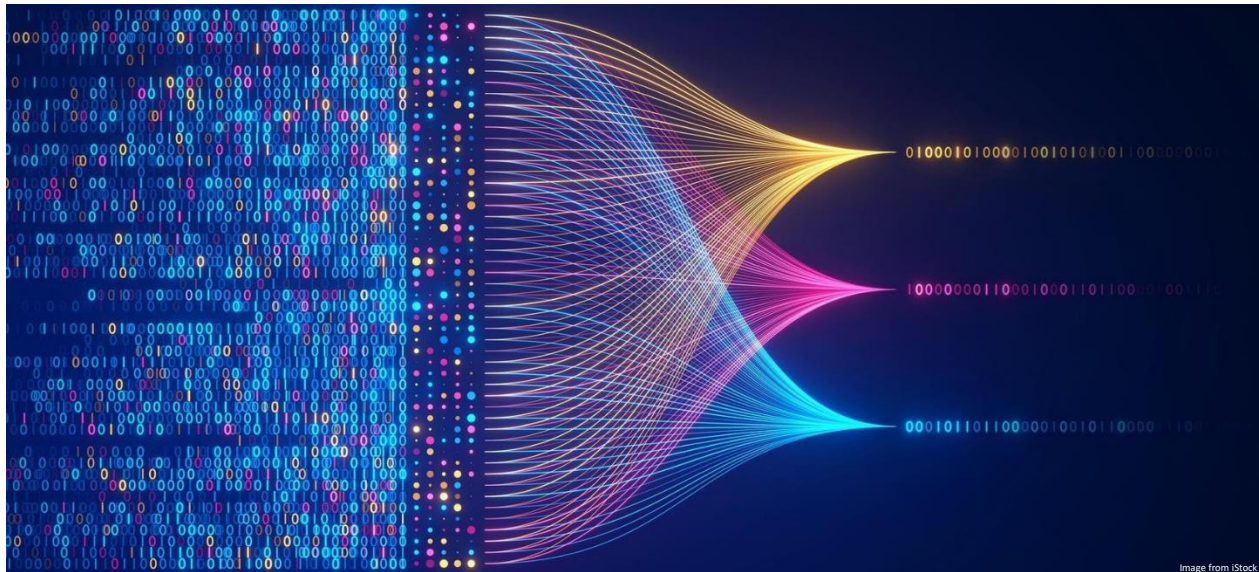


# INTERNSHIP OFFER – ÉCOLE POLYTECHNIQUE

## Mathematical Optimization for Interpretable Machine Learning



### Project

Extracting knowledge from data is a crucial task in Statistics and Machine Learning. Mathematical Optimization plays an important role in building such models, see, e.g., Gambella et al. 2021 for a survey.

With the widespread use of Machine Learning applications, in relevant fields such as Criminal Justice, Health Care and Risk Management, interpretability has become essential for trust on them (Rudin et al. 2022). This is supported by the so-called right-to-explanation in algorithmic decision-making, imposed by the European Union since 2018 [Goodman and Flaxman, 2017], that encourages to design models that are understandable and enable explanation to the users. Mathematical Optimization has been shown to be a flexible enough tool for dealing with this necessity and creating Interpretable Machine Learning models. Some examples include the construction of decision trees (Carrizosa et al. 2021), rule sets (Lawless et al. 2023) and scoring systems (Ustun and Rudin 2019), among others.

### Missions of the intern

The intern is expected to develop novel Mathematical Optimization formulations to build Interpretable Machine Learning models. Research topics might intersect Supervised Learning with Non-Linear Programming, Mixed-Integer Linear Programming and Multi-Objective Optimization. Large-scale global optimization problems are foreseen, for which sophisticated numerical optimization strategies are to be designed, such as heuristics or decomposition techniques.

## Profile required

This position is aimed at master/engineering students with a strong background and expertise in Operational Research (OR), as well as good coding skills. Experience with OR modeling tools and commercial solvers is an asset. A good level of English both written and oral is required. The candidate is expected to have organizational ease, high motivation and autonomy, and willingness to collaborate in the tasks designated by the researchers involved.

## Application portfolio

The application must contain:

- CV
- Courses taken and grades
- Courses being taken on this semester

## Practical information

Duration: 6-months

Starting date: from February (flexible)

Location: Optimix team at LIX – Laboratoire d’Informatique at École Polytechnique

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## References

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- Gambella, C., Ghaddar, B., and Naoum-Sawaya, J.* (2021) Optimization problems for machine learning: A survey. *European Journal of Operational Research*, 290(3):807-828.
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- Rudin, C., Chen, C., Chen, Z., Huang, H., Semenova, L., and Zhong, C.* (2022). Interpretable machine learning: Fundamental principles and 10 grand challenges. *Statistics Surveys*, 16:1 – 85.
- Lawless, C., Dash, S., Günlük, O., Wei, D.* (2023). Interpretable and Fair Boolean Rule Sets via Column Generation. *Journal of Machine Learning Research*, 24:1-50
- Ustun, B., Rudin, C.* (2019). Learning Optimized Risk Scores. *Journal of Machine Learning Research*, 20(150):1-75.