Efficient Quantum Encodings for Combinatorial Optimization

Multiple research internships of duration: 5-6 months.

Starting date (flexible) : No later than April 2023, but better if before

Location : ENSTA Paris, Institut Polytechnique de Paris, Palaiseau, France

Questions : Andrea Simonetto, andrea.simonetto@ensta-paris.fr

Theme :

With the steady advances in quantum technology to develop reliable quantum computers and software interfaces, quantum computing is well on track to disrupt traditional workflows in solving hard problems. A natural question is then whether quantum-based approaches can help the resolution of combinatorial optimization problems, which are both widespread in industrial applications --among which energy management-- and very hard to solve classically.

As a result, quantum optimization algorithms have been intensively studied during the last few years, and some theoretical advantages have been shown on very small size problems. Addressing the scaling of these algorithms is the next crucial challenge on the road to quantum advantage, which we set forth to tackle in this project. In particular, we will use and extend recently proposed logarithmic embeddings, to design new and more efficient encodings for large combinatorial problems into quantum circuits. This could open the way for the use of quantum computing for hard industrial problems, at scale.

Sample references : arXiv:2111.09732; arXiv:2110.10788

Required skills: Enjoy learning new things, Good command of (modern) algebra, Being able to understand the general ideas of the sample references above, Some experience in either combinatorial optimization or quantum computing is an asset. Python is a plus.

Detailed Description: We will start from one of the references above and extend the validity of the algorithms to other graph-based combinatorial optimization problems.

Apply : please contact A. Simonetto for details