PhD Position : Machine Learning and Matheuristics algorithms for urban transportation

1 – Job description

We propose an exciting PhD topic at the crossroads of artificial intelligence and operations research. The objective is to mix machine learning and matheuristics algorithms for urban logistics problems and more specifically to build an open source decision support tool for the resolution of recurrent, dynamic and stochastic vehicle routing. The research directions are as follows : *(a) To identify, learn, and explain the characteristics of a class of VRP problems with pattern recognition approaches. (b) To propose a large scale hybrid solver based on an explainable AI (XAI) instead of black-box models (c) To provide the scientific and industrial community with the problems, instances and algorithms developed through a collaborative and open source platform.*

2 – Funding, Team supervision and PhD registration

The PhD project is funded by the AI@IMT program and the region Bretagne. The student will be localized at IMT Atlantique, Brest Campus, with a close collaboration with Université Bretagne Sud, Lorient, and IMT Nord Europe, Lille/Douai. Regular research visits will be planned during the three years. The student will be supervised by Pr. Romain Billot (co-director), IMT Atlantique, Pr. Marc Sevaux (co-director), UBS, and Dr. Flavien Lucas (co-supervisor), IMT Nord Europe. The PhD candidate will be registred at the doctoral school MathSTICC in Brest, in the computer science domain.

3 - Candidate profile

The ideal candidate should hold a master's degree in Computer Science, preferably with a focus on Artificial Intelligence and/or Operations Research. Experience or training in the following areas would be preferred: - Artificial intelligence, especially machine learning; - Optimization, especially vehicle routing problems. A high level of command in English is required. Knowledge of French would be an advantage. The candidate should have a strong interest in interdisciplinary research in the smart cities context.

4 - How to apply

If you are interested, please send your CV and a cover letter by email to romain.billot@imt-atlantique.fr, marc.sevaux@univ-ubs.fr, and flavien.lucas@imt-nord-europe.fr

5 – References

Bengio, Y., Lodi, A., & Prouvost, A. (2020). Machine learning for combinatorial optimization: a methodological tour d'horizon. European Journal of Operational Research.

Prouvost, A., Dumouchelle, J., Scavuzzo, L., Gasse, M., Chételat, D., & Lodi, A. (2020). Ecole: A Gym-like Library for Machine Learning in Combinatorial Optimization Solvers. arXiv preprint arXiv:2011.06069.

Lucas, F., Billot, R., & Sevaux, M. (2019). A comment on "What makes a VRP solution good? The generation of problem-specific knowledge for heuristics". Computers & Operations Research, 110, 130-134.

Lucas, F., Billot, R., Sevaux, M., & Sörensen, K. (2020). Reducing Space Search in Combinatorial Optimization Using Machine Learning Tools. In LION-2020 (pp. 143-150). Springer.

Hudson B., Li Q., Malencia M., & Prorok A. (2021). Graph Neural Network Guided Local Search for the Traveling Salesperson Problem. Preprint ArXiv 2110.05291.

Mazyavkina N., Sviridov S., Ivanov S., & Burnaev E. (2021) Reinforcement learning for combinatorial optimization: A survey, Computers & Operations Research, 134.

Li, J., Xin, L., Cao, Z., Lim, A., Song, W., & Zhang, J. (2021). Heterogeneous Attentions for Solving Pickup and Delivery Problem via Deep Reinforcement Learning. IEEE Transactions on Intelligent Transportation Systems.

Zhang, K., He, F., Zhang, Z., Lin, X., & Li, M. (2020). Multi-vehicle routing problems with soft time windows: A multi-agent reinforcement learning approach. Transportation Research Part C: Emerging Technologies, 121.