Gaëtan Staquet

PhD in Computer Science

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1 Main Research Interests

My research interests lie in the formal verification of systems field, which is part of theoretical computer science. In particular, I am interested in the following topics:

Model checking. One way to formally guarantee that a system behaves as expected is to first abstract the system into a model, which is a mathematical representation of the system on which it is easier to reason.

Automata theory. Automata are one way to model a system. They are often represented as finite graphs, where each vertex represents an abstracted state of the system, and each edge represents a transition between two states triggered by an input symbol of the system.

Timed models. As finite state automata are too simple to model complex systems, many extensions exist, each considering a different kind of computation resources to augment the automaton with. Two such extensions concern the timing of events: timed automata, and automata with timers. The main difference between the two models comes from how time is represented. I refer to my publication "Automata with Timers" (see Pu2) for more information.

Active automata learning. Constructing an automaton from a system is in itself a complex task. Active automata learning algorithms can automatically infer a model from the system by interacting with it. I refer to my PhD thesis (see Di1) for an introduction.

Game theory. While automata permit to focus on the executions of the system, it is often interesting to consider its interactions with the environment. Games form a possible way to model these interactions, and can be used to study how the system reacts to the environment, e.g., does the printing system always successfully processes each printing request?

2 Positions

Postdoctoral Researcher
October 2024 – Present
Institute: Inria Center of the University of Rennes, Rennes, France.

Research stay
01/08/2023 – 27/10/2023
Institute: Radboud University, The Netherlands.
Description: I collaborated with Frits W. Vaandrager and Bharat Garhewal.
The stay was financed by the Belgian F.R.S.-FNRS and University of Mons.

F.R.S.-FNRS Research Fellow
October 2020 – September 2024
Institute: F.R.S.-FNRS, University of Mons, University of Antwerp, Belgium.
Description: Grant for four years of PhD.

3 Education

Ed1: PhD in Computer Science
2020 – 2024
Institute: University of Mons, University of Antwerp, Belgium.
Dissertation title: *Active Learning of Automata with Resources*.
Description: My PhD was co-directed by Véronique Bruyère, University of Mons, Belgium, and Guillermo A. Pérez, University of Antwerp, Belgium.

Following the Belgian's system, my first defense, with only the members the jury, took place on 19 June 2024, while my second defense, public, took place on 11 September 2024. The jury was constituted of:

- Dana Fisman, Ben-Gurion University, Israel;
- Daniel Neider, TU Dortmund University, Germany;
- Ocan Sankur, CNRS, IRISA, France;
- Frits W. Vaandrager, Radboud University, The Netherlands; and
- Jef Wijsen, University of Mons, Belgium.

More details about my PhD are given on my website, alongside the PDF version of the manuscript.

Ed2: Master's Internship
September to December 2019
Institute: University of Antwerp, Belgium.
Description: My Master's internship focused on active learning algorithms for visibly one-counter automata, under the supervision of Guillermo A. Pérez.

Ed3: Master's Degree in Computer Science
2018 – 2020
Institute: University of Mons, Belgium.
Honor: Summa cum laude.
Description: My Master's thesis, titled "Efficient Learning of Automata and Automata with One Counter", was conducted under the supervision of Véronique Bruyère.

Ed4: Research Initiation Internship
August 2018
Institute: University of Mons, Belgium.
Description: The goal of this internship, proposed to students between their Bachelor and Master, is to work with a PhD student, to discover research.

My internship focused on algorithms to compute Nash equilibria, under the supervision of Aline Goeminne, Thomas Brihaye, Véronique Bruyère, and Hadrien Mélot.

Ed5: Bachelor's Degree in Computer Science
2015 – 2018
Institute: University of Mons, Belgium.
Honor: Magna cum laude.
Description: I went to Montreal (Canada) to follow courses at University of Montreal during the Fall semester of the academic year 2017 – 2018.

4 Awards

Formal Modeling and Analysis of Timed Systems (FORMATS) Best Paper Award
2023
Description: For "Automata with Timers" (see Pu2).

5 Tools and Implementations

I list here the tools and implementations performed for my research or my studies. I have also some open-source projects, which can be consulted on my GitHub page.

JSON Schema Tools
2022
Homepage: https://github.com/DocSkellington/JSONSchemaTools
Role: Sole developer.
Language: Java.
Description: This project implements algorithms that validate whether a JSON document is correct with regards to a set of constraints given as a JSON schema. It can also generate valid and invalid documents from a schema. See my paper *Validating Streaming JSON Documents with Learned VPAs* (Pu3).

Validating JSON schemas with learned visibly pushdown automata
2022
Homepage: https://github.com/DocSkellington/ValidatingJSONDocumentsWithLearnedVPA
Role: Sole developer.
Language: Java.
Description: This project implements the validation algorithm for JSON documents described in *Validating Streaming JSON Documents with Learned VPAs* (see Pu3). It also performs benchmarks between the classical algorithm (see the previous project) and our new approach.

Forks of LearnLib and AutomataLib
2021 – 2022
Homepage: https://github.com/DocSkellington/automatalib and https://github.com/DocSkellington/learnlib
Role: Sole developer of the forks.
Language: Java.
Description: LearnLib is a library for active automata learning, and AutomataLib is the underlying automata library. Both are maintained at TU Dortmund University (Germany). These forks

implement automata augmented with a counter, and their learning algorithm, presented in *Learning Realtime One-Counter Automata* (see Pu4).

Benchmarks for learning one-counter automata

2021 – 2022
Homepage: https://github.com/DocSkellington/LStar-ROCA-Benchmarks
Role: Sole developer.
Language: Java.
Description: This project runs the benchmarks of my paper *Learning Realtime One-Counter Automata* (see Pu4).

Conquesto

2020 – 2021
Homepage: https://github.com/DocSkellington/Conquesto
Role: Main developer.
Language: Python.
Description: This tool was developed for a course followed during my Master, and that lead to a publication (see Pu5). It generates Answer Set Programming programs that decide whether a database query is certain, despite the presence of errors in the database. These programs are then benchmarked.

Learning Visibly One-Counter Automata

2019
Homepage: https://github.com/DocSkellington/LearningVCA
Role: Sole developer.
Language: Java.
Description: This implementation of the active learning algorithm of Daniel Neider and Christof Löding (*Learning Visibly One-Counter Automata in Polynomial Time*) was realized during my Master's internship (see Ed2).

libgsjj – Passive learning of deterministic finite automata

2018 – 2019
Homepage: https://github.com/libgsjj/libgsjj
Role: Main developer.
Language: C++.
Description: This framework for passive learning of deterministic finite automata was realized during the project of my first year of Master. It uses a SAT solver to construct an automaton from a finite set of words that must be accepted and a finite set of words that must be rejected.

Nash equilibria in reachability games

2018
Homepage: https://github.com/AlineGoeminne/reachabilityGame
Role: Sole developer.
Language: C++.
Description: This project, realized during my research initiation internship (see Ed4), implements an algorithm to compute Nash equilibria in reachability games played on weighted graphs. It also

contains generators for random graphs to test and benchmark the algorithm.

6 Teaching

Algorithmic and Experimental Complexity
First semester of academic year 2023 – 2024
Institute: ISTIC, University of Rennes.
Student level: First year of Computer Science.
Role: Supervising practical sessions and grading projects.
Description: Language: Java.
Yearly hourly volume: 28h.

Logic Programmming
Second semester of academic years 2021 – 2022 to 2023 – 2024
Institute: University of Mons.
Student level: Third year of Computer Science.
Role: Teaching assistant giving the exercises sessions.
Description: Language: Prolog.
Yearly hourly volume: 14h.
I participated in writing and grading the exams.

Functional Programmming
First semester of academic years 2021 – 2022 to 2023 – 2024
Institute: University of Mons.
Student level: Third year of Computer Science and second year of Mathematics.
Role: Teaching assistant giving the exercises sessions.
Description: Language: Schema. The course also teaches basic lambda calculus.
Yearly hourly volume: 16h.
I participated in writing and grading the exams.

Programming and Algorithms II
Second semester of academic years 2018 – 2019 and 2019 – 2020
Institute: University of Mons.
Student level: First year of Computer Science and first year of Mathematics.
Role: I was a Master student, helping the teaching assistants supervising the exercises sessions.
Description: Language: Java.

Programming and Algorithms I
First semester of academic years 2018 – 2019 and 2019 – 2020
Institute: University of Mons.
Student level: First year of Computer Science, first year of Mathematics, and second year of Physics.
Role: I was a Master student, helping the teaching assistants supervising the exercises sessions.
Description: Language: Python.

7 Supervision

Master's Theses

Master's Thesis of Kévin Dubrulle
Academic year 2024 – 2025
Institute: University of Mons.
Role: Co-supervisor, with Véronique Bruyère.

Internships

Research Initiation Internships. The goal of the research initiation internships at University of Mons, proposed to students between their last year of Bachelor and first year of Master, is to work with a PhD student, to discover research.

Research Initiation Internship of Julien Ladeuze
August 2024
Institute: University of Mons.
Description: Co-supervised with Véronique Bruyère.
Julien implemented an algorithm studied in my paper "Active Leaning of Mealy Machines with Timers" (see Pu6) to convert a *generalized Mealy machine with timers* into a regular Mealy machine with timers. The student also performed benchmarks to see whether the expected exponential blowup of the algorithm often occurs in practice.

Research Initiation Internship of Nicolas Valois and Hugo Venturoso
August and September 2022
Institute: University of Mons.
Description: Co-supervised with Véronique Bruyère.
Nicolas and Hugo worked on improving the computation of a data structure used in my publication "Validating Streaming JSON Documents with Learned VPAs" (see Pu3).

Research Initiation Internship of Christophe Grandmont
August and September 2021
Institute: University of Mons.
Description: Co-supervised with Véronique Bruyère and Clément Tamines.
Christophe worked on solving generalized parity games using binary decision diagrams as a symbolic representation.

Jury member for Master's theses.

- Aziz Amezian El Khalfioui, 2021, University of Mons, Computer Science.
- Benjamin André, 2021, University of Mons, Computer Science.
- Didier Moniquet, 2021, University of Mons, Computer Science.
- Kamal Belouh, 2022, University of Mons, Computer Science.
- Robin Ganseman, 2022, University of Mons, Computer Science.
- Florent Huylenbroeck, 2022, University of Mons, Computer Science.

- Pierre Zielinski, 2022, University of Mons, Computer Science.
- Thomas Brenart, 2023, University of Mons, Computer Science.
- François Callens, 2023, University of Mons, Computer Science.
- Nicolas Leloux, 2024, University of Mons, Computer Science.
- Hugo Venturoso, 2024, University of Mons, Computer Science.

8 Administrative and Collective Responsibilities

Administrative responsibilities

Member of the Council of the Faculty of Sciences of University of Mons
October 2020 to September 2024

Member of the Council of the Computer Science Department of University of Mons
November 2021 to September 2024

Collective responsibilities

Informant at the University of Mons' open house days
01/07/2023 and 20/04/2024

Informant at the Brussels *Service of Information on Studies and Professions* (SIEP) fair
27/11/2021

Reviews

I reviewed articles for the following conferences and journals:

- In 2022: GandALF, FMSD, and MFCS.
- In 2023: LMCS.
- In 2025: Petri Nets, and ICALP.

Outreach and popular science

Organization of Séminaire Jeune at University of Mons
Academic year 2022 – 2023
Description: The Séminaire Jeune is a series of vulgarization talks geared towards third-year and above Computer Science and Mathematics students. I organized six seminaries throughout the year.

Printemps des Sciences (Spring of Sciences)
25/04/2023 and 26/04/2023
Description: The Printemps des Sciences is an outreach festival for the general public. With Véronique Bruyère and computer science students, we introduced the ideas behind various sorting

algorithms, and gave intuition about their complexity.

À vous de jouer
23/04/2023 and 24/04/2023
Description: It was a vulgarization workshop for high school students, taking place during the "Journées Math-Sciences" (Days Math-Sciences) at University of Mons. It was a joint work with Chloé Capon, Aline Goeminne, Nicolas Lecomte, James C.A. Main, Mickael Randour, Alexandre Terefenko, and Pierre Vandenhove. It introduced concepts from game theory, on various examples and scenarios.

9 Publications

In theoretical computer science, authors are usually ordered by alphabetical order.

Peer-reviewed journal articles

Pu1: The Reactive Synthesis Competition (SYNTCOMP): 2018 – 2021
Authors: Swen Jacobs, Guillermo A. Pérez, Remco Abraham, Véronique Bruyère, Michaël Cadilhac, Maximilien Colange, Charly Delfosse, Tom van Dijk, Alexandre Duret-Lutz, Peter Faymonville, Bernd Finkbeiner, Ayrat Khalimov, Felix Klein, Michael Luttenberger, Klara J. Meyer, Thibaud Michaud, Adrien Pommellet, Florian Renkin, Philipp Schlehuber-Caissier, Mouhammad Sakr, Salomon Sickert, Gaëtan Staquet, Clément Tamines, Leander Tentrup, Adam Walker.
Year: 2024.
Conference: International Journal on Software Tools for Technology Transfer, Volume 26.
Pages: 551 – 567.
DOI: https://doi.org/10.1007/s10009-024-00754-1.

Peer-reviewed conference proceedings

When applicable, I indicate the CORE ranking of the conference. I highlight that the FORMATS conference is not recognized in CORE but has an excellent reputation within the field of timed systems.

Pu2: Automata with Timers
Authors: Véronique Bruyère, Guillermo A. Pérez, Gaëtan Staquet, Frits W. Vaandrager.
Year: 2023.
Conference: Formal Modeling and Analysis of Timed Systems, FORMATS.
Pages: 33 – 49.
DOI: https://doi.org/10.1007/978-3-031-42626-1_3.
arXiv: https://arxiv.org/abs/2305.07451.

Pu3: Validating Streaming JSON Documents with Learned VPAs
Authors: Véronique Bruyère, Guillermo A. Pérez, Gaëtan Staquet.
Year: 2023.
Conference: Tools and Algorithms for the Construction and Analysis of Systems, TACAS (CORE ranking: A).
Pages: 271 – 289.

DOI: https://doi.org/10.1007/978-3-031-30823-9_14.
arXiv: https://arxiv.org/abs/2211.08891.

Pu4: Learning Realtime One-Counter Automata
Authors: Véronique Bruyère, Guillermo A. Pérez, Gaëtan Staquet.
Year: 2022.
Conference: Tools and Algorithms for the Construction and Analysis of Systems, TACAS (CORE ranking: A).
Pages: 244 – 262.
DOI: https://doi.org/10.1007/978-3-030-99524-9_13.
arXiv: https://arxiv.org/abs/2110.09434.

Pu5: Optimization of Answer Set Programs for Consistent Query Answering by Means of First-Order Rewriting
Authors: Aziz Amezian El Khalfioui, Jonathan Joertz, Dorian Labeeuw, Gaëtan Staquet, Jef Wijsen.
Year: 2020.
Conference: Conference on Information and Knowledge Management, CIKM (CORE ranking: A).
Pages: 25 – 34.
DOI: https://doi.org/10.1145/3340531.3411911.

Preprints

Pu6: Active Learning of Mealy Machines with Timers
Authors: Véronique Bruyère, Bharat Garhewal, Guillermo A. Pérez, Gaëtan Staquet, Frits W. Vaandrager.
Year: 2024.
arXiv: https://arxiv.org/abs/2403.02019.

10 Given Talks

Whenever applicable, slides are available on my website.

2024

Active Learning of Mealy Machines wih Timers
20/12/2024
Seminar of the STR (Real Time Systems) team, LS2N, Nantes, France.

Active Learning of Mealy Machines wih Timers
06/12/2024
Seminar of the Formal Methods and Verification team, ULB, Brussels, Belgium.

Active Learning of Mealy Machines wih Timers
28/11/2024

Seminar of the LoVe team, LIPN, Paris, France.

Active Learning of Mealy Machines wih Timers
20/11/2024
WG Verification & SCALP Days, IRCICA, Lille, France.

Active Learning of Mealy Machines wih Timers
20/09/2024
Highlights of Logic, Games and Automata, LaBRI, Bordeaux, France.

Active Learning of Mealy Machines wih Timers
30/05/2024
MOVEP, IRISA, Rennes, France.

Validating Streaming JSON Documents with Learned Visibly Pushdown Automata
06/04/2024
Learning in Verification (LiVe), University of Luxembourg, Luxembourg.

2023

Automata with Timers
15/12/2023
Centre Fédéré de Vérification (CFV), ULB, Brussels, Belgium.

Automata with Timers
01/12/2023
WG Verification Days, IRIF, Paris, France.

Automata with Timers
07/11/2023
68NQRT - Formal Methods Seminar, IRISA, Rennes, France.

Automata with Timers
10/10/2023
Seminar of the Software Science Department, Radboud University, Nijmegen, The Netherlands.

Automata with Timers
20/09/2023
Formal Modeling and Analysis of Timed Systems (FORMATS), University of Antwerp, Belgium.

Automata with Timers
25/07/2023
Highlights of Logic, Games and Automata, University of Kassel, Germany.

Verification of Computer Systems thanks to State Machines
24/05/2023
Day of the Infortech research institute, University of Mons, Belgium.

Validating Streaming JSON Documents with Learned Visibly Pushdown Automata
24/04/2023
Tools and Algorithms for the Construction and Analysis of Systems (TACAS), Sorbonne Université, Paris, France.

2022

Verification of Computer Systems thanks to State Machines
15/11/2022
Annual national day of the F.R.S.-FNRS doctoral school COMPLEX, Mons, Belgium.

Learning Realtime One-Counter Automata
26/10/2022
Seminar of the LRDE team, Paris, France.

Vérifier un Système Informatique grâce à un Automate
24/10/2022
Séminaire Jeune (vulgarization talk towards third-year and above students), University of Mons, Belgium.

Learning Realtime One-Counter Automata
21/10/2022
Seminar of the Formal Methods and Verification team, ULB, Brussels, Belgium.

Active Learning of Automata for JSON-Streaming Validation
29/09/2022
Highlights of Logic, Games and Automata, Université Paris-Cité, Paris, France.

Vérifier Efficacement un Document JSON grâce à un Automate
06/05/2022
Séminaire Jeune (vulgarization talk towards third-year and above students), University of Mons, Belgium.

Learning Realtime One-Counter Automata
05/04/2022
Tools and Algorithms for the Construction and Analysis of Systems (TACAS), TU Munich, Germany.

2021

Learning Realtime One-Counter Automata
17/11/2021
WG Verification Days, LMF, Gif-sur-Yvette, France.

Learning Realtime One-Counter Automata
17/09/2021
Highlights of Logic, Games and Automata, Online.

2020

Optimization of Answer Set Programming for Consistent Query Answering by Means of First-Order Rewriting
22/10/2020
Conference on Information and Knowledge Management (CIKM), Online.

11 Attended events

Events on invitation

Dagstuhl Retreat on Co-Algebra and Automata Learning (23463)
15/11/2023 to 17/11/2023
Schloss Dagstuhl, Germany.

Conferences

Highlights of Logic, Games and Automata
16/09/2024 to 20/09/2024
University of Kassel, Germany.

Formal Modeling and Analysis of Timed Systems, FORMATS
18/09/2023 to 23/09/2023
University of Antwerp, Belgium.

Highlights of Logic, Games and Automata
24/07/2023 to 28/07/2023
University of Kassel, Germany.

European joint conference On Theory And Practice of Software (ETAPS)
22/04/2023 to 27/04/2023
Sorbonne Université, Paris, France.

European joint conference On Theory And Practice of Software (ETAPS)
02/04/2022 to 07/04/2022

TU Munich, Germany.

Highlights of Logic, Games and Automata
28/06/2022 to 01/07/2022
Université Paris-Cité, Paris, France.

Games, Automata, Logics, and Formal Verification (GandALF)
20/09/2021 to 22/09/2021
Online.

Highlights of Logic, Games and Automata
14/09/2020 to 17/09/2020
Online.

Conference on Concurrency Theory (CONCUR)
24/08/2021 to 27/08/2021
Online.

European joint conference On Theory And Practice of Software (ETAPS)
27/03/2021 to 01/04/2021
Online.

Conference on Information and Knowledge Management (CIKM)
19/10/2020 to 23/10/2020
Online.

Games, Automata, Logics, and Formal Verification (GandALF)
21/09/2020 and 22/09/2020
Online.

Highlights of Logic, Games and Automata
15/09/2020 to 18/09/2020
Online.

Workshops and seminars

Learning in Verification (LiVe)
06/04/2024
University of Luxembourg, Luxembourg.

Centre Fédéré de Vérification (CFV)
15/12/2023
ULB, Brussels, Belgium.

Workshop on Automata, Concurrency and Timed Systems
30/05/2023 to 02/06/2023
LMF, Gif-sur-Yvette, France.

Theory and Algorithms in Graph and Stochastic Games
14/03/2019 and 15/03/2019
University of Mons, Belgium.

Summer Schools

MOVEP
27/05/2024 to 31/05/2024
IRISA, Rennes, France.

MOVEP
22/06/2020 to 26/06/2020
Online.

Annual meetings of working groups and institutes

WG Verification & SCALP
19/11/2024 to 21/11/2024
IRCICA, Lille, France.

WG DAAL
25/04/2024 and 26/04/2024
IRISA, Rennes, France.

WG Verification
30/11/2023 and 01/12/2023
IRIF, Paris, France.

Infortech research institute
24/05/2023
University of Mons, Belgium.

WG DAAL Annual meeting
21/04/2023
EPITA, Paris, France.

WG Verification
11/07/2022 to 13/07/2022
LaBRI, Bordeaux, France.

WG Verification
17/11/2021 to 19/11/2021
LMF, Gif-sur-Yvette, France.

12 Miscellaneous

Programming languages. I grade my knowledge in the following languages:

- Java (Advanced)
- LaTeX, with TikZ (Advanced)
- Python (Intermediate)
- Haskell (Advanced beginner)
- Prolog (Advanced beginner)
- Scheme (Advanced beginner)
- Modern C++ (Advanced beginner)
- C (Advanced beginner)
- Rust (Beginner)

In order to experiment with programming languages, I enjoy solving programming puzzles, such as Advent of Code, for whose my repository with my solutions is publicly available on my GitHub page.

Programming competitions. During the academic year 2016-2017, I won the 454th place (out of 5558) in University CodeSprint, and my team won the 43d place in the Benelux Algorithm Programming Contest (BAPC).