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 (Technical University of Vienna), 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**
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 Artificial Intelligence – with provable mathematical guarantees. My interests and expertise have allowed me to work on: tractability of learning and reasoning over relational data; logical expressivity based explainability methods; and quantitative verification of machine learning algorithms.

Awards and Funding

- **Honorable Mention Award** at KR Conference 2024
- **Best Paper Award** at NeSy Conference 2024
- Project titled "Logical Distillation of Machine Learning Models" among 21/84 funding applications invited to the long proposal phase for WWTF ICT funding (Under Review, Role: Principal Investigator, Funding requested: 793,884.00 €)
- 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 team: 215,492 €)

Peer-reviewed Publications[*]

2025 Peter Blohm, Patrick Indri, Thomas Gärtner, **Sagar Malhotra**
Probably Approximately Global Robustness Certification
Accepted for publication at the International Conference of Machine Learning 2025.
Preprint, To appear in 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
[†]Equal Contribution. Accepted for publication at the International Conference of Machine Learning 2025. Arxiv, To appear in ICML 2025 (CORE Rank **A***, **26.9**% acceptance rate)

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

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
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
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**)

[*]Supervised student coauthors are underlined.

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* (Lightweight peer-review)

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

2020 **Sagar Malhotra** and Luciano Serafini. Weighted Model Counting in C^2 (Abstract)
Workshop on Machine Learning and Data Mining, AIxIA 2020
MLDM 2020

Preprints*

2024 Davide Bizzaro, Luciano Serafini and **Sagar Malhotra**
Towards Counting Markov Equivalence Classes with Logical Constraints
Arxiv

*Supervised students coauthors are underlined

Talks and Tutorials

2024 Fundamental Problems in Statistical Relational AI
Tutorial at 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

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

Master's Student Supervision

2025- Michael Pritz, TU Wien, Austria
Thesis title (tentative): Mechanistic Interpretability of Transformers

2024 Peter Blohm, TU Wien, Austria
Thesis title (tentative): Practical PAC-Verification with Signal Temporal Logic

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

Other Student Supervision Roles

2024 Florian Chen, TU Wien, Austria
(Co-supervised in a student internship,
leading to a conference publication at ECML PKDD 2024)

2024 Alexander Pluska, TU Wien, Austria
(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

2025S **Modern Applications of Logic in Machine Learning** (M.Sc. and Ph.D.)
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 inter-dependent sections:

- **Statistical relational learning**: models that integrate logic, probability and learning e.g., Markov logic, Problog etc.
- **Algorithms**: ML relevant algorithmic problems in logic such as weighted model counting and MaxSAT
- **Neuro-symbolic integration:** models that integrate reasoning and learning in neural networks
- **Explainability:** Logic based formal explainability methods like prime-implicant explanations.
- **Theoretical Foundations:** role of logic in learning theory and expressivity analysis of ML models like graph neural networks and transformers.

2023 - Now **Introduction to Machine Learning** (B.Sc. $\sim$100 Students)
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 **Machine Learning Algorithms and Applications** (M.Sc. and Ph.D.)
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 **Theoretical Foundations and Research Topics in Machine Learning** (M.Sc. and Ph.D.)
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 **Scientific Research and Writing** (B.Sc.)
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.