

Samy Badreddine

RESEARCH SCIENTIST · PHD

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Summary

Machine learning researcher and engineer with a background in neurosymbolic methods, probabilistic inference, and applied mathematics. I work on making probabilistic reasoning scalable and expressive with applications in scientific discovery and knowledge graphs. I particularly enjoy turning these ideas into easy-to-use software libraries.

Education

University of Trento

Hybrid

PHD IN NEUROSYMBOLIC AI AND PROBABILISTIC MACHINE LEARNING

Nov. 2023 - Oct. 2026

- Thesis: *Unifying and Scaling Neurosymbolic AI*, (i) unified language/library for cross-framework training and evaluation, (ii) scalable probabilistic reasoning via knowledge compilation and approximation, (iii) expressiveness analysis on large-scale tasks.
- Supervisors: Luciano Serafini (FBK), Emile van Krieken (VU Amsterdam), Michael Spranger (Sony AI)

University of Edinburgh

Edinburgh, UK

VISITING RESEARCHER

Summer 2025

- Host: Antonio Vergari. Approximate knowledge compilation for weighted model counting (weighted #SAT) in probabilistic neurosymbolic systems, via circuits and tensor-train decompositions.

Ecole polytechnique de Bruxelles (ULB)

Brussels, Belgium

MASTER IN COMPUTER SCIENCE AND ENGINEERING (AI SPECIALIZATION)

Sep. 2017 - Jun. 2019

Ecole polytechnique de Bruxelles (ULB)

Brussels, Belgium

BACHELOR IN CIVIL ENGINEERING

Sep. 2014 - Jun. 2017

Research in Industry

Sony AI

Barcelona

RESEARCH SCIENTIST

Oct. 2023 - Present

- Lead research on scaling probabilistic reasoning and knowledge compilation with approximation guarantees, with applications to knowledge graph reasoning (complex query answering).
- Improve the expressivity and performance of embedding-based link predictors at large scale (ICML 2026).
- Design an open-source unified language and library (ULLER) standardizing training and evaluation across neurosymbolic frameworks (oral + tutorial, NeSy 2024).
- Mentor three research interns whose projects produced a peer-reviewed publication and features shipped to product applications.

Sony AI

Tokyo

AI ENGINEER

May 2020 - Sep. 2023

- Led research on Logic Tensor Networks, which relax constraints to differentiable logics used as inductive bias in learning.
- Co-led a project on biomedical hypothesis generation via link prediction over temporal knowledge graphs (US patent filed).
- Delivered a recommender system end-to-end from research prototype to a deployed app tested by professional users (chefs).
- Mentored three research interns whose projects produced three peer-reviewed publications.

Sony Computer Science Laboratories

Tokyo

MACHINE LEARNING RESEARCH INTERN

Summer 2018 and 2019

- Conducted research in Transfer Learning in Reinforcement Learning (RL) and Semantic Image Interpretation with a focus on neurosymbolic AI under the mentorship of Dr. Michael Spranger.

Selected Publications

JOURNALS

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| 2022 | Logic Tensor Networks , S. Badreddine, A.A. Garcez, L. Serafini, M. Spranger, <i>Artificial Intelligence</i> . Featured in press (<i>Nature news</i>). |
| 2023 | Link prediction for hypothesis generation , U. Akujuobi, P. Kumari, J. Choi, S. Badreddine, K. Maruyama, S. K. Palaniappan, T. R. Besold, <i>Artificial Intelligence Review</i> . |

CONFERENCES AND WORKSHOPS

- 2026 **On the Theoretical Limitations of Embedding-based Link Prediction**, S. Badreddine, E. van Krieken, L. Serafini, *ICML'26 (International Conference on Machine Learning)*
- 2026 **Where to Approximate in Neurosymbolic Inference?**, S. Badreddine, E. van Krieken, L. Serafini, A. Vergari, *Spotlight at ICML'26 CoLoRAI workshop (Connecting Low-rank Representations in AI)*. *Under review at a conference.*
- 2025 **Rewarding explainability in drug repurposing with knowledge graphs**, S. Nunes, S. Badreddine, C. Pesquita, *IJCAI'25 (International Joint Conference on Artificial Intelligence)*
- 2024 **ULLER: A Unified Language for Learning and Reasoning**, E. van Krieken*, S. Badreddine*, R. Manhaeve, E. Giunchiglia, *Oral and tutorial at NeSy'24 (International Conference on Neural-Symbolic Learning and Reasoning)*
- 2023 **What's Wrong with Gradient-based Complex Query Answering?**, O. El Harzli, S. Badreddine, T. R. Besold, *Oral at NeSy'23 – Best Paper Award*
- 2019 **Injecting Prior Knowledge for Transfer Learning into Reinforcement Learning using Logic Tensor Networks**, S. Badreddine, M. Spranger, *Oral at NeSy'19*

PATENTS

- 2025 **Method, apparatus, and computer-readable medium for generating a hypothesis from a knowledge graph**, T. R. Besold, U. Akujobi, S. Badreddine, J. Choi, K. Nishikawa, et al., *US Patent Application 18/664,454*

Skills

- Programming** Python (PyTorch, TensorFlow; einsum/einops), Modern C++, C
- ML** Neurosymbolic AI, Probabilistic ML, (Probabilistic) Reasoning, Tensor Networks, Reinforcement Learning, Knowledge Graphs
- Languages** French (native), English (full professional), Japanese & Dutch (limited working)