Universidade do Minho
Escola de Engenharia

Pedido de Admissão à Dissertação/Projeto

Plano de Trabalho

Ano Letivo: 2025/2026	**Nome:** Marta Sofia Matos Castela Queirós Gonçalves **Número:** PG55983 **Título**: Como adicionar uma dimensão temporal numa ontologia **Título**: How to add a temporal dimension to an ontology

Enquadramento e Motivação

OWL [1] ontologies are widely used to represent structured knowledge across domains as diverse as history, law and medicine. However, their nature is fundamentally static: classes and relations are assumed to hold indefinitely, as OWL lacks native mechanisms for handling temporal change.

In dynamic domains such as medical records, legislation or historical narratives, this absence of a temporal dimension represents a limit for reasoning capabilities, preventing the formulation of temporally grounded queries, for instance:

- Which laws were in force in 2010?
- Who was the King of Portugal on a specific date?
- Which patient showed clinical progress between two periods?

Addressing this limitation requires extending ontological models with explicit temporal semantics, allowing knowledge to reflect not only what is true, but when it is true.

Objetivos e Resultados Esperados

The main objective of this research is to investigate and propose approaches for incorporating and exploring temporal information in OWL ontologies.

To achieve this, the study will:

1. Examine existing temporal modeling patterns in OWL, such as W3C Time Ontology [2].
2. Implement and compare different approaches, including whether time should be modeled as an explicit entity (reification of time periods) or through direct annotation using date properties.
3. Build a temporal ontology applied to the historical domain of Portuguese royalty, covering dynasties, reigns, births, deaths, and successions.
4. Define temporal queries and rules to verify data consistency and answer questions.
5. Evaluate the implemented approaches for ontologies with different sizes, in terms of result correctness, query complexity, performance (response time and memory usage) and the ability to detect inconsistencies.

The expected results include a historical temporal ontology of Portuguese royalty, which will be used as the study case, accompanied by a set of SPARQL [3] queries and rules for temporal exploration. The study will also provide a comparative analysis of different modeling approaches and suggest best practices for designing temporal ontologies.

Beyond this study case, the research aims to contribute to the understanding of temporality in OWL ontologies and to develop a methodology that can be applied to other time-dependent domains, including medicine and law.

Calendarização

To achieve the objective set, the following methodology will be followed:

1. Conduction of a broader bibliographic research to deeply understand temporal ontologies, W3C Time Ontology, temporal reasoning in OWL, SWRL[4], and SPARQL, as well as other related works.
2. Construction of a dataset on Portuguese royalty and two versions of the ontology which will reflect the approaches under comparison.
3. Formulation of temporal rules to ensure consistency, as well as temporal queries.
4. Definition of a set of test queries (the gold standard) which will measure result accuracy and completeness, query execution time across datasets of different sizes, and the number and types of detected inconsistencies.
5. Analysis of results, identification of each approach's strengths and limitations and formulation of recommendations for other domains requiring temporal reasoning.
6. Development of the Master's dissertation.

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Task 1												
Task 2												
Task 3												
Task 4												
Task 5												
Task 6												

Referências Bibliográficas

[1] W3C OWL Working Group, *OWL — Web Ontology Language*, `https://www.w3.org/OWL/`, 2012.

[2] W3C Spatial Data on the Web Working Group, *Time Ontology in OWL*, `https://www.w3.org/TR/owl-time/`, 2022.

[3] RDF Data Access Working Group, *SPARQL Query Language for RDF*, `https://www.w3.org/TR/rdf-sparql-query/`, 2008.

[4] I. Horrocks, P. F. Patel-Schneider, H. Boley, S. Tabet, B. Grosof, and M. Dean, *SWRL - Semantic Web Rule Language*, `https://www.w3.org/submissions/SWRL/`, 2004.

Assinaturas

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