M2 Research Internship

Optimization for AI/ML

Location: Samovar, Télécom SudParis, Institut Polytechnique de Paris, Palaiseau, France
Duration: 5/6 months (in the period April/September 2023)

Topic

The broad scope of the internship is the development of novel methods to solve optimization problems related to machine learning and neural networks. The purpose is namely to investigate approaches relying on linear and nonlinear mixed-integer programming formulations.
To deal with the targeted problems, current formulations in the literature often fail to solve (exactly) large instances. The difficulty inherent to these formulations is namely related to two factors: the presence of discrete variables and nonlinear constraints that must be satisfied.
The research direction to be investigated during this internship consists in developing alternative formulations stemming from convexifications of mixed integer sets to derive convex relaxations (LP, SDP or SOCP, namely) that can be solved efficiently and provide interesting bounds on the optimal objective value. Such relaxations can then be embedded in a branch-and-bound framework to solve the original problem exactly.

Expected work

- Literature review on methods and mathematical programming formulations for optimization problems arising in AI/ML which involve continuous and discrete variables.
- Design and investigate new alternative formulations (convex relaxations namely).
- Implement and compare the proposed models with current state of the art approaches on benchmarks from the literature.

Required skills

In addition to being highly motivated, the successful candidate will have

- an excellent level in operations research/mathematical programming/combinatorial optimization,
- excellent programming skills (in C++ and/or Python),
- good knowledge of MIP solvers (Cplex and/or Gurobi),
- good communication skills (in English and/or French).

How to apply

Applications should be sent to José Neto (Jose.Neto@telecom-sudparis.eu) **before January 2, 2023** and include a cover letter, a CV, and transcripts of records. Successful applicants will be contacted within a few weeks.