

# Proceedings

IJCAI Workshop

“Interactions between Analogical Reasoning and Machine Learning”

IARML 2023

August 21, 2023

Macau, China

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<http://iarml2023-ijcai.loria.fr/>

## Preface

This volume contains the proceedings of the 2nd edition of the workshop IARML@IJCAI. The first edition took place at IJCAI-ECAI 2022, Vienna, Austria<sup>1</sup> that counted with the participation of several colleagues from Europe, America and Asia. This year we expanded our audience to the 5 continents. As in the 1st edition, we will organize a Springer special volume in *Annals of Mathematics and Artificial Intelligence*.

Analogical reasoning is a remarkable human capability used to solve hard reasoning tasks. It consists in transferring knowledge from a source domain to a different, but somewhat similar, target domain by relying simultaneously on similarities and differences. Analogies have preoccupied humanity at least since antiquity (cf. the works of Aristotle, Theon of Smyrna, among others) and have been in more recent years characterized as being “at the core of cognition” (Hofstadter 2001) showing that they permeate almost every aspect of cognition (Hofstadter and Sanders, 2013). According to Hofstadter and the Fluid Analogies Research Group, analogy making is intimately related with abstraction and the search of a “common essence”, which can lead to deep understanding of any concept or situation.

Analogies have been tackled from various angles. Traditionally, *analogical proportions*, i.e., statements of the form “A is to B as C is to D”, are the basis of analogical inference. They contributed to *case-based reasoning* and to multiple *machine learning* tasks such as classification, decision making and machine translation with competitive results. Also, analogical extrapolation can support dataset augmentation (analogical extension) for model learning, especially in environments with few labeled examples. Other approaches include the *Structure Mapping* approach of Dedre Gentner that is based on logical descriptions (in the form of predicate-argument structures) of two domains: the more relational similarity one has between the two domains, the more analogous they can be considered.

Recent neural techniques, such as representation learning, enabled efficient approaches to detecting and solving analogies in domains where symbolic approaches had shown their limits. Transformer architectures trained using vast amounts of data have given us Large Language Models (LLMs) such as Chat-GPT, seem to exhibit human-like conversational and analogy making capacities (Webb et al. 2022). However, better evaluation metrics are needed in order to measure elusive concepts such as intelligence and understanding (Mitchel 2023). More than ever we need to understand the role that analogies, abstraction and similarities between concepts play in language and cognition.

The purpose of this series of workshops is to bring together AI researchers at the cross roads of machine learning, natural language processing, knowledge representation and reasoning, who are interested in the various applications of analogical reasoning in machine learning or, conversely, of machine learning techniques to improve analogical reasoning.

The contributions to this 2nd edition of IARML@IJCAI focused on the following:

- Machine learning for analogical reasoning: representation learning, Advanced similarity measures, analogical transfer, neuro-symbolic models for analogical inference.
- Analogical reasoning for machine learning: classification using analogical reasoning, case-Based Reasoning, creativity and data augmentation.
- Analogies in Large Language Models (LLMs): probing LLMs for analogies, evaluating capacities of LLMs for analogies, creativity in language through analogies.

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<sup>1</sup><https://iarml2022-ijcai-ecai.loria.fr/>

- Applications: to visual domains, to Natural Language Processing, etc.

The workshop welcomed submissions of research papers on all topics at the intersection of analogical reasoning and machine learning. The submissions were subjected to a strict double-blind reviewing process that resulted in the selection of five original contributions and one invited talk, in addition to the two plenary keynote talks.

**Plenary talks:**

*Accelerating Innovation and Discovery through Analogy Mining* (Dafna Shahaf)

*Similarity measures at the core of analogical transfer and case-based prediction* (Marie-Jeanne Lesot)

**Invited talks:**

*Multimodal Analogical Reasoning over Knowledge Graphs* (Ningyu Zhang, Lei Li, Xiang Chen, Xiaozhuan Liang, Shumin Deng)

IARML@IJCAI'23 takes place on August 21, 2022 in Macau (China), and we are truly thankful to the IJCAI workshop chairs for their help in the organization of this event. We are greatly indebted to the scientific committee for their reviews and suggestions for improving the accepted contributions.

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