Decision Support through Argumentation-Based Practical Reasoning

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Abstract

This extended research abstract describes an argumentation-based approach to modelling articulated decision making contexts. The approach encompasses a variety of argument and attack schemes aimed at representing basic knowledge and reasoning patterns for decision support.

1 Introduction

The aim of this research is to provide an organised approach for supporting human decisions about what should be done in a particular context (practical reasoning). This is an interesting and complex subject of study since ancient times with Aristotle's Practical Syllogisms. Comparatively, automated support to human practical reasoning is a relatively recent research topic, which involves several fields of research.

In fact, providing decision support is not just a matter of identifying a decision to be suggested. Good decision support, similarly to good human advice, should involve explanation and interaction with decision makers [Girle *et al.*, 2003] by (1) presenting the advice in a form which can be readily understood by the decision maker, (2) allowing access to information and reasoning underpinning the advice, and (3) providing an arena where the decision maker can discuss with his advisor.

As to the first point, the influential work of [Walton *et al.*, 2008] analyses the concept of "argument scheme" intended as the statement of a presumption in favour of a given conclusion, or goal, in a way which is commonly related to how human beings usually make arguments. Whether this presumption stands or falls depends on the positive or negative answers to a set of "critical questions" associated with the scheme. This approach was further developed in [Atkinson *et al.*, 2006] where a refined argument scheme for practical reasoning has been proposed, encompassing the distinction between goals, which are the desired effects of an action, and values, which represent the underlying reasons for an agent to achieve a goal. In [Baroni *et al.*, 2009a; 2010b] we addressed this topic by providing argument schemes for the three entities highlighted in the approach of [Atkinson *et al.*, 2006] (viz. actions, goals and values).

As to the second point, any approach based on argument schemes mentioned above seems to assume the existence of different reasoning levels. To encompass them, several extensions of Dung's argumentation framework (AF) [Dung, 1995] have been proposed, but the most general, as shown in [Baroni *et al.*, 2011], is the Argumentation Framework with Recursive Attacks ($AFRA$) formalism [Baroni *et al.*, 2009b; 2011]. In [Baroni *et al.*, 2009a; 2010b] we showed how to organise arguments that are instances of argument schemes in the $AFRA$ framework. Moreover, in [Baroni *et al.*, 2010b] we proposed also a way to relate the relevant arguments involved in practical reasoning with a model of personality. This helps in explaining the final decision to a human decision maker which could be useful in particular w.r.t. the third point highlighted by [Girle *et al.*, 2003].

In fact this point requires to be able to formalise a dialogue between human decision makers and an automatic system; in [Baroni *et al.*, 2010a] we addressed this problem in the context of knowledge sharing through the Web. Although this was developed in a different context, the underlying idea has several similarities with the requirement of allowing decision makers to discuss with their advisor.

In the following section we sketch the main ideas underlying our approach. The final section concludes this extended abstract by describing some of the main future works.

2 Knowledge Formalisation

A decision support problem may be formalised with an argumentation-based approach where two basic notions, namely arguments and attacks, are encompassed. For the sake of representation, both notions need to be specialised: arguments of different sorts can be identified in relation with different reasoning levels (e.g. about goals rather than about values). This involves in turn different kinds of attack relations. In [Baroni *et al.*, 2009a] we introduced the notion of *attack scheme* intended as the presumption supporting the existence of a given conflict between arguments or attacks. Each conflict which is an instance of an attack scheme can be directly expressed in an $AFRA$ framework. Indeed this framework can encompass any possible attack arising from an argument, and directed against another argument or another attack.

Following [Baroni *et al.*, 2009a; 2010b], the modelling approach we propose is based on an articulated set of concepts, the most important being: practical argument, fact, value, preference, and emotion. First of all, we consider the notion of practical argument scheme **PAS**: {`case:` C, `action:`

A, `goal:` G, `value:` V, `sign:` +/-}, derived from [Atkinson *et al.*, 2006]. The scheme means that "in the case C, the suggested action is A, which achieves the goal G, which, depending on sign, promotes or demotes the value V". For instance, recalling an example from [Atkinson *et al.*, 2006; Baroni *et al.*, 2009a], in a context of medical treatment concerning hearth disease, we can have the following two arguments: **P1**: {`case:` low platelet adhesion, `action:` do nothing, `goal:` having small expense, `value:` cost, `sign:` +}, suggesting to do nothing for treating low platelet adhesion, and **P2**: {`case:` low platelet adhesion, `action:` administer chlopidogrel, `goal:` reducing blood clotting, `value:` safety, `sign:` +}, suggesting to treat the disease by administering chlopidogrel. These two arguments are in conflict since they state different actions for the same case. At a general level, this kind of conflict is formalised through a practical attack scheme **PAtS**: {`src:` an instance of **PAS**, `trg:` an instance of **PAS**, `conds:` `src.action` $\neq$ `trg.action`}. Then we consider the concept of factual argument scheme **FAS**: {`cases:` C}, defining the facts accepted at a given stage of the reasoning process. For instance **C1**: {`cases:` chlopidogrel is not available}, which can give rise to an attack from **C1** against **P2**.

In addition, we consider values through the argument scheme **VAS**: {`value:` V} asserting that a given value is in force. Related to **VAS**, the most important attack scheme is the value defence **VDefence**: {`defending:` an instance of **VAS**, `defended:` an instance of **PAS**}, involving attacks from a value argument in favour of those **PAS** arguments which promote the same value. These defence attacks defeat the attacks that undermine each of those **PAS** argument. In the example, there are two value arguments, wiz. **V1**: {`value:` cost} and **V2**: {`value:` safety}, and any of them defends its promoting practical argument. For instance, **V2** defends **P2** by undermining the attack it receives from **P1**.

Finally, in a similar way we encompass the notions of preference and emotion. The first one is considered in a preference argument scheme **PRAS**: {`preferred:` P, `notpreferred:` nP}, which states that `P` is the argument preferred over `nP`. Emotions give rise to arguments of the form **EAS**: {`emotion:` E}, corresponding to the assertion of a personal emotion which determines "favourable" and "unfavourable" actions.

3 Conclusions

The research line we are working on is focused on argumentation-based practical reasoning and addresses three main issues: (i) knowledge representation, (ii) computation of effective decision support outcomes, and (iii) dialogue protocol for user-oriented argumentation. Concerning the first two points, in [Baroni *et al.*, 2009a; 2010b] we discussed a preliminary approach where several relevant notions for decision support can be encompassed in a representation, based on argument and attack schemes, which is put in correspondence with a formal computational model [Baroni *et al.*, 2009b; 2011] that gives ready access to both information and reasoning process underlying the decision outcome. Argument production relies on argument schemes which specify how arguments are derived from basic conceptual entities. This proposal is at an early stage of development and is far from being unquestionable and complete. In fact we have not fully addressed yet the third requirement discussed in [Girle *et al.*, 2003], concerning a dialogue between an automatic decision support system and human decision makers. In [Baroni *et al.*, 2010a] we proposed a preliminary approach for knowledge elicitation through a formal dialogue but we do not take into account the specific needs of decision support.

The main future research line concerns a deeper analysis about knowledge representation and elicitation in decision support. In addition, we are working on formal dialogue protocols in order to fulfil the third requirement of [Girle *et al.*, 2003]. Finally, metrics for measuring effectiveness of decision support can be discussed, also for helping in evaluating this approach w.r.t. "classical" decision support systems.

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