Nuance Reasoning Framework

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Abstract. In this paper, we report on an extensible reasoning framework developed at Nuance Communications that allows a variety of specialized reasoners to be used simultaneously. We report on the key design features of our reasoning framework, and provide a real world use case in the automotive domain.

Keywords: reasoning framework, plug-n-play framework

1 Overview

Nuance Communications has developed an extensible reasoning framework that allows a variety of specialized reasoners to be combined and used simultaneously (e.g. specialized domain reasoners or spatial reasoners). This is an important, strategic requirement as numerous industries (ranging from automotive to media) move towards providing intelligent interactions for their users through virtual assistants that can reason about their users' preferences, context, and more to provide personalized and efficient interactions.

Nuance's Reasoning Framework (NRF) achieves this capability through the following design features:

1. A plug-and-play architecture that allows different reasoners and reasoning technologies to be added via a common API. New reasoners need to implement the common interface, but the underlying reasoning technology can be a black box.
2. An arbitration module that determines and selects the appropriate reasoners to invoke based on each reasoner's capability and the user's request, plus context. This module can be extended with custom arbitration strategies as needed.
3. A mediation module that combines the conclusions of the invoked reasoners into a consistent conclusion. Like the arbitration module, this module can also be extended with custom mediation strategies.

NRF is underpinned by several semantic technologies including SPARQL[2] as an interlingua to capture a user's request, RDF[1] to represent user preferences and context, etc.

2 Use Case

We describe one application of NRF in the context of The Dragon Drive Framework: a Nuance product used to build state-of-the-art automotive virtual assistants [1].

Drivers need to focus on the road and their surroundings. Hence, a successful automotive assistant should be able to infer the driver's needs without him/her having to explicitly articulate them, which can be distracting and even dangerous. For example, a driver might say "Find parking near downtown until 5pm". In order to successfully complete this request, the automotive assistant must consider many implicit factors, each requiring specialized reasoning.

Temporal reasoning must be performed to determine parking options that are available upon arrival in downtown until 5pm. Moreover, if contextual information indicates that it's raining outside (via precipitation or windshield wiper sensors), then a specialized parking reasoner is invoked to infer that the driver might prefer covered parking options over street parking because most drivers do not like to get wet.

NRF's plug-and-play architecture allows these specialized reasoners to be utilized simultaneously. NRF's arbitration module would invoke these reasoners over others based on the request and context. Finally, NRF's mediation module would combine these conclusions into a consistent response.

3 Conclusion

In this paper, we presented an extensible reasoning framework developed at Nuance Communications that allows different specialized reasoners to be combined and used simultaneously. This is an important, strategic requirement as numerous industries move towards virtual assistants that can interact intelligently with their users. These interactions require different reasoning capabilities that focus on specialized information ranging from a user's preference to contextual information to provide personalized and accurate outcomes.

References

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[1] https://www.nuance.com/mobile/automotive/dragon-drive.html