

ALEXChat: a Generative - Symbolic Approach to Legal eXplainability

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Abstract

This paper introduces ALEXChat, a hybrid generative-symbolic chatbot designed to enhance the accessibility and explainability of legal expert systems. It integrates symbolic reasoning with large language models (LLMs) to bridge the gap between complex legal reasoning and user comprehension. ALEXChat combines the extraction of legally relevant facts from scenarios, rule-based prolog reasoning and an argumentation framework for conformity assessment, with the linguistic power of LLMs for accessible user fruition.

CCS Concepts

• **Applied computing** → **Law**; • **Computing methodologies** → **Logic programming and answer set programming**; **Natural language generation**; **Information extraction**.

Keywords

Expert systems, LLMs, Generative-Symbolic AI, Legal AI Chatbot, Access to Justice

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1 Introduction

Expert systems (ES) have seen widespread use in the field of artificial intelligence (AI) in the legal domain, for tasks such as credit approval, insurance policy determination, and public organisational structures (healthcare, welfare, pensions, etc.) [4–6, 11]. Expert systems, despite their technical capabilities, face challenges related to user accessibility, as they are limited by the scope of their user

interfaces and struggle to convey the relationship between facts and legal effects, making it difficult for them to comprehend scenarios outside of the predefined model [9, 10].

Large Language Models (LLMs), thanks to their great linguistic capabilities, have opened new possibilities to bridge the gap between complex legal reasoning and user comprehension [2, 7, 8]. This new approach, which combines symbolic reasoning with generative AI, is defined as a *generative-symbolic hybrid approach*.

Following this line of thought, this paper presents *ALEXChat*¹ (*Accessible Legal EXplanations Chatbot*), a chatbot interface for the CrossJustice expert system. The goal of *ALEXChat* is to enable real-time interaction with the symbolic reasoning of the expert system, allowing users to request clarifications and receive explanations at both the input and output stages, using a natural language chat interface.

2 ALEXChat

CrossJustice² is an online platform designed to enhance the effectiveness and accessibility of rights of suspects and accused persons in the domain of criminal proceedings across the European Union (EU). It focuses on the protection provided by several EU directives. As Directives, the European texts must be implemented by each state, which often leads to discrepancies in their application. This may result in violations of citizen rights, brought about by the varied interpretations by national courts and legislators.

All articles in the Directives and the relevant portions of national transpositions have been represented in Prolog. These rules are derived directly the text of the norms. The knowledge base integrates these rules through an interface which asks the user to describe the scenario, by selecting from a list the applicable facts.

The tool then identifies the differences between EU and national law and highlights those cases in which the departure from the directive entails a violation of it. This conformity assessment is powered by an argumentation framework based on the Arg2P technology [3].

We aim to develop a chatbot to enhance interaction with an existing expert system, which is already operational and functional. Our

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¹ALEXChat is available online at <https://alexchat.streamlit.app/>.

²All documentation regarding the CrossJustice system is publicly available online at <https://legalmachinelab.unibo.it/crossjustice>.

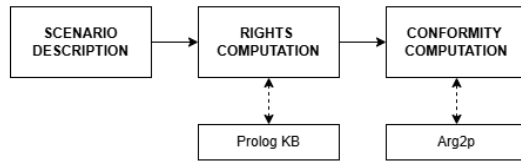


Figure 1: CrossJustic symbolic system.

goal is, first to move the expert system to a LLM environment, beyond the limitations of traditional expert systems in user interaction, making the system more intuitive, accessible, and responsive.

Figure 1 summarizes the main components of the Crossjustice system. To make its computational processes more accessible for natural human interaction – and to support the development of the chatbot – we define three key tasks. The first task focuses on extracting relevant facts from the user’s input in natural language. The second and third tasks aim to translate the formal outputs of the system, both from the Prolog module and the argumentation module, into clear and natural explanations that are easy for users to understand.

We aim to achieve three primary requirements for our chatbot:

- The user must be able to access all the information the system offers within a single instance of the chatbot.
- The system must guide the user through its usage by providing clear instructions on actions to take and information to input.
- The legal information provided to the user must exclusively result from the expert system’s reasoning.

The main challenge in developing such a system lies in the need for constant interaction between the large language model and the symbolic system. Each task, besides being dependent on the results produced by the symbolic system, is closely linked to both the preceding and succeeding tasks.

To this end, we have designed an overarching workflow that the system has to follow in its interaction with the user, essentially reflecting the way the Crossjustice system was designed to be used. The workflow is split into the following phases:

- Scenario Building** phase, where the user may provide the relevant information of their case, for which they seek advice.
- Applicable Rights** phase, where the system showcases the provisions that apply in the specific scenario, according to the European sources.
- Right Explanation** phase, where the user can get an explanation on why a specific norm applies
- Conformity** phase, where the user is informed about the implementation of the retrieved European provision in a specific Member State.
- Scenario Expansion** phase, where the user is informed about additional conditions that may be relevant in their case, in order to have other rights potentially recognised.

Through this approach we can control the behavior of the model and constraint the possible directions that the conversation can take.

To achieve improved performance, we adopted the *Chain of Prompts* methodology [1, 2], separating the instructions for the specific tasks from those related to user interaction. These prompts were

designed independently, with the result being that each task was integrated into the interaction-focused prompt. This separation ensured that the model’s focus during interaction was solely on presenting the results, rather than processing or elaborating them. By employing this approach, we observed a significant reduction in errors made by the model when reporting the outputs of the expert system.

3 Conclusion

This work presents an approach for extending expert systems in the legal domain through the integration of a chatbot, going beyond a simple interface upgrade, as well as merging generative models with symbolic systems. Through what is described as a *generative-symbolic hybrid approach*, which combines the robust and reliable legal reasoning capabilities of a symbolic engine with the natural language generation strengths of an LLM-based architecture, this research addresses key challenges of accessibility and usability in the legal domain.

Our approach demonstrates the potential of AI to bridge the gap between sophisticated legal systems and everyday users. By making expert systems more interactive, transparent, and comprehensible, this research aims to improve access to justice and ensure that legal reasoning is accessible and explainable to a broader audience.

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