

# Controlled Conversational Models through Conversation-Dedicated Ontology

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## 1. Context

Recent advances in Large Language Models (LLMs) have improved conversational agents' realism and compliance towards human requirements and needs. However, **controlling conversation flow towards positive outcomes remains crucial**.

This Ph.D. aims to **represent conversational knowledge using an ontology to enable language model control**. Ontologies allow to model the knowledge in a domain, defining concepts and characterizing relations between them. While often used for domain-specific knowledge, few have explored using ontologies to guide conversation flow. Convology is a recent example focusing on managing health conversations. We plan to extend Convology's conceptualization capacities to a more general setup, therefore adaptable to general-purpose user/agent conversations.

## Want to know more?



An example: OntoGPT for Readability Level Assessment (seminar slides)

## 2. Methodology

**PhD approach.** Iterative process by progressive enrichment of the ontology to conceptualize more and more notions related to conversations.

**Tools.** Protégé, HermiT and Pellet reasoners, owlready2, rdflib, PyTorch, huggingface transformers and parameter-efficient fine-tuning libraries, LoRA adapters.

**Conceptualization.** Progressively incorporate and infer on linguistic features such as part-of-speech tags, affective computing such as emotions or dialog acts.

**Experimental setup.** Toy example design process is a trial and error approach?

**Control.** Explain how we plan to control the conversational dynamic in the context of a dialogue user-agent.

**Challenges.** It is not straightforward that the knowledge the ontology brings can be accurately learnt and applied by a language model, whether it be decoder-only or encoder-decoder.

## 3. Motivation & Objectives

The objective of this thesis is to develop **knowledge-enhanced conversational models** that exploit Large Language Models (LLMs) and Ontologies. This consists in improving state-of-the-art LLMs by providing **structured knowledge** to open-domain conversational agents.

### Objectives:

- Build a conversation ontology that accounts for interpersonal relationships concepts and their evolution.
- Integrate and assess ontology understanding during fine-tuning.
- Bring control on conversational LLM outputs through encapsulated conversation knowledge.

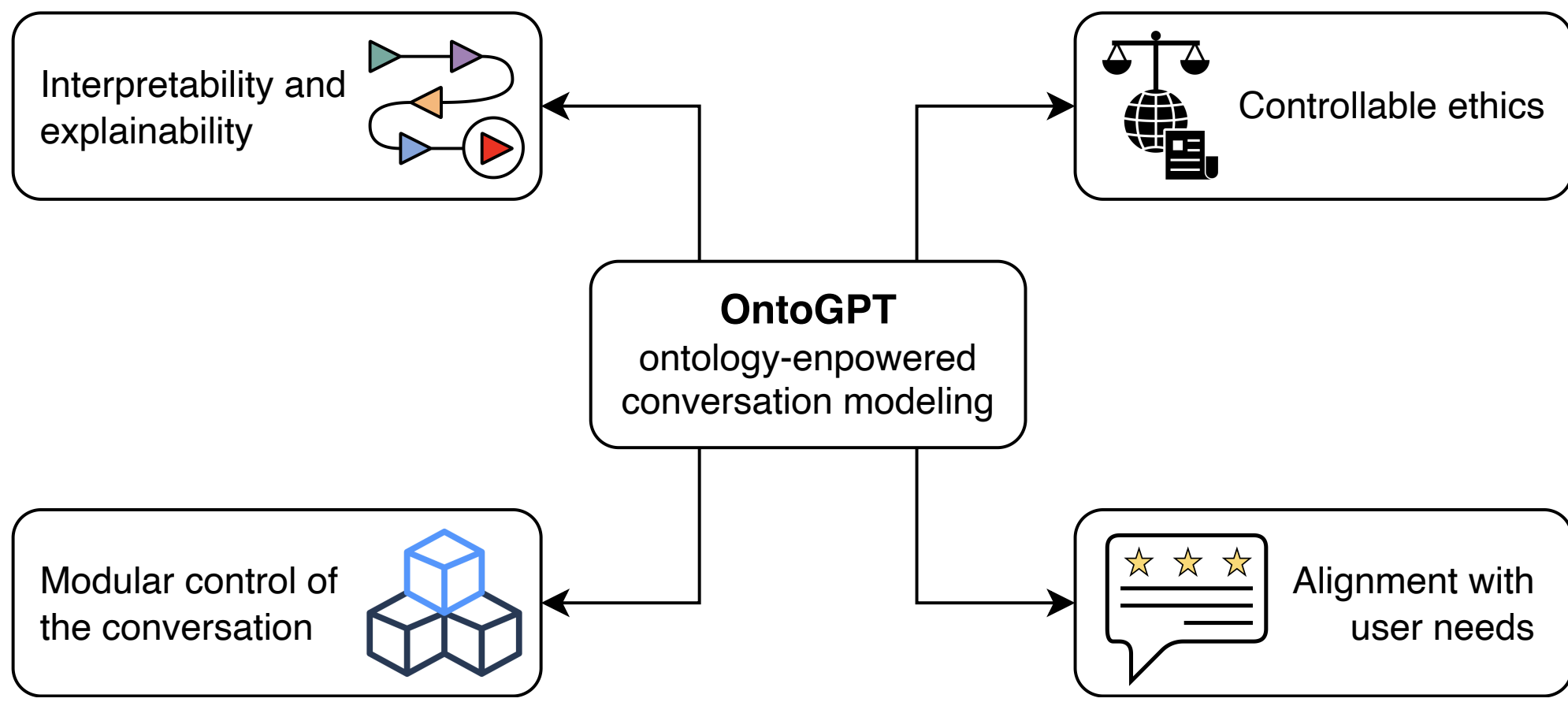


Figure 1: The benefits of ontology-LLM hybridation systems for conversation modeling

## 4. OntoGPT: LLM Fine-Tuning Based on Ontology Validation

**OntoGPT** fine-tunes LLMs using LoRA adapters. It aims at improving generation by learning a classification task guided by the ontology knowledge.

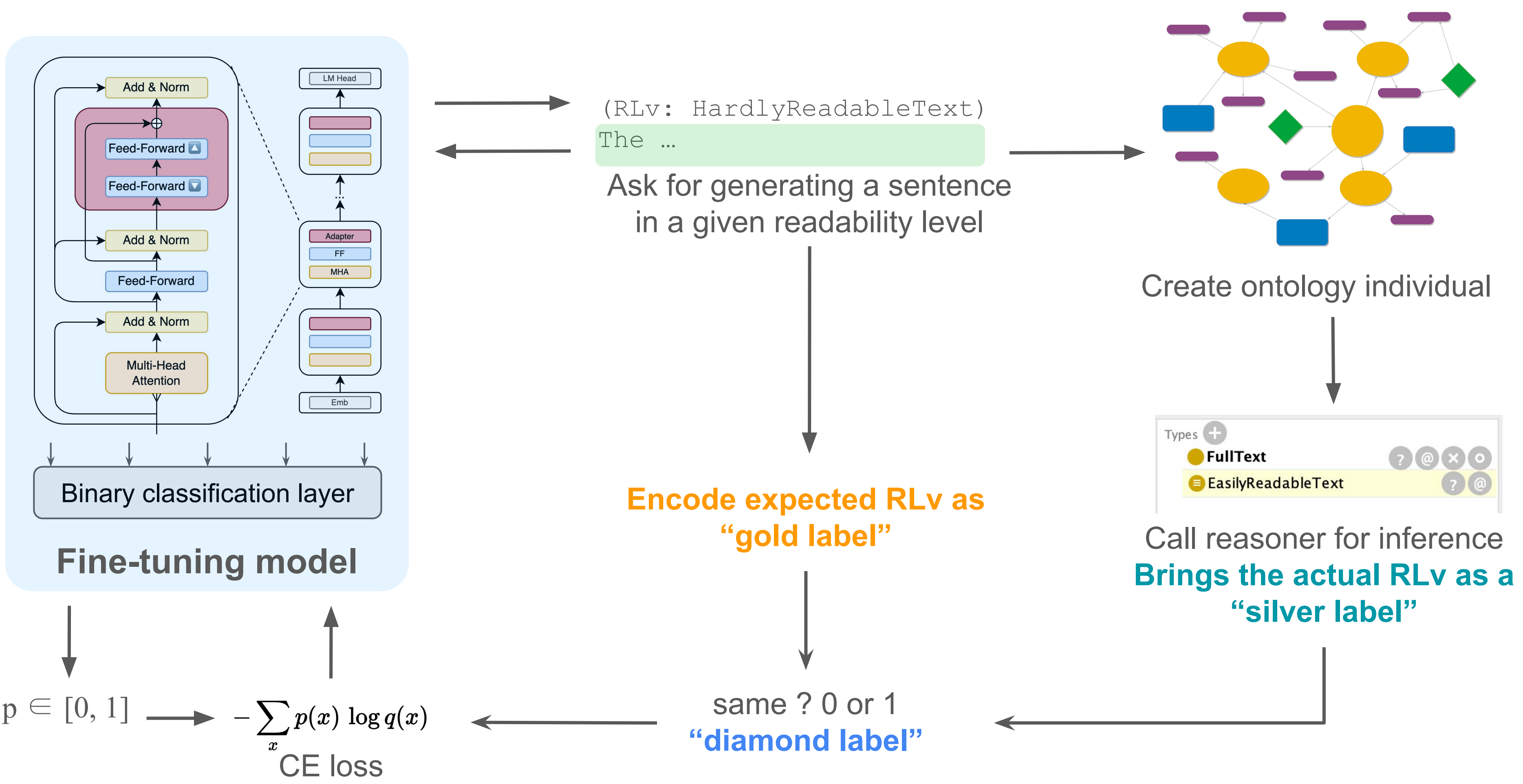
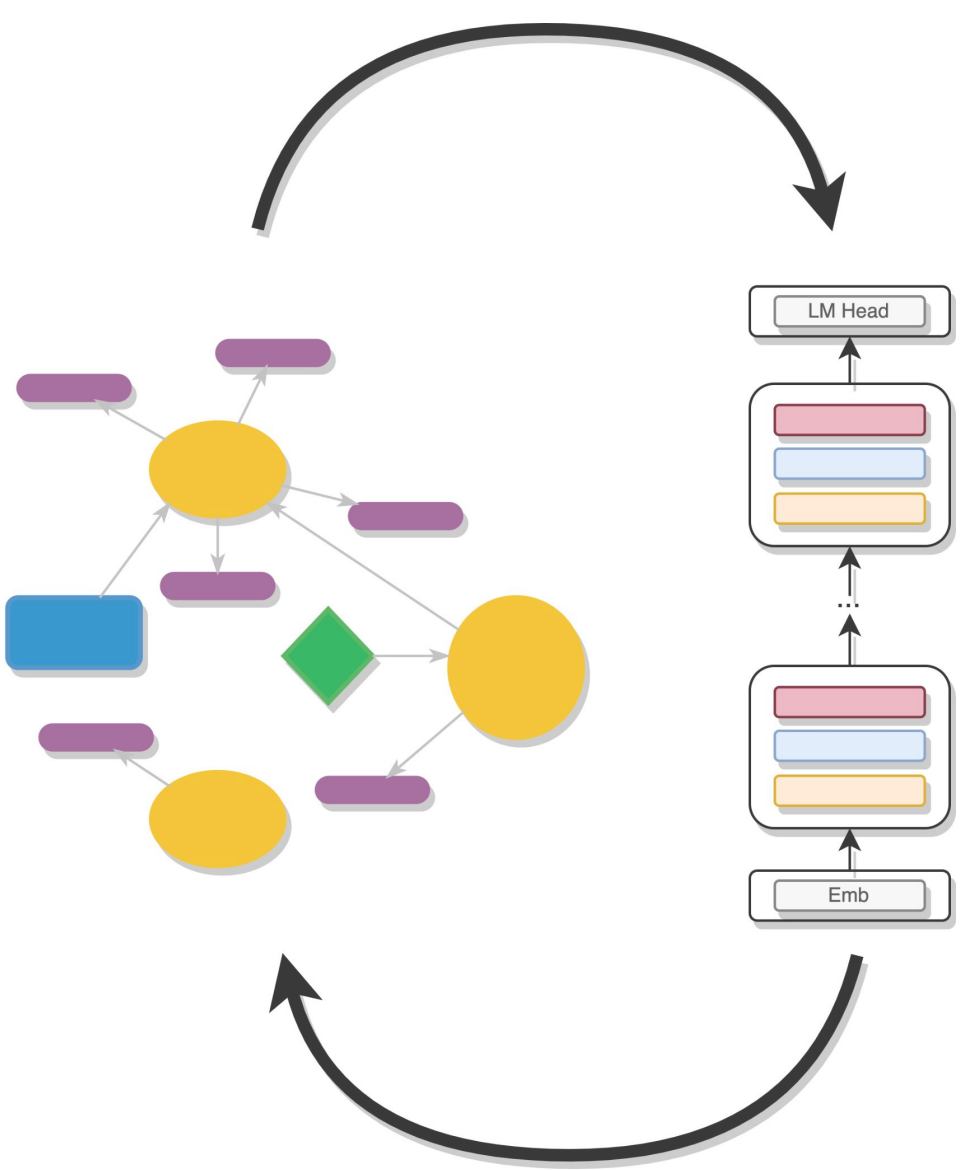


Figure 2: OntoGPT is an end-to-end integration pipeline where the ontology information is assimilated at fine-tuning time. This example focuses on readability level assessment task.

## 5. Advances & Perspectives

Advances in ontology building:

- Advance 1
- Advance 2



Key findings in LLMs:

- Challenges to setup the fine-tuning procedure
- Computational time