Natural-language Inquiry Dialogue in the Law-Enforcement Domain

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A dialogue system, or conversational agent, is an agent that communicates with another agent. In my dissertation research, I study agents for *inquiry dialogue*, which collaborate with each other or with a human user in order to find evidence for a given claim. As an example, we are currently working on an intake agent that inquires into fraud complaints [1, 10]. The claim under discussion is that the complainant is a victim of online trade fraud.

Agents for inquiry in the legal or law-enforcement domain should *accurately* and *efficiently* find the status of the claim under discussion, responding to *natural language input* by asking *relevant* questions or drawing *explainable* conclusions.

None of the existing methods from conversational AI [3, 5, 6, 13] or formal argumentation dialogue [2, 4, 7] meets all of these requirements. However, they have some interesting properties which can be used in a hybrid system: it is common to use machine learning techniques for *handling natural language*; argumentation techniques can be applied to enable *transparent* and *accurate* decision-making and asking *relevant* questions; reinforcement learning techniques can be used to create an *efficient* dialogue.

In my dissertation research, I explore the possibilities of combining these approaches, answering the main research question: *How can we combine formal argumentation dialogues and machine-learning-based conversational systems into hybrid systems for inquiry dialogue and what are the advantages of these hybrid systems?*

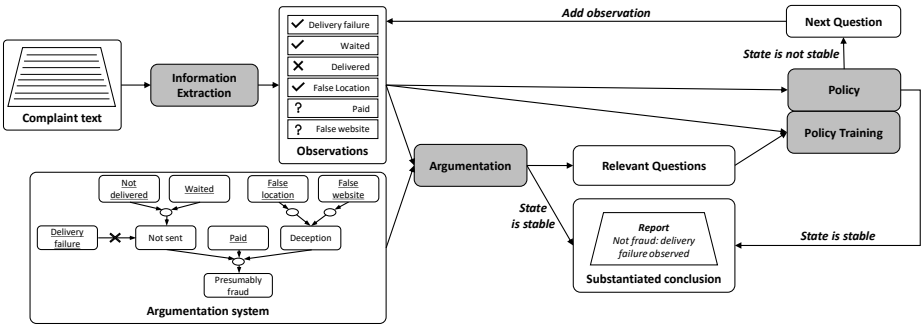

Fig. 1. Overview of the hybrid conversational inquiry agent.

A first hybrid agent architecture for inquiry dialogue was proposed in previous work [10, 11], which is currently being implemented at the Dutch police for the intake of fraud complaints and for cross-border information sharing. The architecture consists of an information extraction, argumentation and policy learning component and is illustrated in Figure 1.

In the **information extraction** component, machine learning techniques are applied to automatically classify observations from the initial free-text user input (*handling natural language*) [9]. The **argumentation** component reasons with these observations, based on its underlying argumentation system [8], which consists of a logical language and a predefined set of rules. Since we assume that the intake agent knows all rules and the user can only contribute knowledge by stating propositions, the agent can infer which observable propositions can still change the acceptability status of the topic [12]. In many cases, there will be multiple of these *relevant* propositions. The **policy learning** component uses reinforcement learning to find the best question to ask for any combination of observations (*efficiency*). When no observable proposition is relevant, the dialogue terminates. The outcome of the dialogue is *accurate*, because of this termination criterion and since the argumentation system is validated by domain experts. Finally, the agent is *transparent* since it is possible to explain for each argument supporting or attacking the topic if it should be accepted.

To conclude, hybrid agents for inquiry are interesting for further investigation. In future research, I will work on optimizing the argumentation and policy component and on comparing hybrid agents to end-to-end systems.

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