

Extracting Object-Location Relations from a Knowledge Graph

Cognitive architectures are often modelled after our understanding of human cognition, thus applying well known techniques like Long-Term Memory to artificial intelligence. However, not all aspects of human knowledge have an adequate technical counterpart. The representation and acquisition of commonsense knowledge is still a big challenge, especially in the domain of cognitive robotics for everyday household activities.

One major common sense problem is the relation between objects and their prototypical location in an environment (e.g. milk is *probably* found in the fridge). In recent years, multiple approaches extracted these relations from Semantic Web resources, text corpora or even images. One novel resource is the CommonSense Knowledge Graph (CSKG) [1], which collects common sense knowledge from multiple sources for the application in general AI tasks. However, despite providing a huge potential, this resource is yet to be applied to the cognitive robotics domain.

In this thesis, you develop a method to extract the prototypical location for a given (household) object from the CSKG. To evaluate your approach, you need to find or create a gold standard to compare to. In addition to this gold standard, you should compare your approach to a large language model (LLM) like (Chat-)GPT [2].

No prior knowledge regarding the Semantic Web, Robotics or LLMs is required. You can use the programming language of your choice, but Python is recommended. The thesis can be taken in German or English.

Related literature

- [1] F. Ilievski, P. Szekely, and B. Zhang, 'CSKG: The CommonSense Knowledge Graph', in *The Semantic Web*, vol. 12731, 2021, pp. 680–696. doi: https://doi.org/10.1007/978-3-030-77385-4_41.
- [2] T. Brown et al., 'Language Models are Few-Shot Learners', in *Advances in Neural Information Processing Systems*, 2020, vol. 33, pp. 1877–1901. [Online]. Available: <https://proceedings.neurips.cc/paper/2020/file/1457c0d6bfc4967418bfb8ac142f64a-Paper.pdf>

The Semantic Computing Group researches and develops methods that enable machines to acquire relevant knowledge as well as linguistic capabilities. Using methods from *natural language understanding* and *machine learning*, we are aiming at machines that are capable of knowledge acquisition by reading unstructured textual data. In particular, the group focuses on methods for information extraction, semantic parsing, ontology learning, sentiment analysis, entity linking, as well as question answering.

More information is available at:

<https://uni-bielefeld.de/fakultaeten/technische-fakultaet/arbeitsgruppen/semantic-computing>

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