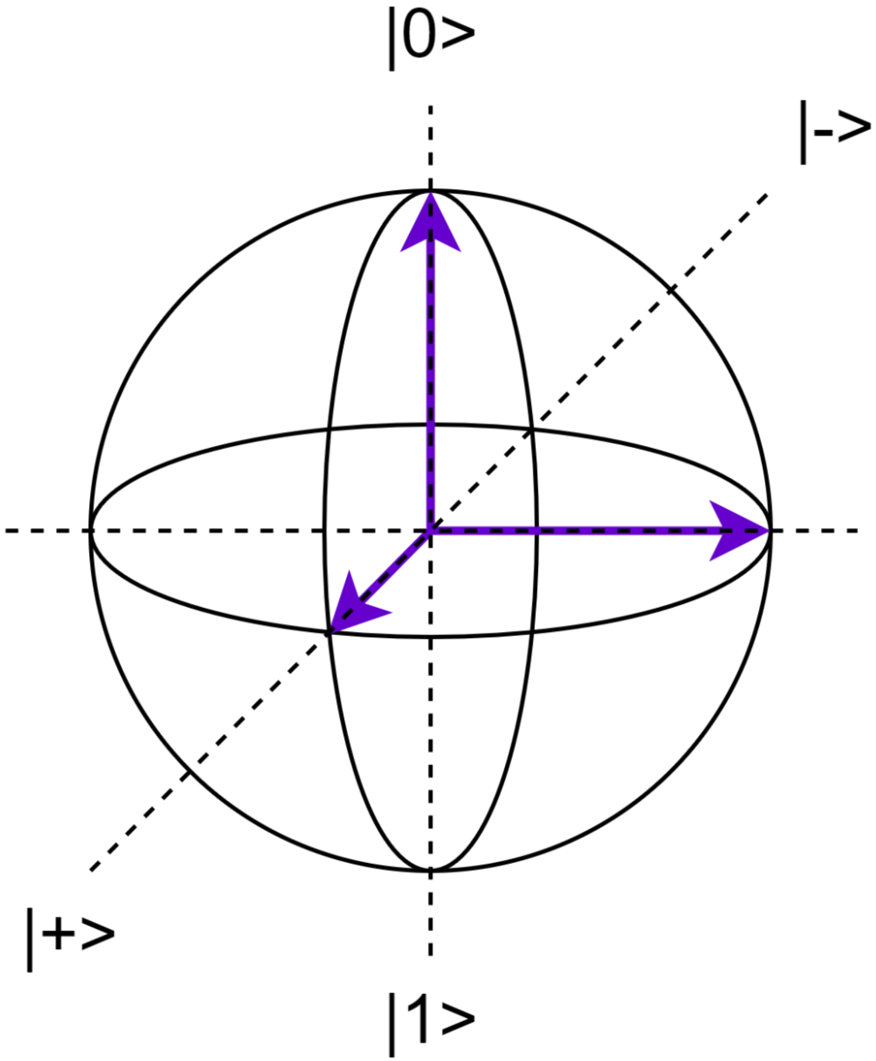
Takeaways

- The concept of gate-model quantum computing is becoming a reality.
  - Simple quantum algorithms can achieve reasonably high fidelity.
- Noise is still the most difficult challenge for current gate-model quantum processors.
  - Noise will accumulate in deep quantum circuits.
  - Complex quantum gates (CNOT, measure) are easily affected by external noise.
- Software and hardware improvements are required for future practical applications
  - Quantum Error Correction (QEC).
  - New hardware implementation technologies.

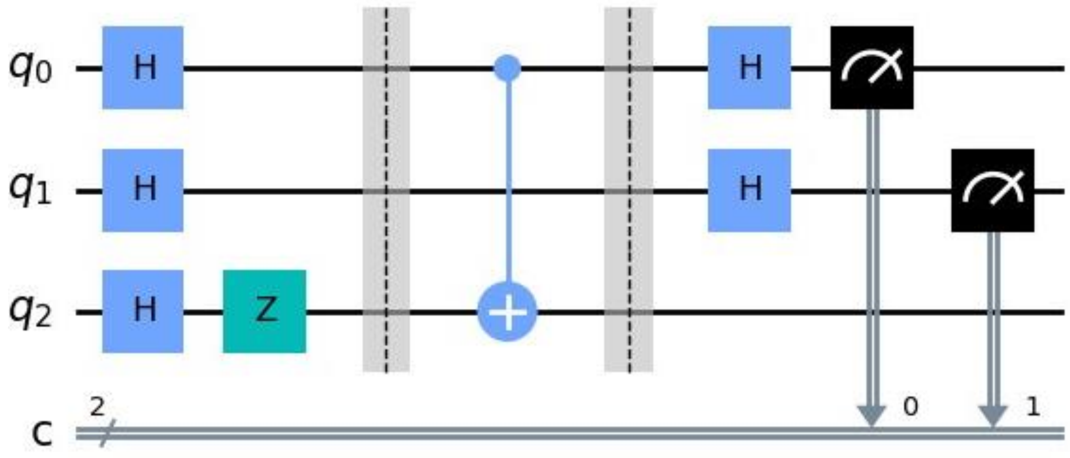
Why?

- A quantum processor can provide exponential speedup for traditionally hard algorithms. E.g., Prime Factorization. (Quantum Advantage)
- We see quantum processor as an augmentation to classical computers.
- Thus, we want to investigate and study the current status of Quantum Computing, especially the performance of the popular gate-model quantum processors.

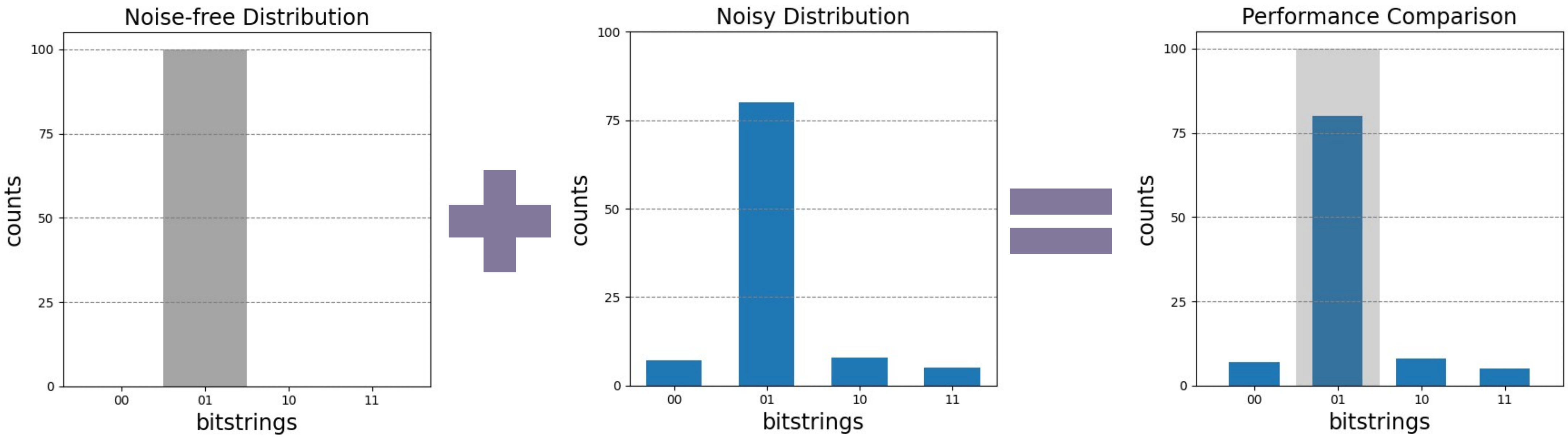


How?

- We took ~25 practical quantum circuits form the open source `QASMBench` Benchmark Suite.
- We surveyed 9 publicly available gate-model quantum processors on the amazon AWS and the IBM Q cloud platform.



How?

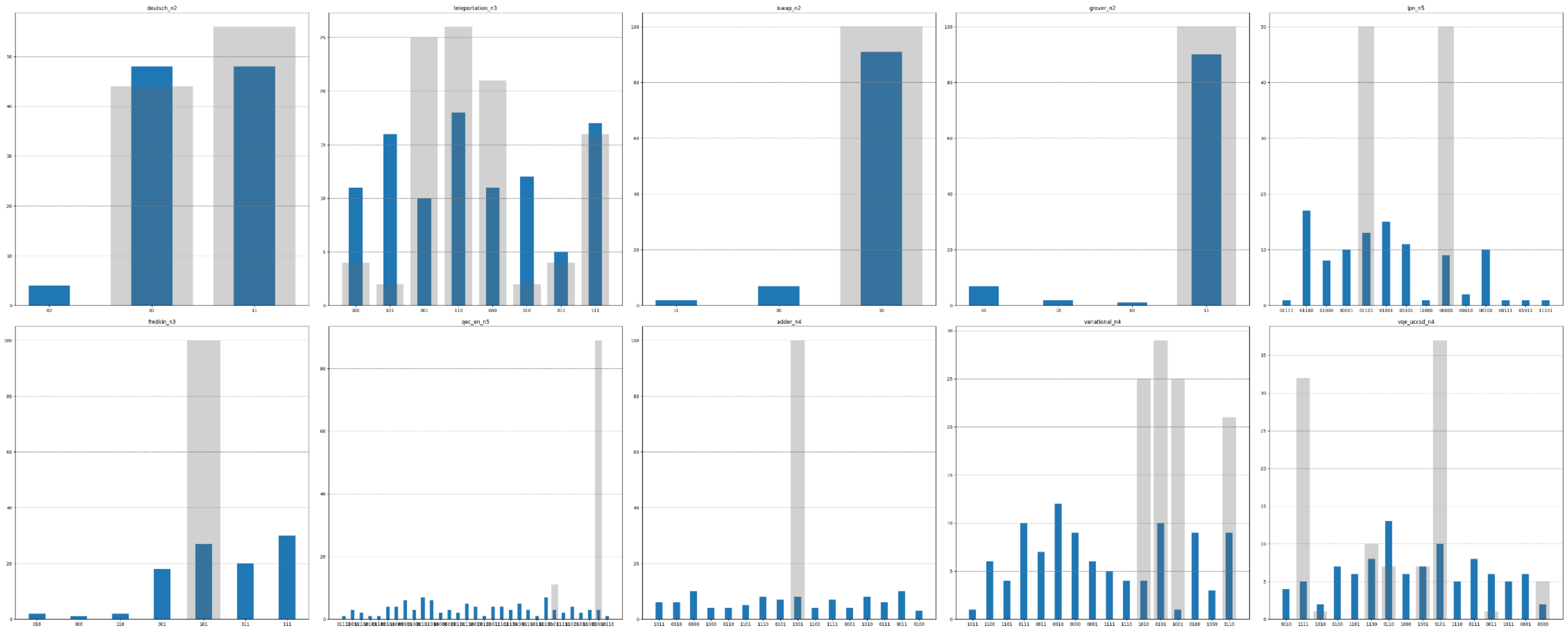


- We compare the noise-free simulation against the noisy output from real processors.

Result

- ibm_nairobi by IBM, 7 qubit (superconducting)

1. Deutsch algorithm, 2. Quantum teleportation, 3. entangling swapping gate, 4. Grover's algorithm, 5. Learning parity with noise.



1. Controlled-swap gate, 2. Quantum repetition code encoder, 3. Quantum ripple-carry adder, 4. Variational ansatz with a linear-swap network, 5. Variational quantum eigensolver with UCCSD.

Result

- Full result on GitHub.

https://github.com/yikaimao/FS_survey

References

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ありがとうございます。