

Ontology-Driven Interaction with Large Language Models: A Semantic Framework for Structured Context Injection and External Reasoning

Anonymous Author(s)



Figure 1: Seattle Mariners at Spring Training, 2010.

Abstract

We present a framework for integrating ontological knowledge into the decision-making processes of large language models (LLMs) using the Model Context Protocol (MCP) as a structured communication layer. The prototype application service provides an ontology service grounded in the Basic Formal Ontology (BFO), extended through intermediate, application-specific ontologies that define roles, conditions, resources, actions, events, and capabilities. These intermediate ontologies vary according to the guidelines and standardized knowledge available for different domains. In one example, the ProEthica application structures a role-based decision-making environment where agents act under defined constraints and are required to act according to professional standards. The framework includes robust temporal capabilities through enhanced RDF triple structures, enabling the simulation of engineering scenarios where events and decisions are communicated to LLMs in proper temporal order. This temporal modeling allows for causal reasoning about ethical decisions as they unfold through time. In another example, the A-Proxy application applies a distinct ontology to simulate persona-driven Web and chat interactions. In both cases, the ontology service transmits structured context to LLMs and supports external reasoning using ontology-related APIs, allowing results from formal inference processes to be incorporated into the conversational context. This approach enables the integration of

symbolic semantic structures with the behavior of statistical models, providing a method for aligning LLM outputs with formally defined knowledge.

CCS Concepts

- **Information systems** → **Semantic web description languages**;
- **Computing methodologies** → **Knowledge representation and reasoning**; **Natural language processing**.

Keywords

ontology-driven LLMs, Model Context Protocol, semantic web, knowledge representation, external reasoning, ethical decision-making

ACM Reference Format:

Anonymous Author(s). 2018. Ontology-Driven Interaction with Large Language Models: A Semantic Framework for Structured Context Injection and External Reasoning. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation email (Conference acronym 'XX)*. ACM, New York, NY, USA, 2 pages. <https://doi.org/XXXXXXX.XXXXXXX>

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

Conference acronym 'XX, Woodstock, NY

© 2018 Copyright held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-XXXX-X/2018/06

<https://doi.org/XXXXXXX.XXXXXXX>

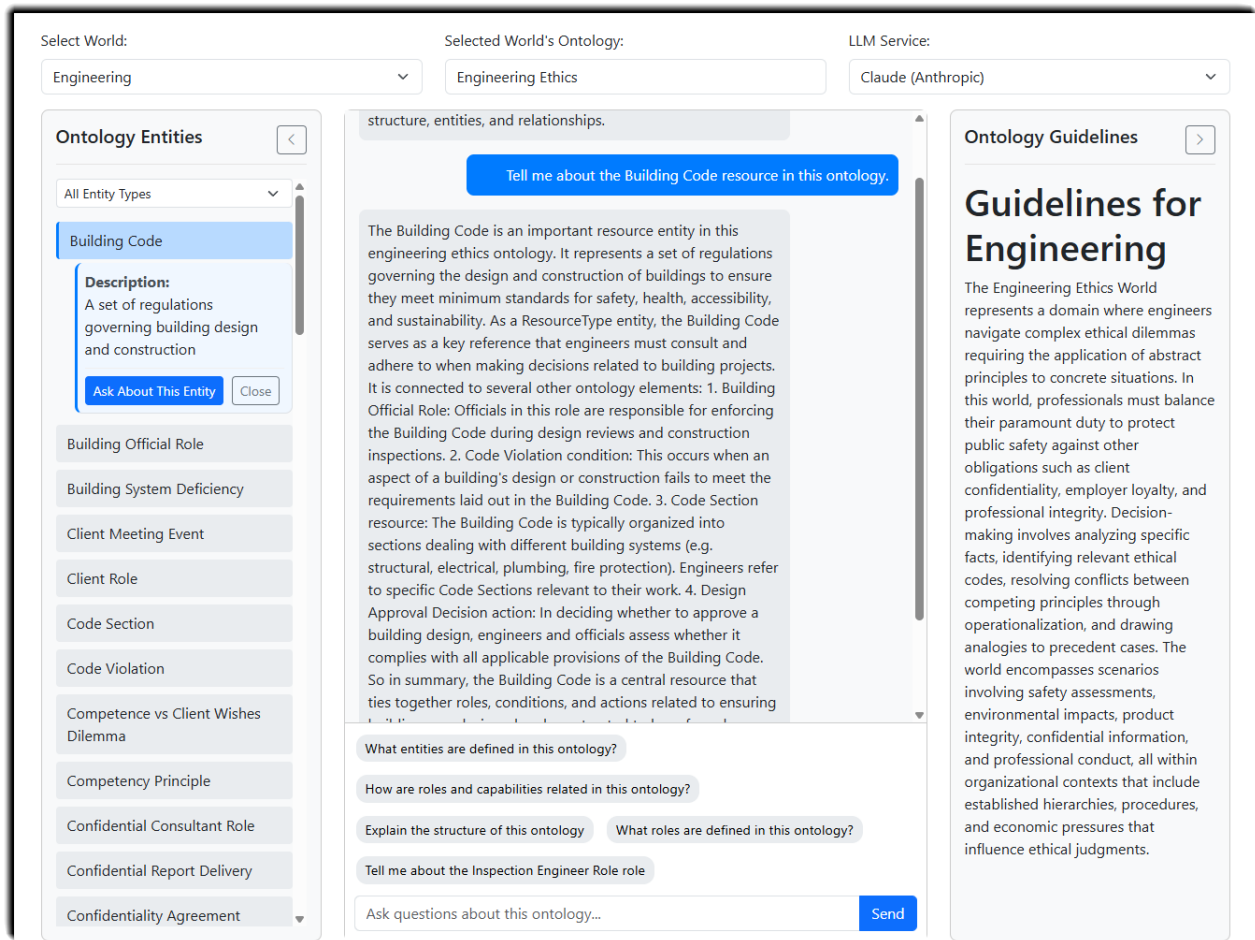


Figure 2: Interactive ontology-driven conversation enabling structured knowledge access through the Model Context Protocol. The interface allows users to explore ontological concepts and relationships while maintaining formal semantic constraints during LLM interactions.