

SEMINAR ANNOUNCEMENT

Tuesday, 8th October 2024
at 15:00 pm
Room "Sala Seminari" - Abacus Building (U14)

Systematic Reasoning with Epistemic Graph Neural Networks

Speaker
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Abstract: Developing models that can learn to reason is a notoriously challenging problem. In this talk, I will focus on reasoning in relational domains, where the use of Graph Neural Networks (GNNs) seems like a natural choice. However, previous work has shown that regular GNNs lack the ability to systematically generalize from training examples. A common solution relies on neuro-symbolic methods that systematically reason by learning rules, but their scalability is often limited and they tend to make strong assumptions which do not always hold, e.g. that the answer can always be inferred from a single relational path.

To address these concerns, we have recently introduced the Epistemic GNN (EpiGNN), a novel parameter-efficient and scalable GNN architecture with an epistemic inductive bias for systematic reasoning. The key underlying idea is that embeddings are explicitly linked to epistemic states (e.g. sets of possible worlds) and that message passing and pooling operations are designed accordingly. In particular, it turns out that several commonly used pooling operations are fundamentally incompatible with the view of embeddings as epistemic states, and should thus be avoided in architectures that are aimed at learning to reason. However, by carefully choosing the considered GNN architecture, principled reasoning with GNNs appears to be possible. For instance, EpiGNNs achieve state-of-the-art results on various link prediction tasks, including those that require systematic reasoning, and thus provide a more scalable alternative to state-of-the-art neuro-symbolic methods. Moreover, EpiGNNs are capable of learning to reason about disjunctive rules, which is something that is not possible with existing methods.

Bio: Steven Schockaert is a professor at Cardiff University, working at the intersection of Natural Language Understanding and Knowledge Representation and Reasoning. He was the recipient of the ECCAI Doctoral Dissertation Award, the IBM Belgium Prize for Computer Science, and an ACL 2023 outstanding paper award, among others. He is co-editor-in-chief of AI Communications, Program co-chair of COLING 2025, and a fellow of the Alan Turing Institute. He also serves on the editorial board of "Machine Learning" and of "Neurosymbolic Artificial Intelligence".