Neurosymbolic AI for social cognition

Promotor(s)

Joost Vennekens   ✉ joost.vennekens@vub.be

Variant (can be both)

☑ 24 ECTS (Master Computer Science/Computerwetenschappen)
☐ 15 ECTS (Master Applied Informatics/Toegepaste Informatica)

Specialization

For 24 ECTS variant: ☑ Artificial intelligence   ☐ Data Management and Analytics
                        ☐ Multimedia   ☐ Software Languages and Software Engineering

For 15 ECTS variant: ☐ Artificial intelligence   ☐ Big Data Technology

Research Lab

AI ~~/ WISE / SOFT / ETRO~~

Context

For several decades, the symbolic approach to AI (typically using hand-crafted logical representations of domain knowledge as input for reasoning algorithms) and the subsymbolic approach to AI (typically using black-box Machine Learning algorithms to derive complex numerical models from data) have mostly existed as parallel streams. *Neurosymbolic AI* tries to unify the two approaches by combining Artificial Neural Networks with logic. A neurosymbolic approach may be key to successfully tackling complex tasks, such as *social coginition*. Recent studies have shown that figuring out the emotional content of complex social interactions is still challenging for state-of-the-art deep learning approaches on their own.

Research activities and goals

In his thesis, you will investigate combinations of deep learning and logic-based AI for tackling social cognition. The goal will be to figure out how such a combination compares to a pure deep learning approach:

- Does the addition of explicit symbolic expert knowledge (e.g., information such as "at a wedding, people are typically happy" or "at a funeral, people are typically sad") help to perform social cognition tasks in a better way (e.g., more accurately or with less training data)?

- Does a neurosymbolic model allow to be better explain its conlusions, and can this shed more light on how a pure deep learning model works?

Over the course of this thesis, you will

- Explore the current state-of-the-art in neurosymbolic AI in order to select appropriate approaches.

- Build logical models of relevant domain knowledge.

- Examine and possibly retrain Artificial Neural Networks to interpret image data.

- Build a prototype of a neurosymbolic AI system for social cognition which you experimentally validate.

References and further reading

To learn more about the kind of social cognition task that should be performed, you can look at [3].

To learn more about neurosymbolic approaches, you can look for instance at [2]

[1] Robin Manhaeve, Sebastijan Dumancic, Angelika Kimmig, Thomas Demeester, and Luc De Raedt. Deepproblog: neural probabilistic logic programming. In *Proceedings of the 32nd International Conference on Neural Information Processing Systems*, NIPS'18, page 3753–3763, Red Hook, NY, USA, 2018. Curran Associates Inc.

[2] Laurent Mertens, Elahe' Yargholi, Hans Op de Beeck, Jan Van den Stock, and Joost Vennekens. FindingEmo: An Image Dataset for Emotion Recognition in the Wild. In *Advances in Neural Information Processing Systems 37 (NeurIPS 2024), NeurIPS 2024, Vancouver, Canada, 9/12/2024 - 15/12/2024*, volume 37, pages 4956–4996. Curran Associates, Inc., February 2025.