KI WISSEN
Automotive AI Powered by Knowledge

3.6 Legal Norm Formalization – An Overview

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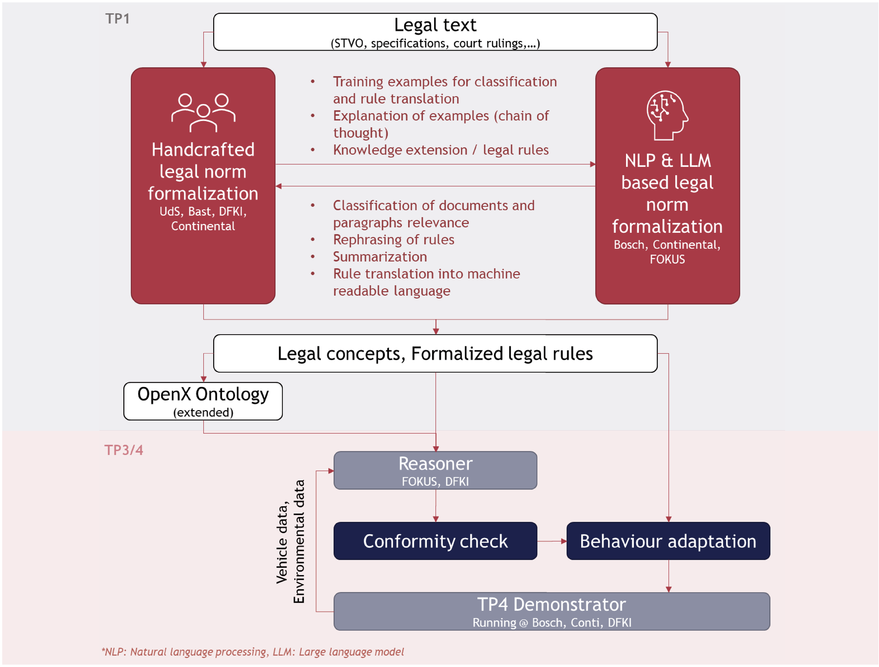

Figure 1: Legal norm formalization approaches and their interaction in KI Wissen (© Robert Bosch GmbH)

Formal Methods and Knowledge Representation

Motivation

Formalized legal rules as modelled domain knowledge helps to design a hybrid AI model in two ways. During interference it allows to check if an AI model is conform to a set of rules. In a training step it allows to adapt the set of training examples or reward functions. In general, project members in KI Wissen followed two different approaches.

Handcrafted Legal Norm Formalization

Legal norm formalization done by experts focused on the formalization of implicit knowledge by extracting additional knowledge (concepts, rules) out of court decisions, legal commentaries and technical specifications.

NLP- and LLM-Based Legal Norm Formalization

LLM-based legal norm formalization was applied in an end-to-end manner where the LLM extracts relevant sections from legal documents to derive rules and translate rules into a machine-readable format, for instance temporal or first-order-logic. In addition, expert knowledge was used to improve the rule translation by adding explanations to training examples in the prompt (via chain-of-thought method).

Collaboration

As shown in Figure 1 both approaches profit from each other and leveraged a collaboration among the partners. Propagating an expert-in-the-loop approach NLP experts and legal experts exchanged results in different stages of the formalization process to obtain more rightful formalized rules in the same amount of time.

Applications

Conformity check: Based on derived concepts and rules the ASAM OpenXOntology was extended and used as input for the symbolic reasoner. The reasoner checked if an automated vehicle was driving conform to a rule set, and if not suggested a conform behavior. In addition, it was investigated to use a LLM as an agent to assist the symbolic reasoner by retrieving the knowledge base and the formalized rules to suggest the next action.

Behavior adaptation: By considering explicit and implicit formalized knowledge, new concrete rules could be added and prioritized. These rules enable the automated vehicle to handle situations more human like (see use case 3 rule exception).

Partners

External partners

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