InferQ Abstract

Aadi Patwardhan [1], Rihan Hai [2]

[1] Delft University of Technology, Netherlands
A.Patwardhan@student.tudelft.nl
[2] Delft University of Technology, Netherlands
R.Hai@tudelft.nl

Recent work suggests that relational database management systems (RDBMSs) can execute quantum circuit simulation by compiling the simulation into SQL workloads (primarily join-and-aggregate tensor contractions). While early results are promising, they largely focus on a narrow set of highly structured circuits and offer limited support for systematic database research, such as query optimization, physical design, and engine-level evaluation across a broad range of circuits. We present InferQ, a database-oriented benchmark for quantum circuit simulation. InferQ generates *general, compositional* circuits by assembling subcircuits from a set of circuit templates, emits each simulation task as an RDBMS-ready SQL workload, and extracts circuit and query features (static, graph, SQL, and dynamic) for workload characterization. InferQ also releases a large dataset of 202,975 circuits online, with a web-based viewer to support searching, filtering, and downloading circuits and feature records. In experiments across RDBMS engines (PostgreSQL, SQLite, DuckDB, and Umbra) and the widely used Qiskit Aer simulator, we find that RDBMSs achieve better peak memory usage than Qiskit Aer on more than 50% of the circuits generated by InferQ. Moreover, using InferQ features, lightweight machine learning models (linear and tree-based models) can accurately predict when SQL execution is preferable (with accuracy up to 95.6% for runtime and 97.4% for memory), enabling data-centric simulator selection and opening the door to principled optimization of SQL-based quantum circuit simulation. [1]

References

[1] Andrei Ilinescu, Aadi Patwardhan, and Rihan Hai. InferQ: A database-oriented benchmark for quantum circuits simulation. arXiv preprint arXiv:2607.29134, 2026. Accepted at ACM SIGMOD 2027.