Interactions between Analogical Reasoning and Machine Learning (IARML)

IJCAI-ECAI 2022 Workshop

Miguel Couceiro and **Pierre-Alexandre Murena**

Organizers

Miguel Couceiro (miguel.couceiro@loria.fr)

Professor at the **University of Lorraine** (UL), head of the **ORPAILLEUR** team at **LORIA**. Miguel's research interests include Knowledge Discovery & Reasoning, Decision Making, and Fair and Explainable Models.

He is the PI of the ANR AT2TA (2023–2026), member of the H2020 TAILOR project and of the Inria project Lab HyAIAI. He is the local coordinator of the European Erasmus Mundus Master's program LCT (Language and Communication Technologies) and the head of the 2nd year of the NLP Master's program at the University of Lorraine.

Pierre-Alexandre Murena (pierre-alexandre.murena@aalto.fi)

Postdoctoral researcher at **Aalto University**. Pierre-Alexandre's research interests include Human-AI Interaction, Intelligent Tutoring Systems and Knowledge Transfer.

He is the coordinator of the team on multi-agent models at **FCAI** (Finnish Center for Artificial Intelligence).

Analogies & analogical reasoning

Two key cognitive processes: Inference and Creativity

Detecting/mining analogies: Given a, b, c, and d,

- is (a, b, c, d) a valid analogy?

Solving analogies: Given a, b, c

- find x **s.t.** (a, b, c, x) a valid analogy

Reasoning and integrating analogical reasoning:

- Depending on the concrete application and ML&AI task

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Different views on analogies and IARML goals

Axiomatic: As 4-ary relations satisfying certain postulates
Examples: reflexivity, (certain) permutations, etc.

Relational: $R(a, b, c, d) \equiv P(P_1(a, b), P_1(c, d))$, for P, P_1 predicates
Example: $R(wine, France, beer, Germany)$

Functional: $R(a, b, c, d)$ if $b = T(a)$ and $d = T(c)$, for some T
Example: $R(go, went, make, made)$

Model Theoretic: Relying on structural transformations and "rewriting"
Examples: *Structure mapping theory* and *Justifications*

Goals: IARML aims to bridge gaps between these different views, and to operationalize analogical reasoning in order to address and tackle problems in fields pertaining to ML&AI

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Program: Morning sessions

9h00-9h15: Welcome and opening presentation

9h15-10h15: Plenary Talk by **Yves Lepage** (Chair: M. Couceiro)
Analogy on text data

10h15-10h30: Break

10h30-11h00: Masked prompt learning for formal analogies... (L. Wang)

11h00-11h30: Theoretical study of sentence analogies (S. Afantenos)

11h30-12h00: Solving morphological analogies... (E. Marquer)

12h00-13h30: Lunch

Program: Afternoon sessions

13h30-14h00: A Galois framework for ACs (M. Couceiro)

14h00-14h30: Measuring the feasibility of AT (P.-A. Murena)

14h30-15h00: Towards a model of visual reasoning (Cancelled)

15h00-15h30: Break

15h30-16h00: Exploring analogical inference in healthcare (S. Alsaidi)

16h00-16h30: Analogical proportions (Ch. Antic)

16h30-17h00: Break

17h00-18h00: Plenary Talk by **Kenneth Forbus** (Chair: P.-A. Murena)
Analogy as a technology for machine learning

18h00-18h30: Closing discussion

We hope for a productive and enjoyable IARML...

...and let us stay in contact!

News: Elsevier issue in *Annals of Mathematics and Artificial Intelligence*

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