

Tensor network methods for quantum error correction (graduate students)

Record number : OPR-1045

Overview

RESEARCH DIRECTION

Stefanos Kourtis, Professeur - Department of Physics

INFORMATION

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ADMINISTRATIVE UNIT(S)

Institut quantique

LEVEL(S)

3e cycle

LOCATION(S)

Département de physique et Institut quantique

Project Description

Context

Quantum computation promises advances in computing in the long run for diverse applications with significant economic and societal footprint. To unlock the full potential of quantum computation, it is necessary to counteract the inherent tendency of quantum systems to decohere and the unavoidably faulty nature of computing components through quantum error correction.

This research project aims to implement and deploy real-world quantum error correction protocols through a partnership between the research group of Prof. Stefanos Kourtis and NVIDIA, the world leader in GPU computing.

Project

The research goals of this project are to

- a) formulate a principled algorithmic approach for the discovery of hardware-specific quantum error-correcting codes capable of supporting fault-tolerant applications, and
- b) develop the algorithmic blocks necessary for high-throughput code evaluation and real-time decoding with state-of-the-art tensor network techniques.

By achieving these goals, it is expected that the team will enable demonstrations of real-time decoding on state-of-the-art GPU hardware. Partner

NVIDIA is a world-leading manufacturer of cutting-edge GPU computing equipment. Research is to be performed in close collaboration with NVIDIA Quantum, the R&D division of NVIDIA that develops high-performance numerical libraries for the simulation of quantum systems and processes on GPUs, including CUDA Quantum and cuQuantum, as well as specialized hardware, such as the NVIDIA Grace Hopper Superchip.

Team & environment

The selected students and postdoctoral researcher will be joining a dynamic team of 15 students, postdocs, and researchers, led by Prof. Stefanos Kourtis. The team's research activities enjoy generous financial support from a Research Chair in Quantum Computing awarded by the Ministère de l'Économie, de l'Innovation et de l'Énergie du Québec and funding agencies (NSERC, Mitacs).

Our research team is embedded in the Faculty of Science at Université de Sherbrooke, a vibrant and diverse body of students, educators, and scientists. We are part of the dynamic research environment of the Institut quantique, a research institute comprised of more than 30 research groups from the Faculty of Science, the Faculty of Engineering, the Faculty of Humanities and the School of Management, 25 technical and professional staff members, and over 200 students and postdocs.

Two graduate student roles are open. Graduate students will be enrolled in the PhD program in physics or computer science. The roles will be remunerated competitively.

The positions are based at the Université de Sherbrooke campus, with flexibility for remote work.

Candidates who identify as women, members of gender, sexual, visible or ethnic minorities, Indigenous people, and people with disabilities are encouraged to apply. Accommodations for maternity / paternity are available. A mentoring and professional development plan will be established for all team members.

Postdoctoral researcher

Main tasks:

Graduate student – tensor network decoding

Main tasks:

- Perform research on high-performance tensor network algorithms for decoding
- Develop GPU-ready code for high-throughput code characterization and real-time applications
- Collaborate with NVIDIA Quantum team on library features

Qualifications:

- MSc in physics, computer science, or mathematics, preferably on quantum information
- Familiarity with quantum error correction
- Demonstrated capabilities in coding (Python and / or C preferred; experience with GPUs a bonus)
- Desire to support a dynamic and diverse research team
- Exceptional BSc students will also be considered for an accelerated MSc-to-PhD passage

Graduate student – code discovery

Main tasks:

- Perform research on statistical mechanics of error correcting code families
- Develop efficient algorithmic strategies for stabilizer code discovery
- Evaluate quantum error correcting code performance

Qualifications:

- MSc in physics; preferably on statistical mechanics of disordered systems
- Familiarity with (quantum) error correction
- Demonstrated capabilities in coding (Python and / or C preferred; experience with GPUs a bonus)
- Desire to support a dynamic and diverse research team
- Exceptional BSc students will also be considered for an accelerated MSc-to-PhD passage.

Application

Interested applicants should provide the following:

- Letter of motivation; where possible, provide concrete examples of qualifications and strong suits
- CV including (i) publication list and (ii) names and contact information of 2 references; where possible, provide concrete examples of qualifications and strong suits
- Sample of independently authored research manuscript or code repository
- For BSc or MSc students: transcripts of most recent degree

Application material should be sent to quantum.ai@usherbrooke.ca

Discipline(s) by

Partner(s)

NVIDIA

sector

Sciences naturelles et génie

Informatique, Physique

The last update was on 6 May 2024. The University reserves the right to modify its projects without notice.