Antoine Lhomme

Laboratoire G-SCOP
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Education

Ph.D. Candidate **2023 - present**
Université Grenoble Alpes, Grenoble, France
Expected graduation: end of 2025
Computational search for theoretical bounds on semi-online algorithms performance
Advisors: Nadia Brauner, Nicolas Catusse
Government research grant

Master ORCO (Operational Research, Combinatoric and Optimization) **2022**
Université Grenoble Alpes, Grenoble, France
Master thesis: *Bounds on the performance of algorithms for the online bin stretching problem*, supervised by Nadia Brauner and Nicolas Catusse

Engineering school of ENSIMAG, Grenoble INP, France **2019 - 2022**
Applied mathematics and computer science engineering degree

1 Research

Scientific keywords

Operational research, combinatorial optimization, online algorithms, computational methods, online scheduling and packing, theoretical bounds, randomized algorithms, online algorithms with predictions

Research Interests

I am particularly interested in computational proofs for online optimization problems. The main idea is that proofs of lower and upper bounds are often fairly long case studies – so perhaps a computer would be better suited to construct such bounds. Online bin stretching is the main problem I tackle as computational proofs are state of the art for it. It is a packing problem where items need to be placed into bins in an online manner. The computational methods consist in viewing this problem as a two-player game between the algorithm and a malicious adversary giving items, and finding strategies for a player via a min-max search. Computation time is the main limiting factor to obtain better results.

My work so far has been to extend computational proofs in several directions: improving the search technique itself to reduce computation times and obtain better bounds, proving their convergence, considering randomized algorithms and algorithms augmented with predictions.

Papers awaiting publication

- *Online bin stretching lower bounds: Improved search of computational proofs*
  Antoine Lhomme, Olivier Romane, Nicolas Catusse, Nadia Brauner, 2022
  Preprint: https://arxiv.org/abs/2207.04931
  The online bin stretching problem is a combinatorial packing problem where items have to be packed into bins in an online manner. Some of the best known bounds on this problem are from computational results. The limiting factor in obtaining better bounds is the computational time. This paper proposes a new idea to prune the search space by viewing search states in a geometrical manner and propagating some information through them. This improves the speed of computational proofs, resulting in new bounds.
- *Computational bounds on randomized algorithms for online bin stretching*
  Antoine Lhomme, Nicolas Catusse, Nadia Brauner, 2024
  Preprint: https://arxiv.org/abs/2405.19071
  Online problems are often considered through worst-case analysis. However such an analysis may be too pessimistic to be insightful. Work-arounds exist, such as considering randomized algorithms. Naturally, randomized algorithms are more complicated to study. This paper proposes computational proofs for randomized algorithms in the online bin stretching problem, based on linear programming. New lower bounds and a new randomized algorithm are proposed through computational results.
- *On the convergence of computational methods for the online bin stretching problem*
  Antoine Lhomme, Nicolas Catusse, Nadia Brauner, 2025
  Preprint: https://arxiv.org/abs/2506.17271
  Computational methods for online bin stretching depend on a granularity parameter: the higher it is, the more precise the bounds obtained are. It is however unclear that these methods converge to the optimal. This paper shows that this is indeed the case for the deterministic methods, and also gives a lower bound on the speed of convergence.
- *Robust single-stage selection problems with budgeted interval uncertainty* (in preparation)
  Antoine Lhomme, Nadia Brauner, Evgeny Gurevsky, Mikhail Y. Kovalyov, Erwin Pesch, 2025
  This paper is a collaboration with visitor M. Kovalyov and considers a class of robust problems where some items need to be selected at some cost. Items can be bought at a fixed cost or at an uncertain cost that is subject to change after having bought items. The uncertain costs may not vary too much - there is a budget constraint on the variations of uncertain costs. For several variations of this problem, exact algorithms are given and complexity is discussed - a problem is notably proven to be Σ_2^p-complete.
- *Lower bounds for online bin stretching with predictions* (in preparation)
  Antoine Lhomme, Nicolas Catusse, Nadia Brauner, 2025
  Online algorithms with predictions is a recent framework to bypass the pessimism of standard worst-case analysis. Algorithms are given some information about the future input which may be more or less precise. The algorithm does not know if that prediction is correct or not. The aim is to construct algorithms that are very performant when the prediction is good while not being much worse if the prediction turns out to be very incorrect. Since there is inherently a tradeoff between trusting and doubting the prediction, it is not clear how to guarantee that some online algorithms with predictions are good. This paper proposes to do that by considering a new notion of lower bounds, which can be constructed computationally. The method is used on the online bin stretching problem.

International collaboration

- Welcomed Pr. Mikhail Kovalyov for 1 month, which led to a paper on robust item selection problems **2025**
- Welcomed Matej Lieskovský to work on online bin stretching for a week **2024**

School attendance

- Participated in a robust optimization school for 3 days in Montpellier, France (`http://gdrro.lip6.fr/?q=node/276`) **2022**
- Participated in an AI and computational social choice school for 4 days in Porquerolles, France (`https://ia2.gdria.fr/ia2-2022/`) **2022**

2 Teaching and collective responsabilities

Teaching Assistant

Total of 109 hours of both lab and exercise sessions **2023 - present**

Automata and language theory
- 27h, exercise sessions
- Second year of bachelor degree
- Université Grenoble Alpes

Mathematics, Modelization and Computer science
- 37h, with exercise and lab sessions alongside a project on a scheduling problem
- Contents: basics of mathematical optimization and problem modelling and solving
- 1st year course at the engineering school of Grenoble INP, Génie Industriel (third year of bachelor degree)

Systems and programming environments (Bash and C course)
- 36 hours of exercise and lab sessions
- 1st year course of bachelor degree
- Université Grenoble Alpes

Introduction to linear algebra
- 9 hours, exercise sessions
- 1st year of bachelor degree
- Université Grenoble Alpes

2022 and 2023

Animated a **mathematics stand** for primary school pupils for the Parvis des Sciences event, to introduce combinatorial optimization to children through games (twice half a day)

2025

Supervised a master 1 intern for 2 months on online algorithms with predictions, with the aim of finding online problems with prediction where the choice of the error measure strongly matters to obtain optimal algorithms

Collective responsibilities

President of the Association of Ph.D. students of the G-SCOP laboratory **2022 - 2023**

- Working in collaboration with lab direction and administration
- Organized social events for the lab, such as Christmas lunch, managing a snack fridge, welcoming new members
- Organized the G-SCOP days, an offsite two-days event with the lab members (about 80 participants)

3 List of publications

Research report

1. *Online bin stretching lower bounds: Improved search of computational proofs*, Antoine Lhomme, Olivier Romane, Nicolas Catusse, Nadia Brauner, 2022, submitted

   Preprint: `https://arxiv.org/abs/2207.04931`

2. *Computational bounds on randomized algorithms for online bin stretching*, Antoine Lhomme, Nicolas Catusse, Nadia Brauner, 2024, submitted

   Preprint: `https://arxiv.org/abs/2405.19071`

3. *On the convergence of computational methods for the online bin stretching problem*, Antoine Lhomme, Nicolas Catusse, Nadia Brauner, 2025, submitted

   Preprint: `https://arxiv.org/abs/2506.17271`

4. *Robust single-stage selection problems with budgeted interval uncertainty*, Antoine Lhomme, Nadia Brauner, Evgeny Gurevsky, Mikhail Y. Kovalyov, Erwin Pesch, 2025, awaiting publication

Presentations

- Poster for **MIP 2025**
- Talks in **ROADEF 2024** and **2025**
- Invited for a 1 hour **seminar** in Institut Mathématiques de Bordeaux, France, 2024
- Talk in **ECCO 2022**