GPU-accelerated quantum circuit

Sulaiman Mohammad*[1]

[1]Mésocentre CALMIP UAR 3667 – COMUE de Toulouse – France

Résumé

Using IBM's open-source framework Qiskit, we implement and simulate Grover's algorithm to
investigate the performance of quantum algorithm simulation on the Turpan machine, an ARM-
based high-performance computing platform equipped with NVIDIA A100 GPUs and part of the
Mesonet infrastructure.
We used an Quantum implementation of Grover's algorithm targets general optimization under
constraints in the case where K available airplans should be scheduled on different routes and
timeslot with repsect to all constrains. The method of implemenation Grover is derived from graph
coloring method with enhanced circuit.
To perform the simulations efficiently, we leverage Qiskit Aer, a high-performance simulator within
the Qiskit ecosystem that supports GPU acceleration. In the correponding quantum circuit, qubits
encodes the scheduling constraints and objectives.
We will present the results obtained with 25 qubits as a start, on both CPU and GPU backends,
comparing execution time and scalability and also the numerical fidelity of the results. Additional
performance analyses are carried out using NVIDIA's cuQuantum library, which provides GPU-
accelerated primitives specifically optimized for quantum simulations.
In this work we will try to demonstrate the potential of GPU-accelerated simulation on ARM
architectures for practical quantum computing experiments and highlights the advantages of
heterogeneous platforms like Turpan in enabling large-scale quantum algorithm.

*Intervenant