Master thesis Project

# Tensor networks and quantum physics with Rust

The product of a sequence of matrices can be represented as a linear chain, for example A × B × C. This concept can be generalized by replacing matrices, which are 2-dimensional tables of numbers, with "tensors", tables of numbers of arbitrary dimension. A product of tensors is no longer necessarily linear in shape. Instead, it may be represented as a graph where the vertices correspond to tensors, and the edges correspond to tensor multiplications (or contractions).

This simple formalism finds fruitful applications in quantum physics, in machine learning, and in numerical analysis in general. Notably, tensor networks provide compact representations for many-body wave functions that would be much too large (in fact exponentially so) to be stored directly. Intuitively, they prioritize the tiny but important regions of Hilbert space that correspond to states with local entanglement over the vastly larger rest.

In this project we set out to improve the state of the art in the diagonalization of tensor networks. The work combines theoretical quantum physics with a good dose of numerical programming involving the Rust programming language. Rust is a modern replacement of C/C++. Its unique properties allow to express high-performance parallel computations such that already the compiler can detect many problems. With other languages, similar problems can remain undetected and manifest themselves only later as difficult to find bugs.

This internship will take place in the theory group of Pheliqs at CEA Grenoble. A specialty of our group is the creation of open-source research software. See for example https://kwant-project.org/.

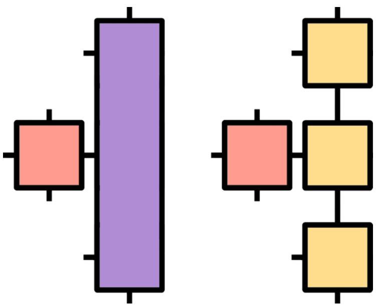

Image source: Wikipedia article "Tensor network"

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To apply for this position, send your application (including CV) by e-mail to: christoph.groth@cea.fr

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