

# Recreating and Evaluating a Food Cutting Ontology Using OntoGPT

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Cognitive robots are challenged by unknown situations in open worlds. They cannot perform everyday tasks like cutting food or pouring drinks without encountering unknown motions, objects or environments. To mitigate this problem, multiple types of approaches exist: Approaches based on machine learning, based on human-robot interaction or based on knowledge representation. In our work, we focus on knowledge representation to make the necessary knowledge for performing unknown task variations available and actionable.

In our current work, we propose a methodology for creating actionable ontologies [1], in which semantic information about the task at hand and involved objects is connected in a machine-readable way. As a proof-of-concept, we (manually) created an ontology that a robot can use to cut a food object (mainly fruits and vegetables) into a specific shape [2]. We now want to investigate, how different other ways of creating this ontology perform in comparison to our methodology.

In this thesis, you focus on the recently developed OntoGPT framework [3, 4], which uses the LLM ChatGPT for generating and filling the ontology. In general, the user needs to provide an annotated schema to the model before ChatGPT takes over and creates the instantiated ontology. Afterwards, you need to compare the resulting ontology to the manually created ontology regarding their syntactic as well as semantic differences. This includes quantitative metrics as well as evaluating the qualitative performance of a simulated robot.

Prior knowledge about ontologies or (Chat-)GPT in general, as well as experience with Python, is recommended but not necessary. The thesis can be taken in German or English.

## Related literature

- [1] J.-P. Töberg, M. Kümpel, V. Hassouna, M. Beetz, and P. Cimiano, '[UNDER REVIEW] Towards a Knowledge Engineering Methodology for Flexible Robot Manipulation in Everyday Tasks', Extended Semantic Web Conference 2024 (ESWC24), Crete, Greece, 2024.
- [2] <https://food-ninja.github.io/FoodCutting/>
- [3] <https://github.com/monarch-initiative/ontogpt/>
- [4] J. H. Caufield et al., 'Structured prompt interrogation and recursive extraction of semantics (SPIRES): A method for populating knowledge bases using zero-shot learning', 2023, doi: 10.48550/ARXIV.2304.02711.

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: <http://www.sc.cit-ec.uni-bielefeld.de/>

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