

Analogies: from Theory to Applications (ATA)

AR & CBR Tools for Metric and Representation Learning

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Analogies & analogical reasoning (AR)



3 key cognitive processes: **Abstraction**, **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

Integrating analogical reasoning and transfer

- Depending on the concrete application and ML&AI task

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Different views on AR and ATA 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: $R(\text{wine}, \text{France}, \text{beer}, \text{Germany})$

Functional: $R(a, b, c, d)$ if $b = T(a)$ and $d = T(c)$, for some T

Example: $R(\text{go}, \text{went}, \text{make}, \text{made})$

Model Theoretic: Relying on structural transformations and “rewriting”

Examples: *Structure mapping theory* and *Justifications*

General Goals: ATA seeks to explore both **foundational aspects and applications** of AR in ML & AI, NLP & NLU, KDD & KRR, and real-world applications, **as well as** bridge gaps with other reasoning frameworks, **especially**, CBR

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More precisely...

AR and CBR are closely related and complementary:

AR: leverages analogies to model human cognitive processes and developing computational theories for inference and transfer

CBR: focuses on conception and knowledge engineering issues when implementing machine reasoning

Following the main theme of ICCBR 2023: this 2nd ATA@ICCBR seeks to exploit new computational theories of AR to *help CBR revisit its foundations and to enhance its role in “modern AI”*.

In particular, it aims to address the following challenges:

- how to represent and learn similarity metrics for specific tasks,
- how to represent and learn adaptation knowledge, and
- how to represent and maintain cases.

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Program

11h30-12h: Welcome and opening presentation (M.Couceiro)

12h-13h: Plenary Talk by **David B. Leake** (Chair: M.Couceiro)

Contributed talks (Chair: E.Marquer)

14h-14h30: Embedding-to-embedding method based on autoencoder for solving sentence analogies (W.Mao & Y.Lepage)

14h30-15h: Improving sentence embedding with sentence relationships from word analogies (Q.Zhang & Y.Lepage)

15h-15h30: Resolution of analogies between strings in the case of multiple solutions (X.Deng & Y.Lepage)

After coffee Break: (Chair: F.Badra)

16h-16h30: Less is Better: An Energy-Based Approach to Case Base Competence (E.Marquer, F.Badra, M.-J.Lesot, M.Couceiro & D.Leake)

16h30-17h30: Plenary Talk by **Jean Lieber**

17h30-18h: Closing Discussions

*We hope for a productive and enjoyable ATA@ICCBR...
...and let us stay in contact!*

News: 2nd issue in *Annals of Mathematics and Artificial Intelligence*
(Elsevier)

Please: send us your slides to add to our page

URL: <https://iccbr-ata2023.loria.fr/>

Published Papers: <https://ceur-ws.org/Vol-3438/>

Acknowledgements

ANR-22-CE23-0023: Analogies: from theory to tools and applications (2023-2026), **PI:** M.Couceiro



<https://at2ta.loria.fr/>

ANR-22-CE23-0032: Similarity Measure Learning for Analogical Transfer (2023-2026), **PI:** F.Badra



<https://smelt.irsan.eu/>