

Gwen MAUDET, Post Doctoral Researcher

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Introduction

I am currently a postdoctoral researcher at the University of Luxembourg, where I explore the integration of machine learning techniques to improve the efficiency of solvers for Mixed Integer Linear Programming (MILP) problems. My work focuses on developing genetic programming-based methods to generate human-readable algorithms, and on defining structural representations of MILP instance spaces—such as distance metrics and clustering techniques.

Previously, I completed my PhD at IMT Atlantique in Rennes, where I investigated data transmission strategies in large-scale, highly constrained sensor networks. My research addressed the design of similarity measures for sensors operating with sparse and noisy data, the development of dynamic clustering algorithms, and adaptive fleet management strategies.

For a quick and structured overview of my profile, please visit: <https://gwenmaudet.github.io/>.

Professional Experience

December 2023 – Present

- At *University of Luxembourg, Esch-sur-Alzette, Luxembourg*. *Postdoctoral Researcher* in **Machine Learning for Mixed Integer Linear Programming (MILP)**. This position is **jointly funded by the ANR (France) and the FNR (Luxembourg)** under the collaborative project UltraBO.

This research focuses on the development of machine learning-based methods to design solving strategies within the branch-and-bound framework for MILP problems, a class of techniques referred to as *MLMILP*. The primary objective is to build generalizable strategies that are effective across the entire MILP instance space and suitable for integration into general-purpose MILP solvers. However, current MLMILP approaches tend to perform well only on homogeneous sets of instances and struggle to generalize to more diverse or heterogeneous cases.

To overcome this limitation, we propose a portfolio-based solving strategy. The idea is to partition the MILP instance space into structurally homogeneous groups and train a dedicated MLMILP method for each group. When presented with a new instance, its closest group is identified, and the corresponding method is applied. This framework involves several key contributions: (i) the design of new MLMILP methods based on genetic programming, which produces lightweight and human-readable solving strategies; (ii) the definition of mathematical distance measures between MILP instances, capturing their structural similarities; and (iii) the development of clustering techniques to effectively partition the MILP space—similar to class definitions, but extended to the full complexity of MILP instances.

Professional Experience (continued)

April - September 2020

- At INRIA, Rennes, France. Internship in **Detecting Bias in Search Engines**. Contributed to the design and implementation of techniques to detect biases between search engines, including the definition of inter-engine distance measures, outlier detection methods, and the development of meta-search engines. Participated in the writing of a journal article and developed a public-facing web platform to demonstrate and allow experimentation with the tools: <https://snide.irisa.fr>.

June - August 2019

- At Acklio, Rennes, France. Internship in **Header Compression for IoT Networks Using Clustering**. Focused on the reduction of IoT protocol header sizes using rule-based compression mechanisms as defined in RFC 8724. Applied hierarchical clustering and genetic algorithms to identify groups of similar headers (e.g., IP, UDP, CoAP), enabling the generation of efficient compression rules tailored to each group. This approach leveraged the redundancy in protocol fields commonly observed in constrained IoT scenarios.

Education

2020 - 2023

- PhD at IMT Atlantique, Rennes, France in **Exploiting Sensor Similarity to Enhance Data Collection in Massive IoT Networks**. This doctoral work was **funded by the VaLaDOE research chair**.

This thesis focuses on efficient monitoring of physical phenomena in environments equipped with a large number of low-power sensors characterized by limited memory, minimal computational capabilities, and finite battery life. These sensors operate within a highly constrained star network and are deployed at scale. The primary objective is to design energy-efficient communication strategies that extend the operational lifetime of the sensor network.

The proposed approach leverages the concept of sensor similarity: if two sensors consistently produce similar data, only one may be required to transmit, thus reducing communication load and conserving energy. The methodology is structured into three main components: (i) Similarity Estimation — a resilient method for quantifying sensor similarity, designed to operate effectively under sparse and noisy data conditions, and without requiring precise sensor localization; (ii) Coverage Set Construction — leveraging the similarity measures, representative subsets of sensors are selected such that their transmissions can approximate the observations of the entire network; and (iii) Transmission Scheduling — a dynamic and adaptive mechanism for assigning transmission periods, tailored to stringent network constraints, including enforced sleep cycles. This component ensures that data quality is preserved while minimizing energy consumption.

A video presentation of the thesis is available here: <https://www.youtube.com/watch?v=0p3jmuffM1k>.

Defense Date: November 23, 2023

Jury Composition: **Laurent Toutain** – IMT Atlantique (*Director*) **Mireille Batton-Hubert** – École des Mines de Saint-Étienne (*Co-director*) **Patrick Maillé** – IMT Atlantique (*Advisor*) **Alexandre Guitton** – Université Clermont Auvergne (*Reviewer*) **Julien Montavont** – Université de Strasbourg (*Reviewer*) **Kinda Khawam** – Université de Versailles.

Education (continued)

- 2016 - 2020 • **Engineering School** at *IMT Atlantique, Nantes, France.*
Specialization in computer science for decision support, including courses in Machine Learning, Operational Research, and mathematical objects such as graphs and Turing machines. Completed an applied exploratory project for solving TSP using neural networks, implementing GAN, Hopfield NN, Q-DL (50h). Also completed a MILP project to find nurse schedules (20h) and developed a scalable TSP solver using heuristics (10h). Also participated in a one-semester academic exchange at Universiti Teknologi Petronas (Malaysia), where he studied database management methods and programming in C.
- 2014 - 2016 • **Classes préparatoires aux grandes écoles** at *Rabelais, Saint-Brieuc, France.*
Completed a two-year intensive program in mathematics and physics to prepare for the national competitive exam for entry into highly ranked engineering schools.

Research Writings

International Journals

- P. Maillé, **G. Maudet**, M. Simon, and B. Tuffin, "Are Search Engines Biased? Detecting and Reducing Bias using Meta Search Engines," en, *Electronic Commerce Research and Applications*, p. 101 132, Feb. 2022, issn: 1567-4223. (SJR: Q1)

International Conferences

- **G. Maudet**, G. Danoy, "A Distance Metric for Mixed Integer Programming Instances," en, in *European Conference on Artificial Intelligence*, 2025. (CORE: A)
- **G. Maudet**, G. Danoy, "Search Strategy Generation for Branch and Bound Using Genetic Programming," en, in *Proceedings of the AAAI Conference on Artificial Intelligence* 39, 2025. (CORE: A*)
- **G. Maudet**, M. Batton-Hubert, P. Maille, and L. Toutain, "Energy Efficient Message Scheduling with Redundancy Control for Massive IoT Monitoring," en, in *IEEE Wireless Communications and Networking*, 2023. (CORE: B)
- **G. Maudet**, M. Batton-Hubert, P. Maille, and L. Toutain, "Emission Scheduling Strategies for Massive-IoT: Implementation and Performance Optimization," en, in *IEEE/IFIP Network Operations and Management Symposium*, Apr. 2022. (CORE: B)

National Conferences

- **G. Maudet**, M. Batton-Hubert, P. Maille, and L. Toutain, "Grouper les Capteurs Similaires Grace à leurs Données dans le Contexte de Massive IoT," in *26èmes Rencontres Francophones sur les Aspects Algorithmiques des Télécommunications*, May 2024.
- **G. Maudet**, M. Batton-Hubert, P. Maille, and L. Toutain, "Réduction de la Redondance de Messages des Capteurs dans un Contexte Massive IoT," in *25èmes Rencontres Francophones sur les Aspects Algorithmiques des Télécommunications*, May 2023.

On Going Work

- **G. Maudet**, M. Batton-Hubert, P. Maillé, and L. Toutain, "Grouping Sensors Based on Observations in a Massive IoT Deployment," en, Under review.

Research Writings (continued)

- **G. Maudet**, M. Batton-Hubert, P. Maille, and L. Toutain, “A Survey On Data Collection Based on Sensors Similarity,” en, In progress.

Grants & Research Funding

Research Projects

April 2025

- **SMILP: Structuring the Mix Integer Linear Programming Space** (*Under review*)

Role: Lead author of the project proposal, under the supervision of Dr. Danoy, PI of the project.

Institution: University of Luxembourg

Funding: CORE Project – FNR Luxembourg (*decision expected in october 2025*)

Requested Funding: 2-year postdoc and 4-year PhD

Summary: The SMILP project aims to improve the generalization of ML-based MILP solvers by introducing a structural similarity metric and clustering framework for MILP instances. It proposes portfolio-based solving strategies, where specialized ML models are trained for instance clusters, enhancing solver scalability and efficiency.

Planned Contributions:

- Hybrid learning strategies combining genetic programming with MILP heuristics.
- Structural similarity metrics for MILP instance characterization.
- Integration with open-source tools SCIP and MIPLIB (in collaboration with ZIB and HTW Berlin).

Supervision

PhD

2023–Present

- **Alisa Vorokhta**, PhD student. Research on the application of machine learning methods to enhance the efficiency of MILP solvers, especially by reducing the impact of the lower bound computation.

Interns

2025

- **Baka Junior Cedric Ble**, Master’s student (5 months). Worked on clustering methods for MILP instances, aiming to develop a portfolio-based approach where specific MLMILP models are applied to homogeneous groups of instances.
- **Mathis Da Cunha**, Master’s student (5 months). Research on the use of genetic programming to define cutting plan selection strategies within branch-and-bound frameworks.

2022

- **Issam Belhorma**, Master’s student (4 months). Applied kriging-based techniques to estimate sensor positions using returned sensor data and references from known-position nodes.

2021

- **Carlos Delgado**, Master’s student (3 months). Worked on sensor deployment in vertical green walls for monitoring and regulating soil humidity levels.

Supervision (continued)

Student jobs

- 2025 • **Diptaraj SEN**, Master's student (5 months, 5 hours per week). Evaluating an heterogeneous benchmark of instances considering an alternative distance metric between instances.
- 2024 • **Daniele Ferrario**, Master's student (3 months, 5 hours per week). Understanding a scientific paper and the code that defines a reinforcement learning method for cutting plan selection.

Teaching

- 2024-2025 • Project Lead for student groups at *University of Luxembourg, Esch-sur-Alzette, Luxembourg*. Supervised a team of three master's students in Information and Computer Science, working on a research project for four hours per week over four months. The first project (2024) focused on analyzing the performance of two lower-bound strategies in branch-and-bound algorithms applied to the Permutation Flowshop Scheduling Problem. The second project (2025) addressed cutting plan selection in branch-and-bound frameworks. The aim was to investigate the trade-off involved in choosing an appropriate cutting strategy and to develop methods based on genetic programming for automatically generating effective cutting plan selection strategies.
- Lecturer at *University of Luxembourg, Esch-sur-Alzette, Luxembourg*. Taught the winter semester of the first-year master's program in Information and Computer Sciences in an amphitheater. Delivered 4 sessions for 58 students in 2024 and 6 sessions for 62 students in 2025, each lasting 1.5 hours:
- * Introduction to Integer Linear Programming: Explained the components of branch-and-bound with an interactive example for students to follow. Presentation of different branching and searching strategies, with different impacts on the performance of the solving.
 - * Development of Population-Based Metaheuristic Algorithms: Focused on evolutionary algorithms (e.g., genetic algorithms, genetic programming) and swarm intelligence methods (e.g., ant colony optimization, particle swarm optimization), discussing design choices and applications.
 - * Application of Optimization Methods to the Traveling Salesman Problem: Designed a hands-on session using a self-contained Jupyter Notebook to tackle the problem with brute force, Integer linear programming resolution, heuristics, and metaheuristics. Students implemented and analyzed results from algorithms such as genetic algorithms and ant colony optimization.
 - * Presentation of Recent Research: Demonstrated the integration of branch-and-bound and genetic programming to automate the construction of a key branch-and-bound component (search strategy), showcasing the practical application of these tools to current optimization challenges.

Teaching (continued)

2022 - 2023

- Practice teacher at *IMT Atlantique, Rennes, France*. Supported the first semester of a two-year international master's program in IT, focusing on mathematics and programming foundations. Courses were conducted remotely, with instructors based in Brest. Worked with 12 students in 2022 and 24 in 2023.
 - * Matlab - 6h (2022) + 6h (2023): Introduction to Matlab programming, applying it to mathematical concepts such as complex numbers, matrix calculations, sequences, and signal processing.
 - * Algebra - 6h (2022) + 6h (2023): Covered linear spaces, eigenvectors, eigenvalues, and matrix transformations.
 - * Introduction to Python - 9h (2022) + 9h (2023): Introduced Python programming, focusing on objects, functions, and libraries such as *RegEx*, *Numpy*, and *Pandas*.
 - * Python for Data Science - 16h (2022) + 16h (2023): Explored data science concepts from visualization to machine learning. Students completed projects such as analyzing forest fire data (2022) or researching and applying novel machine learning concepts (2023).
 - * Operational Research - 7h30 (2022): Provided an overview of linear programming, integer linear programming, and heuristics. Students tackled optimization problems in heating, telecommunications, and hub location networks.
 - * Probability and Statistics - 4h (2022): Assisted with statistical tasks, including generating random variables from cumulative distribution functions.
 - * Signal Processing - 2h30 (2023): Supported signal analysis tasks in Matlab, including identifying harmonics and object positioning through trilateration.

2012 - 2019

- Private tutor in *Brittany, France*. Provided personalized teaching to primary and secondary school students, averaging two students per week.

Review Committee

PC chair

2025

- Shadow PC Chair for the *Algotel-Cores* Conference. Led the organization of the shadow reviewing process, including the call for shadow reviewers, introductory sessions on peer-review methodology, bidding setup, and paper discussions. The shadow review program allows early-career researchers to participate in a full peer-review process without impacting the official paper selection.

Reviewing

2024-2025

- Two times reviewed two seven pages double column papers for the *PDCO* Workshop of the international conference *IPDPS*.

2024

- Reviewed one twelve pages double column paper for the international journal *IEEE TNSM*.
- Reviewed one fourteen pages double column paper for the international journal *IEEE Sensors Journal*.

Review Committee (continued)

- 2023 • Shadow reviewed four four-page single-column conference papers for the French national conference "Cores et Algotel".

Presentations

- 2025 • **Search Strategy Generation for Branch and Bound Using Genetic Programming**, at *AAAI, Philadelphia, USA*. Oral presentation and poster. The oral presentation was one of approximately 600 selected from over 3,000 accepted papers at the conference.
- 2024 • **Grouper les capteurs similaires grâce à leurs données dans le contexte de Massive IoT**, at *ALGOTEL, Saint-Briac-sur-Mer, France*.
- 2023 • **Energy Efficient Message Scheduling with Redundancy Control for Massive IoT Monitoring**, at *IEEE WCNC, Glasgow, Scotland*.
• **Réduction de la Redondance de Messages des Capteurs dans un Contexte Massive IoT**, at *ALGOTEL, Cargese, France*.
- 2022 • **New Monitoring Strategies using Massive IoT**, at *Plate-forme Intelligence Artificielle, Saint-Étienne, France*.

• **Emission Scheduling Strategies for Massive-IoT: Implementation and Performance Optimization**, at *IEEE NOMS, Budapest, Hungary*.
- 2021 • **Poster: Dynamic management of a field of sensors to extend the monitoring time**, at *Symposium IMT: internet du futur, Villeneuve d'Ascq, France*.

• **Strategies for transmitting LoRa wireless sensors to optimize supervision**, at *Journées LP-WAN, Clermont-Ferrand, France*.
- 2019 • Master of ceremonies, at *IMT Atlantique students' graduation ceremony, Nantes, France*.

Miscellaneous Experience

Position in Associations and Institutions

- 2022 - 2023 • **President of the association of PhD students and young researchers** in *IMT Atlantique Rennes*.

2023 • **Representative of the PhD students** for the *doctoral school "SPIN"*.

Sports

- Indoor and outdoor climber.
- Trail and road runner.
- Judoka.

Skills

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|-----------|---|
| Languages | <ul style="list-style-type: none">Strong reading, writing and speaking competencies for English (C1), basic comprehension and expression skills in Spanish (A2) and Italian (A2). |
| Coding | <ul style="list-style-type: none">Python (ML & DS packages), R (statistics and Kriging), DBeaver, MongoDB, L^AT_EX, ... |
| Misc. | <ul style="list-style-type: none">Academic research, teaching, training, internship supervision, L^AT_EX typesetting and publishing. |

References

Dr Grégoire Danoy

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Supervisor of the PhD thesis

Prof Laurent Toutain

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Director of the PhD thesis