M2 Internship proposal: Online Problems with Stochastic Signals

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Context Online algorithms are notoriously pessimistic as they tend to optimize over pathological low-probability instances, to the detriment of their expected performance. A recent model has emerged to leverage the potential of AI predictions while providing theoretical guarantees despite the unknown quality of such predictions, which has been the focus of hundred of studies in the past years [6, 5]. This internship will explore a newer and related model where the algorithm does not have access to a prediction, but to a stochastic signal correlated with the future instance. For instance, this signal can inform that an intermediate step has been reached, and this intermediate step can be interpreted as a randomized completion percentage.

Objectives The stochastic signal model has already been studied in three separate problems: scheduling [3], secretary problem [4] and ski rental [2]. This internship will continue the exploration of this model power. A promising problem is the Online Bidding problem, which has already been studied under the prediction framework [1] and seems a good candidate to explore more general signal distributions. A first objective of the internship would then be to study this problem under uniform distribution signals, before tackling more complex distributions.

Environment The internship will be hosted in the DataMove team of the LIG computer science laboratory, in the IMAG building at Saint Martin d'Hères. The team is composed of researchers and research engineers working on thematics including scheduling, simulations, memory and I/O optimisation, high-performance computing, algorithms and frugality. It will also be part of the MIAI Frugal AI chair, part of which focuses on trustworthy and explainable solutions under uncertainty.

References

[1] Spyros Angelopoulos and Bertrand Simon. "Learning-augmented online bidding in stochastic settings". In: *Advances in Neural Information Processing Systems* 38 (2026), pp. 67649–67679.

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[3] Romain Cosson et al. "Online Scheduling with a Stochastic Signal". In: *arXiv preprint arXiv:2607.17784* (2026).

[4] Franziska Eberle and Alexander Lindermayr. "The Secretary Problem with a Stochastic Precursor". In: *arXiv preprint arXiv:2605.22653* (2026).

[5] Alexander Lindermayr et al. *ALPS – Algorithms with Predictions*. `https://algorithms-with-predictions.github.io/`. Community-driven resource for research on learning-augmented algorithms. Accessed: 2026-09. 2026.

[6] Thodoris Lykouris and Sergei Vassilvitskii. "Competitive Caching with Machine Learned Advice". In: *Proceedings of the 35th International Conference on Machine Learning (ICML)*. PMLR. 2018, pp. 3296–3305.