

Benchmarking Framework for Neuro-Symbolic Ontology Reasoners

As neuro-symbolic systems gain momentum by combining the learning capabilities of neural networks with the expressivity and interpretability of symbolic reasoning, they open up exciting opportunities for intelligent systems that can reason over structured knowledge. However, existing evaluation frameworks are heavily tailored to traditional symbolic systems and fall short in capturing the unique strengths and limitations of hybrid reasoning approaches.

This project aims to design and implement a comprehensive benchmarking framework specifically for neuro-symbolic ontology reasoners, with a focus on core reasoning and querying tasks.

Key Objectives:

- Generate synthetic ontologies suited for both neural and symbolic processing, varying in complexity and noise.
- Design evaluation metrics that assess robustness, generalization, uncertainty handling, and integration quality.
- Build a modular benchmarking tool to run tests, track performance, and create reports.
- Evaluate multiple existing neuro-symbolic systems across diverse conditions.
- Produce reusable benchmarks and guidelines to support future system development.

Relevant Literature and Resources

- Benchmarking neuro-symbolic description logic reasoners: Existing challenges and a way forward, *Neurosymbolic Artificial Intelligence*, 2025:1. [🔗](#)
- Neuro-symbolic RDF and description logic reasoners: The state-of-the-art and challenge. *Frontiers in Artificial Intelligence and Applications*, vol. 369, pp. 29–63, 2023. [🔗](#)
- Neuro-symbolic AI and the semantic web. *Semantic Web Journal*, vol. 15, 1261-1263, 2024. [🔗](#)

This thesis will be supervised by **Prof. Dr. Harald Sack**, Information Service Engineering at Institute AIFB, KIT, in collaboration with FIZ Karlsruhe.

Prerequisites

- Familiarity with ontologies and knowledge graphs
- Basics of machine learning and neural networks
- Collaborative mindset and good communication skills

Contact person(s):

Gunjan Singh
gunjan.singh@fiz-Karlsruhe.de
Ebrahim Norouzi
ebrahim.norouzi@fiz-karlsruhe.de