Paolo Morettin | Ph.D.

Trento, Italy
paolo.morettin@unitn.it • paolomorettin.github.io • paolomorettin

My research lies at the intersection of *machine learning* and *automated reasoning*, with a focus on probabilistic inference with algebraic and logical constraints. I am currently fully supported by a Marie Skłodowska-Curie Action fellowship. The project aims at advancing the trustworthiness of AI systems by developing verification tools that provide formal guarantees on their correctness.

Current position

DISI, University of Trento — **Trento, Italy**
Assistant professor (RTDa) — *2023–now*
From March 2023 to February 2024, I was supported by the PNRR project FAIR.
Since March 2024, my position is self-funded with a Marie Skłodowska-Curie Action fellowship.

Work Experience

Declarative Languages and AI group, KU Leuven — **Leuven, Belgium**
Postdoctoral researcher — *2020–2023*
Advisor: Prof. Luc De Raedt.
Funded by the ERC project SYNTH.

Statistical Relational AI lab, UCLA — **Los Angeles, California**
Visiting scholar — *2019 Jul–Oct*
Tractable WMI models, advisor: Prof. Guy Van den Broeck

Declarative Languages and AI group, KU Leuven — **Leuven, Belgium**
Visiting scholar — *2018 Apr–Jun*
Learning hybrid and structured distributions, advisor: Prof. Luc De Raedt

Advanced Laboratory on Embedded Systems, (UTRC) — **Trento, Italy**
Engineer — *2016 Jun–Nov*
Formal methods group

ITIS J.F. Kennedy — **Pordenone, Italy**
Substitute teacher — *2016 Apr–Jun*
Substitute teacher in a technical high school (computer science program)

Insight Centre for Data Analytics, University College Dublin — **Dublin, Ireland**
Data science intern — *2015 Mar–May*
Dynamic tracking of communities in social networks, advisor: Prof. Padraig Cunningham

Compix — **Pordenone, Italy**
Software developer — *2008–2009*
Consulting, Visual Basic and .NET development

Education

ICT Doctoral School, University of Trento — **Trento, Italy**
PhD, cum laude — *2016–2020*
Thesis: *Learning and reasoning in hybrid structured spaces*.
Advisor: Prof. Andrea Passerini, co-advisor: Prof. Roberto Sebastiani

University of Trento — **Trento, Italy**
MSc in Computer Science, 110/110 cum laude — *2013–2016*
Thesis: *Learning Modulo Theories with latent variables*.
Advisor: Prof. Andrea Passerini, co-advisor: Prof. Stefano Teso

University of Udine **Udine, Italy**
BSc in Computer Science, 110/110 cum laude *2009–2013*
Thesis: *A comparative study on constraint solvers*.
Advisor: Prof. Agostino Dovier

Projects

Marie Skłodowska-Curie Action Postdoctoral Fellowship **UniTN**
Role: fellow. *2024 – now*

Probabilistic Formal Verification for Provably Trustworthy AI (PFV-4-PTAI).

PNRR project FAIR **UniTN**
Role: researcher. *2023 – 2024*

Future AI Research (FAIR).

ERC project SYNTH **KU Leuven**
Role: postdoc. *2020 – 2022*

Synthesising Inductive Data Models (SYNTH).

International collaborations

Luc De Raedt: Full professor, KU Leuven.
Topics: Neuro-symbolic artificial intelligence.

Guy Van Den Broeck: Associate professor, UCLA.
Topics: Weighted Model Integration

Antonio Vergari: Associate professor, University of Edimburgh.
Topics: Weighted Model Integration, Neuro-symbolic artificial intelligence.

Pedro Zuidberg Dos Martires: Assistant professor, Örebro University.
Topics: Weighted Model Integration.

Zhe Zeng: Assistant professor, University of Virginia.
Topics: Weighted Model Integration.

Research output

Google Scholar citations: 239, h-index: 10. **Scopus** citations: 127, h-index: 7.

Books

Learning and Reasoning in Hybrid Structured Spaces *Book, 2022*
P. Morettin
Frontiers in Artificial Intelligence and Applications series, IOS Press.
My PhD thesis was published by IOS Press after being shortlisted for the EurAI Dissertation Award (link).

Selected articles in journals

Enhancing SMT-based Weighted Model Integration by structure awareness *2024*
G. Spallitta, G. Masina, P. Morettin, A. Passerini, R. Sebastiani
Artificial Intelligence (AIJ), volume 328,
Q1 (impact factor 5.1).

Advanced SMT techniques for Weighted Model Integration *2019*
P. Morettin, A. Passerini, R. Sebastiani
Artificial Intelligence (AIJ), volume 275,
Q1 (impact factor 5.1).

Selected articles in conference proceedings

A neuro-symbolic benchmark suite for concept quality and reasoning shortcuts *2024*
S. Bortolotti, E. Marconato, T. Carraro, P. Morettin, E. van Krieken, A. Vergari, S. Teso, A. Passerini
Proc. of the 38th Conference on Neural Information Processing Systems (NeurIPS)
CORE ranking: A*.

SMT-based weighted model integration with structure awareness *2022*
G. Spallitta, G. Masina, P. Morettin, A. Passerini, R. Sebastiani
Proc. of the 38th Conference on Uncertainty in Artificial Intelligence (UAI)
CORE ranking: A.

Hybrid Probabilistic Inference with Logical and Algebraic Constraints: a Survey *2021*
P. Morettin, P. Zuidberg Dos Martires, S. Kolb, A. Passerini
Proc. of the 30th International Joint Conference on Artificial Intelligence (IJCAI)
CORE ranking: A*.

Probabilistic Inference with Algebraic Constraints: Theoretical Limits and Practical Approximations *2020*
Z. Zeng*, P. Morettin*, F. Yan*, A. Vergari, G. Van den Broeck
Proc. of the 34th Conference on Neural Information Processing Systems (NeurIPS)
CORE ranking: A*.

Efficient Generation of Structured Objects with Constrained Adversarial Networks *2020*
L. Di Liello, P. Ardino, J. Gobbi, P. Morettin, S. Teso, A. Passerini
Proc. of the 34th Conference on Neural Information Processing Systems (NeurIPS)
CORE ranking: A*.

Scaling up Hybrid Probabilistic Inference with Logical and Arithmetic Constraints via Message Passing *2020*
Z. Zeng*, P. Morettin*, F. Yan*, A. Vergari, G. Van den Broeck
Proc. of the 37th International Conference on Machine Learning (ICML)
CORE ranking: A*.

Learning Weighted Model Integration distributions *2020*
P. Morettin, S. Kolb, S. Teso, A. Passerini
Proc. of the 34th AAAI Conference on Artificial Intelligence (AAAI)
CORE ranking: A*.

The pywmi Framework and Toolbox for Probabilistic Inference using WMI *2019*
S. Kolb, P. Morettin, P. Zuidberg Dos Martires, F. Sommavilla, A. Passerini, R. Sebastiani, L. De Raedt
Proc. of the 28th International Joint Conference on Artificial Intelligence (IJCAI)
CORE ranking: A*.

Efficient Weighted Model Integration via SMT-Based Predicate Abstraction *2017*
P. Morettin, A. Passerini, R. Sebastiani
Proc. of the 26th International Joint Conference on Artificial Intelligence (IJCAI)
CORE ranking: A*.

Workshop papers

Top-Down Knowledge Compilation for Counting Modulo Theories *2023*
V. Derkinderen, P. Zuidberg Dos Martires, S. Kolb, P. Morettin
Workshop on Counting and Sampling (MC).

Is Parameter Learning via Weighted Model Integration Tractable? *2021*
Z. Zeng*, P. Morettin*, F. Yan, A. Vergari, A. Passerini, G. Van den Broeck
4th Workshop on Tractable Probabilistic Modeling (TPM).

Co-creating Platformer Levels with Constrained Adversarial Networks *2021*
P. Morettin, A. Passerini, S. Teso

ACM Workshop on Intelligent User Interfaces (IUI).

* denotes equal contribution.

Tutorials / Invited talks

Towards Probabilistic Verification of AI Systems via Weighted Model Integration:
Invited talk, International Symposium on AI Verification, co-located with the Conference on Computer Aided Verification (CORE ranking: A*), 2024.

Hybrid Probabilistic Inference with Algebraic and Logical Constraints:
Tutorial, 31st International Joint Conference on Artificial Intelligence, 2022.
Co-organizers: Pedro Zuidberg Dos Martires, Samuel Kolb and Andrea Passerini.

Awards

ECAI 2024 Outstanding SPC Member Award:
Awarded to 2-3% of the SPC members (link).

Shortlisted to the EurAI Dissertation Award 2021:
PhD thesis published by IOS Press as a result (link).

Service

Program/reviewing committee member:
AAAI 2021, 2022, 2023, 2024, 2025
AISTATS 2022, 2023 (top reviewer), 2024, 2025
ECAI 2020, 2024 (outstanding SPC member award)
KR 2024
ICLR 2022, 2023, 2024
ICML 2021, 2022, 2023
IJCAI 2020, 2021, 2022, 2023
NeurIPS 2020, 2021, 2022, 2024

Reviewer for journals: Machine Learning Journal (editorial board member), Journal of Machine Learning Research, Frontiers in AI, Data Mining and Knowledge Discovery, Künstliche Intelligenz (Journal of AI of the German Informatics Society).

Volounteer: AI*IA 2018

Organizer: GNI 2016 finals (the Italian Computer Science competition for high-school students)

Teaching

Courses

Fundamentals of AI — **UniTN**
Teaching assistant, 12CFU, Master in AI Systems — *2024-2025*
Laboratory sessions, exams.

Fundamentals of AI — **UniTN**
Teaching assistant, 12CFU, Master in AI Systems — *2023-2024*
Laboratory sessions, exams.

Uncertainty in AI — **KU Leuven**
Teaching assistant, 4ECTS, Master of AI — *2022-2023*
Laboratory sessions, exams.

Uncertainty in AI **KU Leuven**
Teaching assistant, 4ECTS, Master of AI *2021-2022*
Laboratory sessions, exams.

Computer Science **UniTN**
Teaching assistant, 6CFU, BSc Scienze e Tecnologie Biomolecolari. *2019-2020*
Laboratory sessions, exams.

Computer Science **UniTN**
Teaching assistant, 6CFU, BSc Scienze e Tecnologie Biomolecolari. *2018-2019*
Laboratory sessions, exams.

Computer Science **UniTN**
Teaching assistant, 6CFU, BSc Scienze e Tecnologie Biomolecolari. *2017-2018*
Laboratory sessions, exams.

Thesis co-advisor

Gianvito Taneburgo. *Constrained Adversarial Networks*. 2018.

Pierfrancesco Ardino. *Multinomial Constrained Adversarial Network*. 2019.

Jacopo Gobbi. *Constraining Generative Adversarial Networks with Semantic Loss*. 2019.

Luca Di Liello. *Level Generation with Constrained Adversarial Networks*. 2019.

Francesco Sommavilla. *Pushing the envelope of SMT-based Weighted Model Integration*. 2019.

Senne Dirkx. *Co-creative Generation of Game Levels using Generative Adversarial Networks*, 2022.

Quentin Stroobants. *Co-creative Generation of Game Levels using Generative Adversarial Networks*, 2022.

Giulia Tortoioli. *Learning Constraints in Robot Trajectories*, 2022.

Georgios Patrikis. *Keeping humans safe from robots*, 2023.

David Debot. *Approximating Volume Computations with Neural Networks*, 2023.

Software

I am the core maintainer of the following software:

ReCoIn An approximate WMI solver based on the relax-compensate-recover framework.

MP-WMI An exact WMI solver based on Belief Propagation.

LARIAT A framework for learning distributions with hard logical/algebraic constraints.

pywmi A python toolbox for probabilistic modelling and inference using WMI.

WMI-PA The state-of-the-art exact WMI solver based on advanced Satisfiability Modulo Theories techniques.