Sagar Malhotra

Machine Learning Research Unit, TU Wien, Austria

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Academic Employment

2023-now **Postdoctoral Researcher**
Host: Prof. Thomas Gärtner
Machine Learning Research Unit,
TU Wien, Austria

Education

2019-2023 **PhD in Computer Science**
Thesis: On Tractability and Consistency of Probabilistic Inference in Relational Domains
Advisor: Luciano Serafini
University of Trento, Italy
Fondazione Bruno Kessler, Italy (dual affiliation)

2016-2018 **MSc in Physics**
Advisors: Roberto Iuppa (University of Trento), Marco Cristoforetti (FBK)
Thesis: Deep Learning for Track Reconstruction in Next Generation HEP Experiments
Fondazione Bruno Kessler, Italy
University of Trento, Italy

2012-2015 **BSc in Physics (Honors)**
University of Delhi, India

Research Interests

I am interested in algorithms for sound, efficient, and trustworthy Machine Learning – with provable mathematical guarantees. To this end, I have worked on: tractability of learning and reasoning over relational data; logical expressivity based explainability methods; Neurosymbolic AI and quantitative verification of machine learning algorithms.

Awards and Funding

- **Honorable Mention Award** at the International Conference on Principles of Knowledge Representation and Reasoning Conference 2024
- **Best Paper Award** at the International Conference of Neurosymbolic Learning and Reasoning 2024
- Project "Logical Distillation of Machine Learning Models" among 21/84 funding applications invited to the long proposal phase for WWTF ICT 2025 funding
  Role: Principal Investigator, Funding requested: 793,884.00 €, Final Decision awaited
- ANR-FWF joint project "Nanostructure evolution in oxide materials at high temperature investigated with advanced X-ray scattering and machine learning based data analysis"
  Role: Part of the project team, majorly contributed towards writing the WP for machine learning. Total Funding: 1,008, 858 €. Funding for our group: 215,492 €

Publications

Supervised student coauthors are underlined.

Journal Publications

2025 **Sagar Malhotra**, Davide Bizzaro and Luciano Serafini
Lifted Inference beyond First Order Logic
Artificial Intelligence Journal.
AIJ (**Q1** Journal)

Conference Publications

2025 Peter Blohm, Patrick Indri, Thomas Gärtner, **Sagar Malhotra**
Probably Approximately Global Robustness Certification
International Conference of Machine Learning 2025.
ICML 2025 (CORE Rank **A***, **26.9**% acceptance rate)

2025 Steve Azzolin[†], **Sagar Malhotra**[†], Andrea Passerini, Stefano Teso
Beyond Topological Self-Explainable GNNs: A Formal Explainability Perspective
International Conference of Machine Learning 2025.
ICML 2025 ([†]Equal Contribution, CORE Rank **A***, **26.9**% acceptance rate)

2024 Alexander Pluska, Pascal Welke, Thomas Gärtner and **Sagar Malhotra**.
Logical Distillation of Graph Neural Networks
International Conference on Principles of Knowledge Representation and Reasoning 2024
KR 2024 (CORE Rank **A***, **17%** acceptance rate in the special track. **Honorable Mention**)

2024 Florian Chen, Felix Weitkämper, and **Sagar Malhotra**.
Understanding Domain-Size Generalization in Markov Logic Networks
Machine Learning and Knowledge Discovery in Databases. Research Track - European Conference
ECML PKDD 2024 (CORE Rank **A**, **24%** acceptance rate)

2024 Alessandro Daniele, Tommaso Campari, **Sagar Malhotra** and Luciano Serafini
Simple and Effective Transfer Learning for Neuro-Symbolic Integration
International Conference on Neural-Symbolic Learning and Reasoning, NeSy 2024
NeSy 2024 (**Best Paper Award**)

2023 Alessandro Daniele, Tommaso Campari, **Sagar Malhotra** and Luciano Serafini.
Deep Symbolic Learning: Discovering Symbols and Rules from Perception
International Joint Conference on Artificial Intelligence 2023
IJCAI 2023 (CORE Rank **A***, **15%** acceptance rate)

2022 **Sagar Malhotra** and Luciano Serafini
On Projectivity in Markov Logic Networks
Machine Learning and Knowledge Discovery in Databases. Research Track - European Conference
ECML PKDD 2022 (CORE Rank **A**, **26%** acceptance rate).

2022 **Sagar Malhotra** and Luciano Serafini
Weighted Model Counting in FO^2 with Cardinality Constraints and Counting Quantifiers: A Closed Form Formula
AAAI Conference on Artificial Intelligence 2022
AAAI 2022 (CORE Rank **A***, **15%** acceptance rate, **accepted as oral presentation**)

2021 **Sagar Malhotra** and Luciano Serafini
A Combinatorial Approach to Weighted Model Counting in the Two Variable Fragment with Cardinality Constraints
International Conference of the Italian Association for Artificial Intelligence 2019
AIxIA 2021

Workshop Publications (Peer-reviewed)

2025 Klaus Weinbauer, Tieu-Long Phan, Peter F. Stadler, Thomas Gärtner, and **Sagar Malhotra**
Prime Implicant Explanations for Reaction Feasibility Prediction
Workshop on Advances in Interpretable ML and AI, ECML-PKDD 2025

2024 Patrick Indri, Peter Blohm, Anagha Athavale, Ezio Bartocci, Georg Weissenbacher, Matteo Maffei, Dejan Nickovic, Thomas Gärtner, **Sagar Malhotra**
Distillation based Robustness Verification with PAC Guarantees
Next Generation of AI Safety Workshop, ICML 2024
NextGenAISafety, ICML 2024

2024 Alexander Pluska, Pascal Welke, Thomas Gärtner and **Sagar Malhotra**.
Logical Distillation of Graph Neural Networks
Workshop on Mechanistic Interpretability, ICML 2024
MI Workshop, ICML 2024

2023 Alessandro Daniele, Tommaso Campari, **Sagar Malhotra** and Luciano Serafini.
Deep Symbolic Learning: Discovering Symbols and Rules from Perception
International Workshop on Neural-Symbolic Learning and Reasoning 2023
NeSy 2023 (**Accepted for spotlight presentation**)

2022 **Sagar Malhotra** and Luciano Serafini
On Projectivity in Markov Logic Networks
International Workshop on Probabilistic Logic Programming 2022
PLP 2022

2021 **Sagar Malhotra** and Luciano Serafini. Weighted Model Counting in FO^2 with Cardinality Constraints and Counting Quantifiers: A Closed Form Formula
International Workshop on Statistical Relational AI, IJCLR 2021.
StarAI, IJCLR 2021

Talks and Tutorials

2025 What can logic do for safe and explainable AI?
Invited talk at Aachen Symposium on Representation Learning to Act and Plan, 2025
Aachen RLeap Symposium 2025

2025 Probabilistic Verification of Black-Box Systems
Spring workshop on Mining and Learning, 2025
SMiLe 2025

2024 Fundamental Problems in Statistical Relational AI
International Conference on Principles of Knowledge Representation and Reasoning, 2024
Half-day tutorial as a solo presenter
KR 2024

2024 On Consistency of Learning and Inference in Statistical Relational Learning
Invited Talk at MLDM Workshop at the AIxIA Conference 2024, Bolzano, Italy
MLDM 2024

2022 On Probabilistic Inference in Logical Domains
Invited talk at the Institute of Informatics, Ludwig Maximilian University of Munich, Germany

2022 A Tutorial on Probabilistic Inference in Logical Domains
Guest Lecture at the Knowledge representation and Learning course, University of Padova, Italy

2022 Weighted First-Order Model Counting
DocInProgress Colloquium, Department of Mathematics, University of Trento, Italy

2022 Weighted First-Order Model Counting
AAAI 2022@FBK Workshop, Trento, Italy (Video)

Selected Reviewing and PC Experience

Session Chair at ECML 2024 and KR 2024
PC Member for AAAI 23-25, KR 23-25, ECAI-25 and IJCAI 24-25
Reviewer for ICML 24-25, ICLR 24-25, NeurIPS 23-25, AISTATS 23-25, ICALP 2025
Reviewer for Q1 AI/ML journals like DAMI and AIJ

Student Supervision

Master's thesis supervision

2025-Now Michael Pritz, TU Wien, Austria
Title: Towards Enforcing Behaviors within Transformers using Differentiable Constraints

2025 Peter Blohm, TU Wien, Austria
Title: Probabilistic Verification of Black-Box Systems

2023 Davide Bizzaro, University of Padova, Italy
Title: Lifted Inference Beyond First Order Logic

Other Student Supervision Roles

2024 Florian Chen, TU Wien, Austria
Role: Co-supervised in a bachelor student internship, leading to an ECML-PKDD publication

2024 Alexander Pluska, TU Wien, Austria
Role: Supervised in a graduate course, leading to a conference publication at KR 2024

2023-Now Supervised multiple (10+) Bachelor's, Master's and PhD students in seminar courses.

Teaching Experience

2025W **Neurosymbolic Reasoning (VU, 6 ECTS, MSc. and Ph.D., TU Wien)**
Experience. Designing a new 6 ECTS course with Prof. Thomas Eiter for the Master's in Logic and AI at TU Wien. The course is a significant extension of my previous 3ECTS course on "Modern Applications of Logic in Machine Learning" (designed and taught as a solo-instructor). The course will introduce students to fundamentals of Neurosymbolic AI and its applications, especially for developing safe and explainable AI.

2025S **Modern Applications of Logic in Machine Learning (VU, 3 ECTS, MSc. and Ph.D., TU Wien)**
Experience: Responsible for creating and teaching the entire course as a **solo instructor**. Created a new curriculum for graduates students interested in recent developments on the intersection of logic and machine learning. The course consists of five inter-dependent sections: Statistical relational learning, Algorithms (model counting and MaxSAT), Neuro-symbolic AI, logical expressivity of ML models and Explainable AI. **The course was well attended, with all 15 of the 15 offered places taken-up by the students. The course evaluation also showed positive results.**

2023 - Now **Introduction to Machine Learning (VU, 6 ECTS, B.Sc. ∼100 Students, TU Wien)**
Experience: Part of the team that designed the first edition of the course, responsible for creating and teaching the module on Probabilistic ML. I also taught the lectures for Probabilistic Machine Learning and was responsible for the office hours for various modules of the course. I developed automatically graded python based exercises that gave students hands-on experience. Also wrote a large question bank for the theoretical exam.

2023 - Now **Theoretical Foundations and Research Topics in Machine Learning (VU, 3 ECTS, M.Sc. and Ph.D., TU Wien)**
Experience: Responsible for conducting interactive active-learning based coursework and exercise sessions involving concepts from ML, like PAC learning, Kernel methods and GNNs.

2023 - Now **Machine Learning Algorithms and Applications (PR, 3 ECTS, M.Sc. and Ph.D., TU Wien)**
Experience: This is a project based course organized by the Machine Learning Research Unit. I have consistently offered new projects in this course. One of the offered projects led to a publication with a student, Alexander Pluska, at the *International Conference on Principles of Knowledge Representation and Reasoning 2024*.

2023 - Now **Scientific Research and Writing (SE, 3 ECTS, B.Sc., TU Wien)**
Experience: This course is part of the TU Wien scientific writing course. For the practical part of the course, our research unit offers many research topics to students to write a report. I organize a mock-conference and peer-review procedure for reviewing the reports of the participating students.

2025W-Now **Teaching Co-ordinator for Machine Learning Research Unit, TU Wien**
Experience: Responsible for managing the teaching coordination between the Machine Learning Research Unit and the deans of education at TU Wien. Learning to navigate administrative aspects of organizing teaching hours for the research unit.

References

Prof. Thomas Gärtner
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Prof. Luciano Serafini
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Email: serafini@fbk.eu

Prof. Andrea Passerini
Structured Machine Learning Group
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