

# **Postdoctoral job offer: efficient & parallel graph algorithms for decision-focused learning in logistics**

## **Subject**

Decision-focused learning (DFL) [1] is an emerging field that bridges the gap between constrained optimization and machine learning. When solvers are used as layers inside a neural network, the decision pipeline can adapt to specific input data, thus scaling to larger and more intricate problems (e.g. with real-time or stochastic inputs). This new paradigm is relevant for numerous practical applications to transportation and logistics, as shown by previous research from our group [2], [3], [4].

Unfortunately, DFL remains computationally expensive. The main culprits are calls to third-party optimization libraries, running on CPUs in a way that is difficult to parallelize. We are thus looking for a postdoctoral researcher to design and implement GPU-friendly graph algorithms, which may be used to speed up data-driven decision pipelines. These algorithms must be tailored for modern parallel hardware [5], while taking advantage of batching and amortized preprocessing to handle many slight variants of the same underlying problem during training. Alongside methodological innovations, a major focus will be put on developing cross-platform open-source software, preferably (but not exclusively) in the Julia programming language [6], [7]. The end goal is to use the resulting algorithms and software on challenging tasks from the supply chain sector (vehicle routing, inventory management, network design).

Among the possible research directions, we can mention:

- Leveraging the GraphBLAS linear-algebraic framework [8].
- Precomputing graph transformations to reduce query costs [9].
- Leveraging sparse compiler frameworks [10].

## **Context**

The position is offered by École nationale des ponts et chaussées ([ENPC](#)), which is part of Institut Polytechnique de Paris ([IP Paris](#)). It is hosted by the transportation laboratory ([LVMT](#)), in close proximity with the applied mathematics laboratory ([CERMICS](#)).

Funding comes from the [ACME project](#) on multimodal collaborative eco-friendly logistics, supported by Agence Nationale de la Recherche as part of France 2030. The aim of ACME is to enable decarbonation of supply chain operations through mutualization and economies of scale. Thanks to this consortium, the postdoctoral researcher will have access to real data from our industrial partners, and might even foster change at the operational level.

## **Practical details**

- Supervisor: Dr. [Guillaume Dalle](#) (LVMT).
- Duration: 2 years.
- Starting date: spring or fall of 2026 (negotiable).
- Salary: around 2400€ per month before taxes.
- Location: LVMT, 6-8 Avenue Blaise Pascal, 77420 Champs-sur-Marne, France.

The position is fully funded, including salary, computer equipment and participation in conferences. Note that professional trips will need to abide by LVMT's [environmental charter](#), which discourages long-distance plane travel and encourages greener alternatives like trains.

Beyond the primary research directions mentioned above, it is understood that a postdoctoral researcher will get to spend part of their time finishing papers from their PhD, pursuing their own

research, and possibly looking for a permanent position. This journey towards research independence is not only normal but encouraged.

Involvement in student mentorship, teaching and grant applications is also possible and welcome, albeit not mandatory.

## How to apply

The prospective candidate must have obtained a PhD (or be nearing completion of a PhD) in either mathematics or computer science, with a specialization in at least one of the following subfields: machine learning, optimization, operations research, graph theory, numerical algorithms, high-performance computing.

Before applying, please spend some time reading related research, and feel free to reach out if you have any questions.

To apply, send an email to [guillaume.dalle@enpc.fr](mailto:guillaume.dalle@enpc.fr) with the following documents:

- Resume, including a list of publications.
- Cover letter (1 page max), specifying how you would fit into the project described above.
- Research statement (1 page max), describing topics you would like to research in the future if you could pick freely.
- Links to one or two articles or preprints you are proud of.
- Links to one or two open-source software projects you were involved in.
- Optional: reference letter, e.g. from your PhD advisor or a close collaborator.

The email subject must start with “[postdoc-graphs]”. Incomplete applications will not be considered.

## Bibliography

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- [2] G. Dalle, L. Baty, L. Bouvier, and A. Parmentier, “Learning with Combinatorial Optimization Layers: A Probabilistic Approach.” [Online]. Available: <http://arxiv.org/abs/2207.13513>
- [3] L. Baty, K. Jungel, P. S. Klein, A. Parmentier, and M. Schiffer, “Combinatorial Optimization-Enriched Machine Learning to Solve the Dynamic Vehicle Routing Problem with Time Windows,” *Transportation Science*, vol. 58, no. 4, pp. 708–725, July 2024, doi: [10.1287/trsc.2023.0107](https://doi.org/10.1287/trsc.2023.0107).
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- [5] W.-m. W. Hwu, D. B. Kirk, and I. E. Hajj, *Programming Massively Parallel Processors: A Hands-on Approach*. Morgan Kaufmann, 2022.
- [6] J. Bezanson, A. Edelman, S. Karpinski, and V. B. Shah, “Julia: A Fresh Approach to Numerical Computing,” *SIAM Review*, vol. 59, no. 1, pp. 65–98, Jan. 2017, doi: [10.1137/141000671](https://doi.org/10.1137/141000671).
- [7] T. Besard, C. Foket, and B. De Sutter, “Effective Extensible Programming: Unleashing Julia on GPUs,” *IEEE Transactions on Parallel and Distributed Systems*, vol. 30, no. 4, pp. 827–841, Apr. 2019, doi: [10.1109/TPDS.2018.2872064](https://doi.org/10.1109/TPDS.2018.2872064).
- [8] J. Kepner and J. Gilbert, *Graph Algorithms in the Language of Linear Algebra*. SIAM, 2011.

- [9] H. Bast *et al.*, “Route Planning in Transportation Networks,” *Algorithm Engineering: Selected Results and Surveys*. in Lecture Notes in Computer Science. Springer International Publishing, Cham, pp. 19–80, 2016. doi: [10.1007/978-3-319-49487-6\\_2](https://doi.org/10.1007/978-3-319-49487-6_2).
- [10] W. Ahrens, T. F. Collin, R. Patel, K. Deeds, C. Hong, and S. Amarasinghe, “Finch: Sparse and Structured Array Programming with Control Flow.” [Online]. Available: <http://arxiv.org/abs/2404.16730>