Explanation Dialogues in the Service of Durum Wheat Sustainability Improvement

Abdallah Arioua, Patrice Buche, Madalina Croitoru

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Abdallah Arioua[1,2], Patrice Buche[1], Madalina Croitoru[3]

[1] UMR IATE, MONTPELLIER, FRANCE

[2] LIRMM, UM2, MONTPELLIER FRANCE

Résumé : We consider the application setting where a domain-specific knowledge base about Durum Wheat has been constructed by knowledge engineers who are not experts in the domain. This knowledge base is prone to inconsistencies and contradictions. The goal of this work is to propose a dialogue model of explanation to facilitate knowledge acquisition in inconsistent knowledge bases in order to (1) reduce inconsistencies ; and (2) acquire more domain knowledge to enrich the knowledge base.

Mots-clés : Argumentation, Explanation Dialogue, Inconsistency.

1 Introduction

The Dur-Dur research project [1] aims at reducing the use of pesticide and fertilizer in Durum Wheat cultivation while providing a protein-rich Durum Wheat. In the project we construct a multidisciplinary *Datalog*± (Calì *et al.* (2012)) knowledge base which will be used as a reference for decision making. Since this knowledge base is built by non-expert knowledge engineers, it is potentially prone to *inconsistencies*. In the litterateur, inconsistencies are addressed by reparation techniques : one only keeps the contradiction-free subsets of knowledge (Lembo *et al.* (2010)). In the project, this approach is too drastic as it **removes** a lot of expert knowledge.

To circumvent such problem we consider the following solution. We start with a system that uses a *prototypical* knowledge base [2] that has been constructed manually by non-experts, then on top of such knowledge base we allow for querying under inconsistency using the semantics of Lembo *et al.* (2010) to be able to reason with the available knowledge, then we allow for another facility called *explanation dialogues*. It works as follows, when the `Expert` queries the knowledge base and gets an unexpected result he/she can be engaged in a dialogue with the `System` to understand why the `System` has answered with such result. The `Expert` can ask further questions and the `System` can respond accordingly. The main salient point is that the `Expert`, when he/she perceives inconsistencies, contradictions, or errors can give *argumentative feedback* where he/she opposes to the result obtained by the `System`, and proposes a correction. This approach helps in reducing inconsistencies without removing possibly important pieces of knowledge.

To understand the approach consider the following query $Q =$ "*Is there any technical itinerary where do we use Maize as precedent* ?" which has been asked by the `Expert` and to which the `System` has answered *yes*. The `Expert` wants an explanation about the reason behind Q's entailment :

1. `http://www.agence-nationale-recherche.fr/?Projet=ANR-13-ALID-0002.`
2. The Durum Wheat Knowledge Base can be found in : `http://www.lirmm.fr/~arioua/dkb`

1. `Expert` : Explain why do we use Maize as a precedent ?
2. `System` : The burial of Maize residue will reduce the dose of nitrogen fertilizer.
3. `Expert` : Could you elaborate ?
4. `System` : The buried residues of Maize will enhance the soil by organic matter which in turn will give sufficient nitrogen to the plant, consequently we will use a lesser dose of nitrogen fertilizer.
5. `Expert` : I don't agree. Using the Maize is risky because burying its residues exposes the plant to a toxin contamination.

After stage (5) the `System` can either : (6) respond with another explanation or ($6'$) declares its inability of providing another explanation. If the `System` opts for (6) then the `Expert` can respond by (7) a feedback stating that he doesn't understand the new explanation, or ($7'$) a feedback stating that he doesn't agree thus advancing an argument or ($7''$) declaring understanding. If the `System` opts for ($6'$) the dialogue ends and all arguments advanced by the `Expert` are stored. Note that the `System` doesn't attack `Expert`'s arguments because we assume that the human expert has the authority. An alternative to stage (5) would be ($5'$) the `Expert` acknowledges *understanding* of using a Maize precedent. Then the dialogue ends.

This dialogue exposes the content of the knowledge base in a goal-directed manner. As been highlighted the importance of such dialogue (besides making the `Expert` understand the entailment of Q) is to have an *argumentative feedback*. In fact, that is what happened at stage 5 where we come to know that the knowledge base lacks an important piece of knowledge that has been highlighted by the `Expert`.

The explanation dialogue is formalized within the frameworks of McBurney & Parsons (2002); Walton (2011), where locutions as "explain", "providing explanation", "argumentation" , etc have been considered. Moreover, the generation of arguments and explanations is based on a logical instantiation of Dung's abstract argumentation frameworks Dung (1995). The dialogue has been implemented in a system called DALEK (**D**i**AL**ectical **E**xplanation in **K**nowledge-bases) [3]. A preliminary evaluation with two experts showed a promising result when comparing with approaches without explanation dialogues. In the evaluation we observed an increase in the acquired knowledge (45%) and a considerable reduction of inconsistencies (24%).

Références

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3. Can be found here : `http://www.lirmm.fr/~arioua/dkb/#rulesdalek`