LLM-powered HDDL-GUI : A Tool to Understand, Visualize, and Manage Hierarchical Strategies in HDDL Domains

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Abstract

Hierarchical planning with the Hierarchical Domain Definition Language (HDDL) provides a powerful framework for modeling complex tasks through recursive decomposition into subtasks. However, understanding and editing HDDL domains remains difficult, especially for users unfamiliar with its formal structure. To address this, we introduce an LLM-powered HDDL User Interface tool designed to make HDDL domains more accessible, interpretable, and interactive for human users. The tool offers intuitive visualization of HDDL structures and resulting plans, semantic interpretation of domain components, support for converting user inputs into HDDL high-level strategies, and direct manipulation of hierarchical task networks (HTNs). At the core of our approach is the integration of a large language model (LLM), which serves as a bidirectional translator between natural language and HDDL syntax. This enables users to explore, query, and modify hierarchical planning domains through natural language, significantly reducing the barrier to entry and strengthening the role of end-users in the planning process.

Demo Video Link: `link-here`

1 Introduction

Hierarchical Domain Definition Language (HDDL) (Hoefler et al. 2019) is a formal language used in Hierarchical Task Network (HTN) (Erol, Hendler, and Nau 1994) planning to represent complex tasks through recursive decomposition. Its structured format enables rich modeling of real-world planning problems, making it a powerful tool in AI (Ghallab, Nau, and Traverso 2004). While HDDL provides a powerful framework for modeling real-world planning problems, its formal syntax creates significant barriers for domain experts who need to modify planning strategies but lack expertise in hierarchical planning languages.

Consider a logistics coordinator who needs to modify a delivery planning system when new regulations require temperature monitoring for pharmaceutical shipments. Currently, implementing this change requires understanding HDDL syntax, method structures, and hierarchical decomposition principles – expertise that domain specialists typically lack. This forces organizations to rely on planning experts for routine domain modifications, creating bottlenecks and limiting the adaptability of planning systems in dynamic environments.

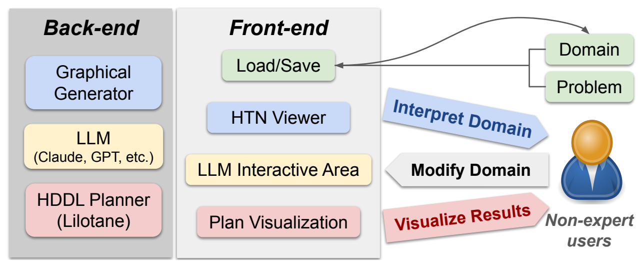

Figure 1: Architecture of LLM-powered HDDL GUI

The challenge becomes even more pronounced as planning systems are increasingly deployed in interactive and user-facing applications (Freedman et al. 2018), where end-users need to incorporate their domain knowledge and preferences directly into planning models (Amershi et al. 2019). The hierarchical structure of HDDL, while expressive, often results in deeply nested and abstract representations that are difficult for non-experts to interpret and modify (Alford et al. 2016). Users struggle to trace how high-level tasks map to low-level actions or to understand the effects of specific constraints within the planning hierarchy. These challenges highlight the need for tools that can simplify the interpretation and management of HDDL domains, especially for non-expert users (Fox and Long 2017).

To address these challenges, we develop an LLM-powered HDDL Graphical User Interface (GUI) that helps users intuitively understand and interact with HDDL domain structures. At the core of HDDL domains are high-level strategies, hierarchical task networks (HTNs), which define how complex tasks are decomposed into simpler actions. The interface visualizes domain components and their relationships through interactive graphs and provides natural language explanations via the embedded LLM. Users can add or remove HTNs using natural language, which the LLM translates into HDDL syntax. Plans are generated using integrated open-source planners and displayed as text or hierarchical diagrams (Magnaguagno 2024), with optional graphical visualization. These features together create an end-to-end environment for human-centric exploration and editing of hierarchical planning models.

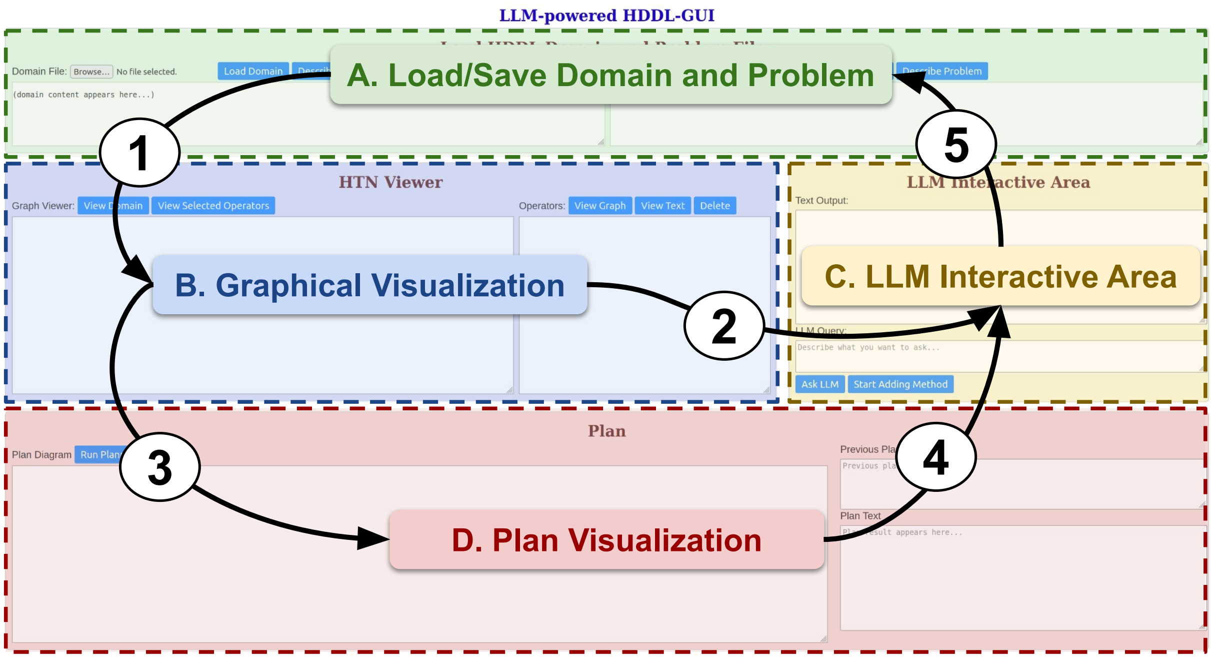

Figure 2: LLM-powered HDDL GUI and Workflow

2 LLM-powered HDDL-GUI

The LLM-powered HDDL-GUI offers three core capabilities: (i) interpreting HDDL domains through natural language explanations and interactive visualizations, (ii) enabling users to modify domain strategies via conversational input, and (iii) generating and visualizing hierarchical plans to reflect the impact of these modifications. To demonstrate the tool, Fig. 1 presents its architecture, showing key components and their relation to these functionalities, while Fig. 2 illustrates the user interface and workflow for effectively using each capability.

Interpret HDDL Domain: The HDDL-GUI integrates with an LLM to assist in interpreting HDDL domains and problems. Its HTN Viewer component visualizes the relationships between operators and the dynamics of each action through interactive graphs. By combining natural language explanations with graphical representations, this LLM-powered interface helps users better understand domain structures and the underlying hierarchical strategies.

Modify Domains: The interface enables users to create new methods by entering natural language descriptions in the LLM Interactive Area (Part C of Fig. 2), which the LLM translates into HDDL-compatible format. As shown in Fig. 2, users can review and modify the domain through three main areas: Area A displays and allows direct editing of the domain text; Area B visualizes operator graphs and supports method removal; and Area C facilitates interaction with the LLM for domain understanding. A reset option is available to revert the domain to its original state.

Run Planner: Our HDDL-GUI currently supports the plan generation using the open-source HDDL planner Lilotane (Schreiber 2021), with plans displayed both as text and as hierarchical diagrams (Magnaguagno 2024). Future versions will include additional options for HDDL planners, such as planners from International Planning Competition (Alford, Behnke, and Schreiber 2024) or others (Hierarchical Task Network Planning Systems 2020), to offer greater flexibility and compatibility across different planning needs.

3 Conclusion

This paper presents an overview of the LLM-powered HDDL User Interface, a tool designed to interpret, visualize, and manage hierarchical strategies within HDDL domains. The demo video will guide users through how the interface can be used to better understand, explore, and interact with HDDL environments. In the future, we plan to enhance the tool with additional features, including support for more HDDL planners, plan comparison capabilities, integration with rendering tools such as PDSim (De Pellegrin and Petrick 2024) for improved visualization, and compatibility with HDDL 2.1 that includes temporal features (Pellier et al. 2023).

Acknowledgments

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