NALOMA 2025

The 5th Workshop on

Natural Logic Meets Machine Learning
(NALOMA)

Proceedings of the Workshop

August 4 - 8, 2025
Bochum, Germany

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Introduction

Welcome to the 5th edition of the Natural Logic Meets MAchine Learning workshop (NALOMA).

NALOMA continues to serve as a venue dedicated to bridging the gap between machine/deep learning approaches on the one hand, and symbolic/logic-based approaches to natural language understanding and reasoning on the other. A central focus of the workshop remains the development of hybrid approaches and the exploration of theoretical insights that shape and guide computational models of reasoning.

NALOMA took place in August 4-8 during ESSLLI 2025, hosted at Ruhr University Bochum, Germany. We are deeply grateful to the ESSLLI organizers for their support. The workshop was held over a period of five days, with time slots of about one and a half hours. This year's program featured three inspiring keynotes, five regular talks with accompanying archival papers included in this proceedings, and three contributed talks based on non-archival submissions.

We would like to thank all authors of archival or non-archival submissions, as well as the dedicated members of the program committee whose careful reviews ensured the quality of the workshop. Our thanks also go to our keynote speakers for sharing their expertise and vision.

As in prior years, NALOMA serves as a platform connecting the symbolic AI and logic communities with the machine learning community, with the dual purpose of promoting discussion and fostering joint research initiatives. We look forward to the collaborations and insights that will arise from this year's event.

NALOMA is endorsed by the Special Interest Group on Computational Semantics (SIGSEM), for which we are grateful.

Lasha Abzianidze and Valeria de Paiva, Program Co-Chairs

Organization

Program Co-Chairs

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Keynote Talk
Understanding Complex Situation Descriptions

Aaron Steven White
University of Rochester

Abstract: We use natural language to convey information about situations: things that happen or stuff that is true. This ability is supported by systematic relationships between the way we conceptualize situations and the way we describe them. These systematic relationships in turn underwrite inferences that go beyond what one strictly says in describing a situation. The question that motivates this talk is how to design systems that correctly capture the inferences we draw about situations on the basis of their descriptions.

Classical approaches to this question-exemplified in their modern form by graph-based representations, such Uniform Meaning Representation-attempt to capture the situation conceptualization associated with a description using a symbolic situation ontology and to draw inferences on the basis of rules stated over that ontology. An increasingly popular alternative to such ontology-factored approaches are ontology-free approaches, which attempt to directly represent inferences about a situation as natural language strings associated with a situation description, thereby bypassing the problem of engineering a situation ontology entirely.

I discuss the benefits and drawbacks of these two approaches and present case studies in synthesizing them that focus specifically on how best to capture inferences about complex situations-i.e. situations, like building a house, that themselves may be composed of subsituations, like laying the house's foundations, framing the house, etc. I argue that we should ultimately strive for ontology-free representations but that the challenges inherent to reasoning about complex situations highlight the persistent benefits of situation ontologies in providing representational scaffolding for the construction and evaluation of such representations.

Bio: Aaron Steven White is an Associate Professor of Linguistics at the University of Rochester, with a secondary appointment in Computer Science and an affiliation with the Goergen Institute for Data Science. He directs both the Center for Language Sciences and the FACTS.lab (Formal and Computational Semantics Lab) at the University of Rochester. His research focuses on the development of large-scale, theoretically informed semantic annotation frameworks and natural language understanding systems.

Keynote Talk
How Can Large Language Model Become More Human?

Mehrnoosh Sadrzadeh
University College London

Abstract: Psycholinguistic experiments reveal that efficiency of human language use is founded on predictions at both syntactic and lexical levels. Previous models of human prediction exploiting LLMs have used an information theoretic measure called surprisal, with success on naturalistic text in a wide variety of languages, but under-performance on challenging text such as garden path sentences. This paper introduces a novel framework that combines the lexical predictions of an LLM with the syntactic structures provided by a dependency parser. The framework gives rise to an Incompatibility Fraction. When tested on two garden path datasets, it correlated well with human reading times, distinguished between easy and hard garden path, and outperformed surprisal.

Bio: Mehrnoosh is a professor of Computer Science at University College London. She holds a Royal Academy of Engineering Research Chair and leads a lab on mathematical and quantum methods in AI. Her research mainly focuses on studying logical and mathematical models of natural language, in particular, uisng algebraic grammars for syntax modeling and tensor spaces for semantics, often these methoids incorporating machine learning and quantum methods.

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Keynote Talk

Understanding the Logic of Generative AI through Logic

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Kyle Richardson
Allen Institute for AI

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Abstract: Symbolic logic has long served as the de-facto language for expressing complex knowledge throughout computer science, owing to its clean semantics. Symbolic approaches to reasoning that are driven by declarative knowledge, in sharp contrast to purely machine learning-based approaches, have the advantage of allowing us to reason transparently about the behavior and correctness of the resulting systems. In this talk, we focus on the broad question: Can the declarative approach be leveraged to better understand and formally specify algorithms for large language models (LLMs)? We focus on formalizing recent direct preference alignment (DPA) loss functions, such as DPO, that are currently at the forefront of LLM alignment. Specifically, we ask: Given an existing DPA loss, can we systematically derive a symbolic expression that characterizes its semantics? We outline the details of a novel formalism we developed for these purposes. We also discuss how this formal view of preference learning sheds new light on both the size and structure of the DPA loss landscape and makes it possible to derive new alignment algorithms from first principles. Our framework and approach aim not only to provide guidance for the AI alignment community, but also to open up new opportunities for researchers in formal semantics to engage more directly with the development and analysis of LLM algorithms.

Bio: Kyle Richardson is a senior research scientist at the Allen Institute for AI (AI2) in Seattle. He works at the intersection of NLP and Machine Learning on the Aristo team, with a particular focus on generative AI and language models. Recently, he has been interested in using formal methods to better understand and specify algorithms for large language models. Prior to AI2 he was at the IMS and the University of Stuttgart, where he obtained his PhD in 2018.

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Bill Noble, Rasmus Blanck and Gijs Wijnholds

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17:00 - 17:30   *Implementing a Logical Inference System for Japanese Comparatives*
Yosuke Mikami, Daiki Matsuoka and Hitomi Yanaka

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Mehrnoosh Sadrzadeh

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Kyle Richardson

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Lasha Abzianidze

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