Neuro-symbolic AI for simplifying legislation using Knowledge Graph and LegalXML

Neuro-symbolic AI is a new trend in which semantic web technologies and non-symbolic AI are mixed to mitigate critical issues such as overfitting and underfitting, lack of context, and poverty of explainability of results. We want to study a new approach that includes neuro-symbolic and symbolic artificial intelligence and the large language model (e.g. Llama) applied in the legislative field. We intend to use, for example, the Knowledge Graph based on RDF information and LegalXML to support RAG. These models will be applied to the legislative legal context, including a series of heterogeneous document types that must first be marked in Akoma Ntoso to exploit the descriptive elements of the legal document and the metadata representing the principles of legal theory.

Particular attention will be paid to two thematic aspects: legislative simplification and explainability of the results.

This last aspect will guide the methodologies for modeling technological solutions in light of the requirements required by the AI Act and in general to guarantee the decision-making autonomy of the legislator or decision making.

In this project we want to integrate the existing state of the art in the AI and Law community with the Neuro-Symbolic approach for creating use-cases:

i)   To apply these technologies to the legislative simplification tasks (e.g., LLM applied the approach to legislative documents including preparatory documentation, the parliamentary documents like the transcripts, committee minutes, and dossier);

ii)   To monitor the Legislative process (e.g., legal drafting, simulation of scenarios for legislative simplification) for detecting anomalies or analyzing the diagnostic;

iii)   To evaluate the effectiveness of the legislation in the light of the policies (e.g., ex-post analysis of the effectiveness of the legislation) using KG;

iv)   To explain the results to the decision-maker using the XAI methodologies following legal-ethics principles and methodologies (e.g., coming from AI Act and GDPR).

We follow the objective of the SLOTS PRIN 2022 project.

The steps of the project are the following:

1. Analysis of the state of the art and integration of different disciplines of literature;
2. Design use-case specifications and selection of the best Neuro-Symbolic approach;
3. Implement some experiments using the parliamentary documents, and legislation;
4. Visualization techniques: comparative and critical analysis.
5. Testing, evaluating and validating the results;
6. Interpret using the legal disciplines methodology;
7. Work with the interdisciplinary group in presence for adopting the *by-design* and *human-in-the-loop* method.

The project has to produce technical reports for the PRIN 2022 (deliverables), coding well documented and stored in gitlab repo of ALMA-AI center, at least one paper for an international conference.