Curriculum Vitae
Short version

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Personal

Born in 1987. Married, three children: Léa (2019), Noé (2021), Éva (2024).

Research Positions and Education

Habilitation	**University of Bordeaux**
French degree allowing me to supervise PhD students	*11 Feb 2022*

Current

Researcher	**CNRS, LaBRI, Bordeaux**
Chargé de recherche	*Since Jan 2018*

Past

Visiting Researcher	**University of Warsaw, Poland**
Automata group	*Sept. 2022 – July 2023*
Research Fellow	**Alan Turing Institute of data science, London**
Logical Foundations of Data Science	*Jan. 2017 – Aug. 2022*
Research Fellow	**Simons Institute, University of Berkeley**
Theoretical Foundations for Computer Systems	*Jan. 2021 – May. 2021*
Research Fellow	**Simons Institute, University of Berkeley**
Logical Structures in Computation	*Aug. 2016 – Dec. 2016*
Research Assistant	**University of Oxford**
Dynamical Systems	*Nov. 2015 – July 2016*

Education

PhD in Computer Science	**Paris 7 & Warsaw**
Counting and Randomising in Automata Theory	*Sept 2012 – Oct 2015*
Jointly supervised by Mikołaj Bojańczyk and Thomas Colcombet	

Five most important publications

In computer science, it is (unfortunately!) customary to publish mainly in conference proceedings, and some of the most prestigious venues are peer-peviewed international conferences. In theoretical computer science the order of authors is typically alphabetical; this is not the case in artificial intelligence venues. The listing below respects the authors' order from the respective publication. It is organised along three axes, reflecting my research activities: reactive synthesis through the prism of games on graphs, machine learning for program synthesis, and logic and automata learning.

Infinite duration games on graphs

[1] Nathanaël Fijalkow, Nathalie Bertrand, Patricia Bouyer, Romain Brenguier, Arnaud Carayol, John Fearnley, Hugo Gimbert, Florian Horn, Rasmus Ibsen-Jensen, Nicolas Markey, Benjamin Monmege, Petr Novotný, Mickael Randour, Ocan Sankur, Sylvain Schmitz, Olivier Serre, Mateusz Skomra. *Games on Graphs: From logic and automata to algorithms*, 2023

Publicly available: `https://arxiv.org/abs/2305.10546`.

I initiated a collaborative textbook on the field of infinite duration games on graphs. The book is composed of 16 chapters (550 pages in PDF format) and written in a mathematically rigorous way with uniform notations, definitions, and technical developments, in order to give the only existing comprehensive account on the state of the art for this dynamic field of research. It is published online on Arxiv, and is being printed by Cambridge University Press. I coauthored 5 chapters and acted as project leader, organising the book contents and inviting the 24 other authors.

[2] Marius Belly, Nathanaël Fijalkow, Hugo Gimbert, Florian Horn, Guillermo A. Pérez, Pierre Vandenhove (alphabetical). *Revelations: A Decidable Class of POMDPs with Omega-Regular Objectives*, AAAI Conference on Artificial Intelligence 2025

Full version available as preprint: `https://arxiv.org/abs/2412.12063`

Partially observable Markov decision processes (POMDPs) form a prominent model for uncertainty in sequential decision making, which is not very popular in the AI research community, but not so much in formal methods because most problems are undecidable. In this paper we introduce a revelation mechanism which restricts information loss, inspired by related works in mathematics. What I find interesting in this work is that it adopts a new point of view: analysing a very natural algorithm to better understand what problem it solves. This opens the way to a lot more work on understanding algorithms for POMDPs, orthogonal to the classical undecidability results.

[3] Nathanaël Fijalkow. *An optimal value iteration algorithm for parity games*, ArXiv 2018

Full version available as preprint: `https://arxiv.org/abs/1801.09618`

The most important problem in the field of graph game theory and a central question for reactive synthesis is the complexity of parity games: does a polynomial-time algorithm exist? In 2017, unprecedented progress was made on this problem, which has been open for four decades: the construction of a quasi-polynomial-time algorithm. The technical report above establishes a corresponding lower bound on the symbolic approaches developed for this algorithm, in three steps: introducing the (purely combinatorial) notion of universal trees, showing its central role in these algorithms, and proving a lower bound on the size of universal trees.

A month after its publication, this result was complemented by introducing the notion of separating automata, leading to a joint publication in the proceedings of a major conference in algorithmics, SODA, in 2019. This important negative result has already been cited 53 times since 2019 (according to Google Scholar), which is remarkable in this community.

Machine learning for program synthesis

[4] Théo Matricon, Nathanaël Fijalkow, Guillaume Lagarde (by contributions). *Eco Search: A Constant-Delay Best-First Search Algorithm for Program Synthesis*, AAAI Conference on Artificial Intelligence 2025

Full version available as preprint: `https://arxiv.org/abs/2412.17330`

Neurosymbolic algorithms for program synthesis are based on the following idea: in order to explore the (very large) space of programs, a neural network is used to give predictions about the solution

program. This gives rise to a biased search problem, where the algorithm relies on these predictions to guide the search. There are a large number of algorithms in this neuro-symbolic framework, from several fields (genetic algorithms, meta-heuristics, enumeration, constraint solving, etc.).

The main contribution of this article is to construct the first constant-delay algorithm, i.e. one that requires a constant amount of computation between each program generated. This very important property ensures from a theoretical point of view that the algorithm does not slow down over time, which is observed in practice in all existing algorithms. This theoretical result is accompanied by an implementation evaluating the interest of this algorithm on classic benchmarks.

Logic and automata learning

[5] Mojtaba Valizadeh, Nathanaël Fijalkow, Martin Berger (by contributions). *LTL learning on GPUs*, International Conference on Computer Aided Verification, CAV 2024

Full version available as preprint: `https://arxiv.org/abs/2402.12373`

Linear Temporal Logic (LTL) is an important logic for specifying temporal properties on finite or infinite traces. The fundamental problem we study is to learn LTL formulas from traces: given a set of positive and negative traces, find an LTL formula separating the positive from the negative ones. LTL learning brings together different research communities, each contributing applications, approaches and points of view to this problem: software engineering, programming languages and formal methods, control of cyber-physical systems and robotics, and artificial intelligence.

The originality of this article is to show the extent to which the computational problems for LTL are perfectly aligned with GPU architectures. By building a GPU-accelerated algorithm, this article improves the state of the art by several orders of magnitude, and opens up numerous research prospects by showing the strong links between LTL and GPUs. Here's a parallel, admittedly a rather daring one: just ten years ago, the first works showing the interest of GPU architectures for training neural networks were warmly welcomed. Ten years on, GPUs are standard architectures for training and deploying LLMs. Could other fields, such as logic synthesis and more generally automated synthesis, benefit from these advances?

Invited talks

The lists include declined invitations for personal reasons (health, family).

International conferences: ▷ **2024** GanDALF: Symposium on Games, Automata, Logics, and Formal Verification (declined) ▷ **2024** Jewels of Automata Theory ▷ **2019** Symposium on Games, Automata, Logics, and Formal Verification ▷ **2015** ESF AutoMathA conference

International workshops: ▷ **2025** Complexity, Algorithms, Automata and Logic Meet (declined) ▷ **2025** Viennese Conference on Optimal Control and Dynamic Games (declined) ▷ **2024** Machine Learning and Theory Workshop in University of East Anglia (declined) ▷ **2024** Mediterranean Game Theory Symposium (declined) ▷ **2023** Workshop on Open Problems in Learning and Verification of Neural Networks (Wolverine, CAV satellite event) ▷ **2020** Coalgebraic Methods in Computer Science (CMCS, ETAPS satellite event) ▷ **2019** Games for Logic and Programming Languages (GaLoP, ETAPS satellite event) ▷ **2019** Complexity, Algorithms, Automata and Logic Meet (CAALM, Chennai) ▷ **2017** Logical Structures for Computation at the Simons Institute, Berkeley ▷ **2016** Collective Adaptive Systems Synthesis (Cassting, ETAPS satellite event)

Tutorials and research schools: ▷ **2024** Plate-Forme Intelligence Artificielle (PFIA) ▷ **2024** Symposium on Principles of Programming Languages (POPL) ▷ **2023** World Symposium on Formal Methods (FM) ▷ **2022** French School for Young Researchers in Computer Science and Mathematics

(EJCIM) ▷ **2020** European Conference on Artificial Intelligence (ECAI) ▷ **2019** ForMaL DigiCosme Spring School on Formal Methods and Machine Learning

Specialised workshops by invitation: ▷ **2023,2025** Dagstuhl Seminar: Approaches and Applications of Inductive Programming ▷ **2024** Dagstuhl Seminar: Artificial Intelligence and Formal Methods Join Forces for Reliable Autonomy ▷ **2023** Dagstuhl Seminar: Model Learning for Improved Trustworthiness in Autonomous Systems ▷ **2022** Dagstuhl Seminar: Finite Model Theory ▷ **2021** Dagstuhl Seminar: Unambiguity in Automata Theory ▷ **2021** Lorentz Center: Rigorous Automated Planning ▷ **2020** Barbados Bellairs Centre: Probabilistic Programming ▷ **2019** Dagstuhl Seminar: Logic and Learning ▷ **2019** Barbados Bellairs Centre: Logical Foundations for Data Science

Seminar talks: over 30 research groups across Europe

Professional service

Scientific Leadership

Head of GT-DAAL: Data, Automata, Algebra, and Languages

2018 − 2024

GDR-IM is a French network gathering computer scientists and mathematicians, it is composed of a dozen working groups and organises and supports several national scientific events. As one of the two Heads of GT-DAAL, one of the working group of GDR-IM, I coordinated the national events pertaining to Database Theory, Automata Theory, and Logic.

Managing Editor for TheoretiCS

2021 − 2024

TheoretiCS is a Diamond Open Access Journal covering all areas of Theoretical Computer Science and launched in Oct 2021. It works as an ArXiV overlay journal, implying that access to all papers is free. Authors are not required to pay any publication fees or article processing charges, and retain copyright. TheoretiCS ambitions to attract the very best papers in each field of Theoretical Computer Science. As one of the two Managing Editors I actively participated in materialising this ambition.

Publicity Chair for the Highlights of Logic, Games, and Automata Conference

2017 − 2022

Highlights of Logic, Games and Automata is an annual conference aiming at integrating the community working in these fields. It is modelled after mathematics conferences: all relevant papers, published elsewhere or not, are accepted for a short presentation. A visit to the Highlights conference offers a wide picture of the latest research in the field and a chance to meet everybody in the community. As Publicity Chair I helped disseminating the conference and related events, and in this capacity I sat in the Steering Committee.

Principal Investigator of Research Grants

PEPR IA — **4 years, 900k€**
SAIF: Safe AI using Formal Methods — *Sept. 2023 − Aug. 2027*

IRP — **5 years, 75k€**
Le Trójkąt: Collaboration between Bordeaux, Paris, and Warsaw — *Jan 2024 − Dec 2028*

IEA — **2 years, 14k€**
WinCent: Applications of Program Synthesis — *Jan 2022 − Dec 2024*

ANR JCJC — **4 years, 140k€**
G4S: Games for Synthesis — *Jan 2022 − Dec 2025*

CNRS Momentum — **3 years, 380k€**
DeepSynth: Machine Learning Guided Program Synthesis — *Jan 2019 − Dec 2021*

Program Committees of International Conferences

▷ **2026** Symposium on Principles of Programming Languages (POPL) ▷ **2026** Symposium on Logic in Computer Science (LICS) ▷ **2025** International Colloquium on Automata, Languages and Programming (ICALP) ▷ **2025** International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI) ▷ **2025** International Conference on Artificial Intelligence (AAAI) ▷ **2024** International Conference on Artificial Intelligence (AAAI) ▷ **2024** International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI) ▷ **2023** International Joint Conference on Artificial Intelligence (IJCAI) ▷ **2023** International Conference on Artificial Intelligence (AAAI) ▷ **2023** International Conference on Quantitative Evaluation of SysTems (QEST) ▷ **2022** Computer Science in Russia (CSR) ▷ **2022** Mathematical Foundations of Computer Science (MFCS), ▷ **2019** International Conference on Reachability Problems (RP), ▷ **2019** International Colloquium on Automata, Languages and Programming (ICALP), ▷ **2019** Foundations of Software Systems and Computer Science (FoSSaCS), ▷ **2019** Highlights of Logic, Games and Automata (Highlights), ▷ **2018** Mathematical Foundations of Computer Science (MFCS), ▷ **2018** Highlights of Logic, Games and Automata (Highlights)

PhD Committees

▷ **2024** Nathanaël Beau, Python Code Generation from a Natural Language Description (*Formal Linguistics Lab, University of Paris Cité*) ▷ **2024** Mohamed Reda Marzouk, Intelligibité des réseaux de neurons recurrents par des machines à états finis (*University of Nantes*) ▷ **2023** Nathan Thomasset, Strategy complexity for Gale-Stewart games (*LMF*) ▷ **2023** Soumyajit Paul, Games with imperfect information (*LaBRI*) ▷ **2023** Grégoire Menguy, Black-box analysis of binary code (*CEA List*) ▷ **2022** Cedric Koh, On Linear, Fractional and Submodular Optimization (*London School of Economics*) ▷ **2022** Xavier Badin de Montjoye, Strategy Improvement Method for Solving Simple Stochastic Games (*Université de Versailles Saint-Quentin-en-Yvelines*) ▷ **2019** Hugo Bazille, Detection and Quantification of Events in Stochastic Systems (*ENS Rennes*)

Co-Organisation of Scientific Events

▷ **2025** Theoretical Foundations of Trustworthy AI (*Simons Institute, Berkeley*) ▷ **2024** Program Synthesis Days (*LaBRI, Bordeaux*) ▷ **2024** Dagstuhl Seminar on Stochastic Games ▷ **2023** Dagstuhl Seminar on the Futures of Reactive Synthesis ▷ **2020** Learning and Verification day (*LaBRI, Bordeaux*) ▷ **2019** Learning and Verification day (*UCL, London*) ▷ **2018** Logic and Learning FoPSS School (*Oxford, affiliated to FLOC*) ▷ **2018** Summit on Machine Learning Meets Formal Methods (*Oxford, affiliated to FLOC*) ▷ **2018** Logic and Learning Workshop (*The Alan Turing Institute, London*) ▷ **2015** Annual meeting of the GT ALGA (*IRIF, Paris*)

Supervision

I have supervised **23** interns, **8** PhD students (4 defended), **3** research engineers, and **4** postdocs.

Teaching

▷ **Starting 2025** Stochastic Games, Parisian Master in Computer Science, MPRI (12h) ▷ **Since 2025** Large Language Models, Master Vision Apprentissage, MVA (24h) ▷ **Since 2024** Theory and Practice of Machine Learning, IA Master in University of Bordeaux (24h) ▷ **Since 2021** Games Techniques in Computer Science, Parisian Master in Computer Science, MPRI (12h) ▷ **Since 2019** Theory and Practice of Reinforcement Learning, PhD Programme in LaBRI, Bordeaux (12h) ▷ **Since 2019** Reinforcement Learning, IA Master at ENSEIRB (18h)