Bachelor/Master Thesis Topic

Capturing Uncertainty in Knowledge Modeling

Motivation and Background

Each system operates on some kind of knowledge or data, and makes decisions based on this knowledge. However, there is still a challenge on how to model knowledge accurately. Imagine, for instance, a system that can estimate its environment through sensors. Since even the best sensors suffer from inaccuracy (aleatoric uncertainty), the system's knowledge will never be perfect. Additionally, sensors usually cannot be used continuously, so any knowledge may also become deprecated over time. Uncertainty reduction controllers have been proposed to mitigate this gap between ground truth and knowledge as captured in a system, using the PARLEY framework. However, recent proposal use only a very naïve notion of knowledge modeling, capturing for any data point in the real worl only an estimate, as the most likely correct value. Other approaches to modeling might better capture this gap, for instance using statistical models.

Goals

The goal of this thesis is to identify other models to capture estimates of real-world data and model them as a markov chain. This should extend previous work on uncertainty reduction controllers, using the PARLEY framework. Existing evaluation scripts can be reused for this purpose.

Description of the Task

The specific tasks are:

- Identify other notions of models
- Discuss (dis-)advantages
- Implement them in a model and evaluate them regarding the PARLEY framework.

Research Type

Theoretical Aspects:	*****
Industrial Relevance:	*****
Implementation	*****

Prerequisite

The student should be enrolled in the bachelor or master of computer science program, and has completed the required course modules to start a bachelor or master thesis.

Skills required

Programming skills in Python, understanding of, or willingness to learn, the software engineering models (in particular Markov models) and tools (e.g., PARLEY) needed for the project.

Contacts

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References

[1] Carwehl, M. et al.: Formal Synthesis of Uncertainty Reduction Controllers. In: SEAMS'24, ACM.