



QuEST and the importance of the interconnect in large scale quantum circuit simulations

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Representing a quantum computer classically

Qubits are in a superposition of $|0\rangle$ and $|1\rangle$ states, with a complex probability amplitude associated with each state

↑ ↓
 $|0\rangle$ $|1\rangle$

2 qubit State = $c^1|00\rangle +$
 $c^2|01\rangle +$
 $c^3|10\rangle +$
 $c^4|11\rangle$

Sum over all
probabilities:

$$\sum_{n=1}^N |c^n|^2 = 1$$

Memory requirements are huge

- $2^{(\text{number of qubits})}$ complex double precision floating point values

For a 44 qubit system
= $2^{44} \times 2 \times 8$ bytes
= 256TB

For a 45 qubit system
= $2^{45} \times 2 \times 8$ bytes
= 512TB

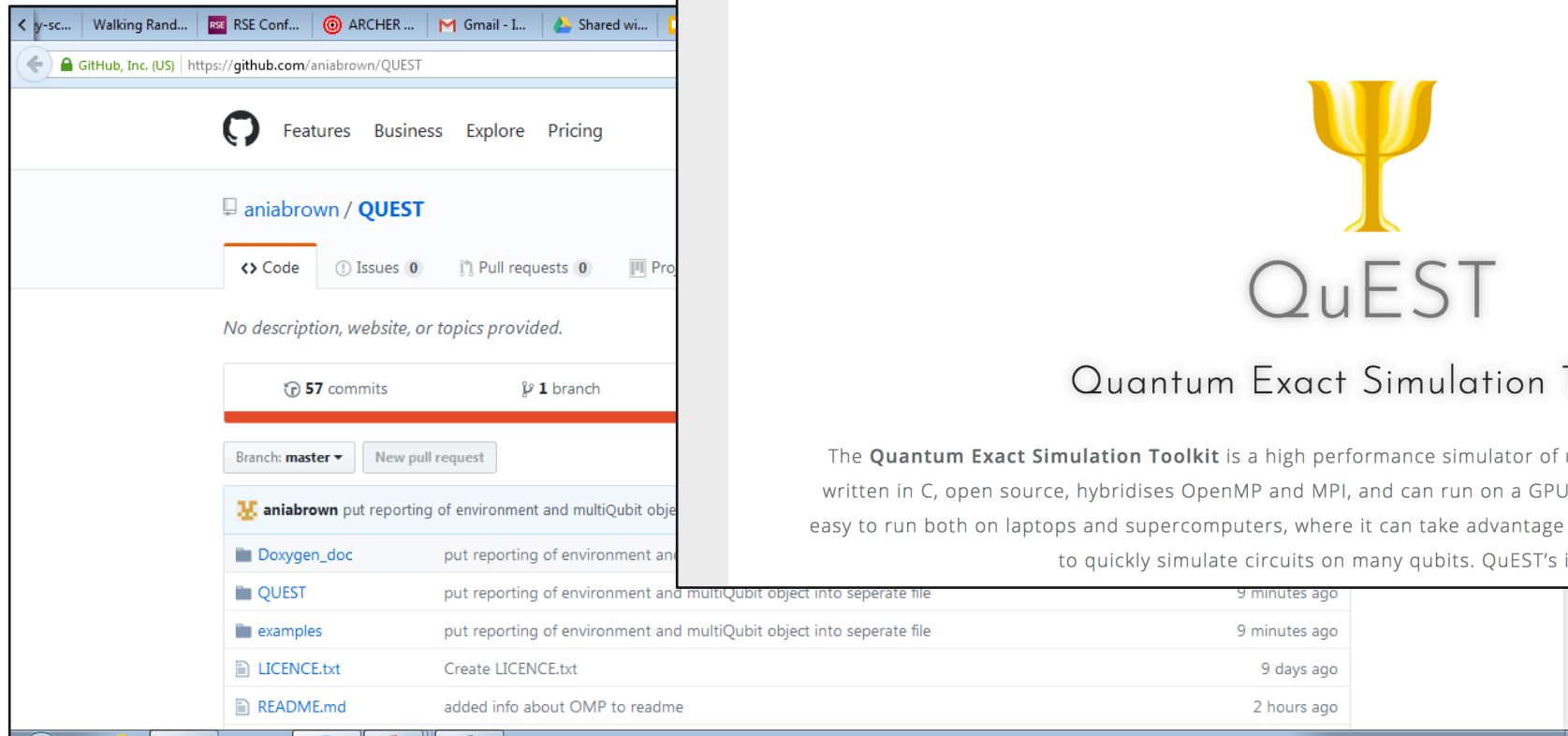
- Initial solution: Single node with 6TB of memory

Our users



<https://qtechtheory.org/>

QuEST for MPI, OMP, GPU



The screenshot shows the GitHub repository page for 'aniabrown / QuEST'. The repository has 57 commits and 1 branch. The commit history is as follows:

Commit	Message	Time
aniabrown	put reporting of environment and multiQubit object into separate file	9 minutes ago
Doxygen_doc	put reporting of environment and multiQubit object into separate file	9 minutes ago
examples	put reporting of environment and multiQubit object into separate file	9 minutes ago
LICENCE.txt	Create LICENCE.txt	9 days ago
README.md	added info about OMP to readme	2 hours ago



The website homepage features a navigation bar with links for Home, About, Documentation, Download, and Team. The main content area displays the QuEST logo (a golden chalice) and the text 'QuEST Quantum Exact Simulation Toolkit'. Below this, a paragraph describes the toolkit as a high-performance simulator of universal quantum circuits, written in C, open source, and hybridizing OpenMP and MPI. It notes that QuEST can run on a GPU and is easy to run on both laptops and supercomputers, leveraging multicore and networked machines for quick simulation of many qubits. The interface is partially visible at the bottom of the text.

<https://quest.qtechtheory.org/>

MPI communication pattern for an 8 compute node system

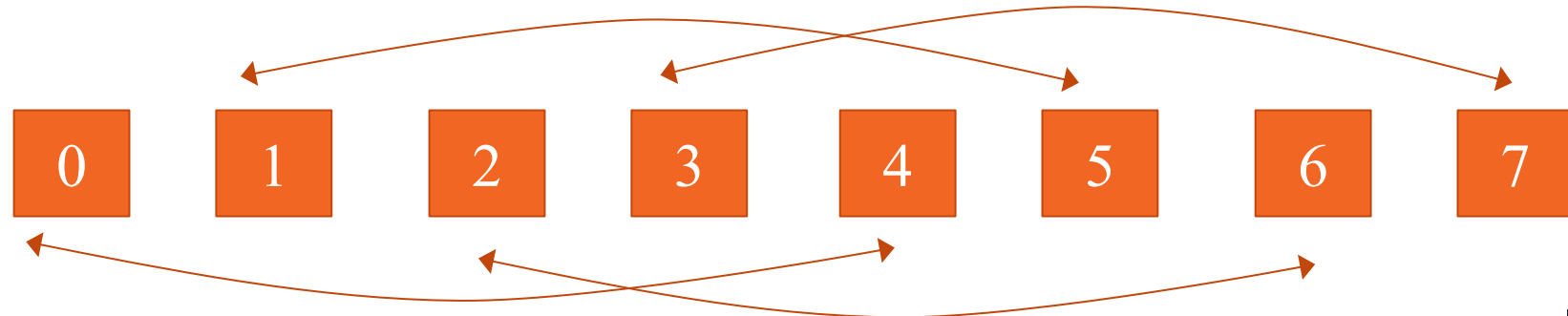
Rotate qubit n-2



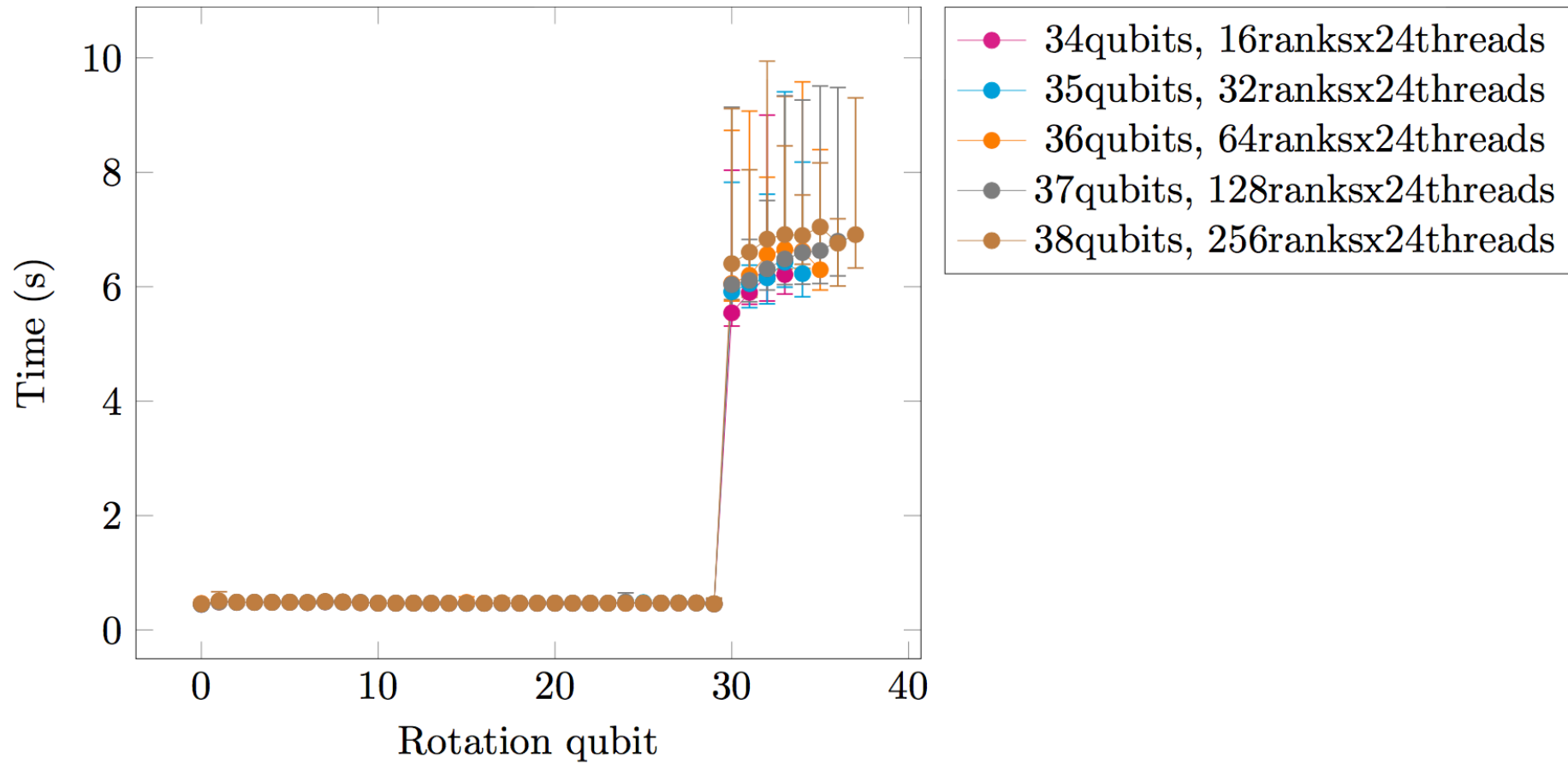
Rotate qubit n-1



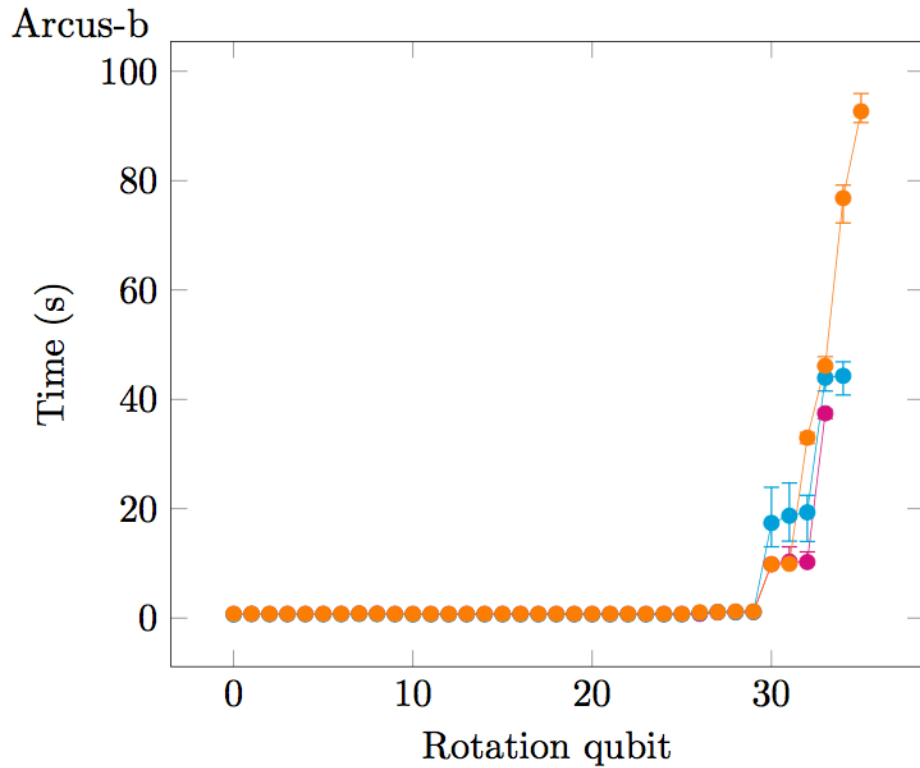
Rotate qubit n



Archer weak scaling



Infiniband weak scaling



CX2

