Towards a Foundation for Comprehensive Argumentation Scheme Support in Argumentative Dialogue Games

Simon Wells[1]

University of Aberdeen simon.wells@abdn.ac.uk

Abstract. This paper reports preliminary work into the exploitation of argumentation schemes within dialogue games. We identify a property of dialogue games that we call "scheme awareness" that captures the relationship between dialogue game systems and argumentation schemes. Scheme awareness is used to examine the ways in which existing dialogue games utilise argumentation schemes and consequently the degree with which a dialogue game can be used to construct argument structures. The aim is to develop a set of guidelines for dialogue game design, which feed into a set of Dialogue Game Description Language (DGDL) extensions in turn enabling dialogue games to better exploit argumentation schemes.

1 Introduction

Argumentation schemes have become established as useful formal argumentation tools that enable arguments to be analysed and collated according to the stereotypical patterns of reasoning that they exhibit. A large number of natural language arguments have been analysed, for example the Araucaria corpus [1], to yield several groups of undifferentiated schemes known as scheme-sets. There are three main groups of computational scheme-sets, due to Katzav-Reed [1], Pollock [2], and Walton [3]. Schemes from any of these sets can be used within the Araucaria tool to annotate a specific analysed argument structure to indicate that it is an example of a specific scheme. Schemes have also been used to guide argument generation and to suggest relevant responses within dialogue. However, whilst Argumentative dialogue has become a popular approach to structuring interaction, for example between people [4], between people and intelligent agents [5] in pedagogic and mixed-initiative systems, and between intelligent agents within Multi-agent Systems (MAS) [6] the dialogue games that are available have not fully exploited the benefits that are to be wrought from argumentation schemes. The development of each of dialogue games and argumentation schemes has, with a few exceptions, occurred in parallel, and yet, used in concert, schemes and games are hugely complimentary. Schemes can be used in relation to dialogue games both at the development stage, to

[1] Available from http://http://araucaria.computing.dundee.ac.uk/doku.php

provide guiding principles for developing new games, and at the deployment stage, to provide guidance towards relevant lines of argument for the player to explore, to suggest appropriate responses to the expressed positions of others, and to provide a facet of strategic information which a player can use in their reasoning process in order to achieve their desired goals. This approach becomes increasingly important when argumentation tools are applied to real-world problem domains. For example, the SASSY project [2] aims to use argumentation to provide scrutability about decisions made by intelligent systems, similarly in the SUPERHUB project [3] argumentation schemes appear to be a useful way to capture the patterns of reasoning used by 'critic' agents within a multi-modal journey planner. In both these projects, getting from the recognition that schemes might be very useful to an implemented system has proven problematic as it is not just a matter of schematising the relevant reasoning into arguments but also providing appropriate ways to interact with those arguments.

2 Related Work

A number of approaches have been taken that attempt to unite arguments, dialogue, and schemes. If we envision a hierarchy of dialogue game groups organised with respect to argumentation schemes we might produce the following: (1) Games unable to utilise argumentation schemes. (2) Games able to utilise a single scheme. (3) Games able to utilise multiple/arbitrary schemes.

By taking this approach we discover that there have been attempts to develop games at level 2, for example Atkinson's games that utilise the practical reasoning scheme [7] is representative here. There has also been an attempt to define how games at level 3 might work, for example in [8], Walton's game CB [9] is extended to support basic integration of critical questions through the additions of a 'Pose C' move, related to posing a critical question, and support for recognising that an argument is a 'substitution instance' of a scheme. However automatically recognising that an argument is an instance of a particular scheme is a difficult problem and an alternative is to be explicit when uttering an argument about which scheme it is representative of. The Dialogue Game Description Language (DGDL) [10] also supports the description of games in which a similar substitution instance approach is used in the formulation of the correspondence condition predicate which defines a named rule in which Argument is an instance of the scheme denoted by SchemeID:

```
Correspondence ::= corresponds(Argument, SchemeID)
```

The majority of extant dialogue games occupy group 1 and require additional rules to enable schemes to be used. This suggests that there are two approaches

[2] http://www.abdn.ac.uk/ncs/computing/research/ark/projects/current/sassy/

[3] http://superhub-project.eu/

to incorporating argumentation schemes into dialogue games (1) describe a new game that utilises schemes, and (2) adopt an existing game and retrofit with scheme specific functionality. In either case it is useful to enquire which properties a game must possess in order to move from group 1 to either group 2 or group 3.

Two further approaches that have some bearing on the current work are scheme support in the Argument Markup Language (AML) and scheme support in the Argument Interchange Format (AIF)[11]. In [8] arguments and schemes are recorded using AML, fragments of which are generated from a pre-partitioned agent belief database, and exchanged between agents during their communications. However this approach does not examine argumentative communication from the dialogical perspective but rather deals with arguments and schemes at the language level, arguments and their associated schemes are communicated entirely as content and the protocol itself is not 'aware' of the additional data available within the content, hence, it is difficult to exploit the additional context sensitive information provided by the scheme when constructing and selecting subsequent moves to perform. In this paper we take the alternative approach of starting at the dialogical level, and asking, what does it mean for a dialogue game to be able to exploit schemes, and consequently what properties does a game need to possess in order to exploit them. An alternative approach to uniting arguments, dialogues, and schemes might be to extend the Argument Interchange Format (AIF) [12]. However, whilst it is true that the AIF already supports expression of arguments and schemes, it does not currently support dialogue very well. The most advanced approach to dialogue in the AIF to be found in [13] which is currently unsupported by tooling and which lacks fine grained expressions for defining dialogue protocols. Furthermore, the AIF is, by definition, a high-level tool that is designed to be very flexible, enabling interchange of argument structures between tools. However that is a different endeavour to the provision of basic, targeted support for schemes within dialogue games.

3 Scheme Awareness

An argument comprises a number of statements that are related. One statement is named the conclusion and the other statements are named premises, related such that the conclusion is said to follow from the premises. Furthermore the set of premises may be subdivided such that one is named the major premise and expresses a rule that defines how the remaining premises, named minor premises, support the conclusion. When an argument is expressed during a dialogue, the argument may be completely expressed, corresponding to the principle of total evidence [14], or else partially expressed, in which case the argument is enthymematic. As outlined above we assume that arguments arise during a sufficiently expressive dialogue game, and that a given argument may not have been fully expressed within the dialogue game at a given time point, although the argument may be completed at subsequent time-points in the remainder of the dialogue. This captures the idea that a dialogue is dynamic and that an under-specified argument expressed at time-point T_n may be elaborated on at some subsequent time-point $T_{n'}$. This gives rise to the question, 'does the dialogue game enable arguments to be fully expressed and recognisable at the dialogue game level (as opposed to assuming that the argument can be parsed from the underlying logical language level)?' This is important because a game in which it is difficult to express fully formed and identifiable argument structures is one in which it will also be difficult to incorporate other machinery that builds on those argument structures without resorting to a *deus ex machina* solution.

Dialogue games should therefore be able to support the aforementioned levels of argument expression as a prerequisite to comprehensive scheme support. These are summarised as follows and constitute the requirements for sufficient expressiveness for a dialogue game with respect to argumentation schemes: (1) Assert an entire argument within a single locution (2) Assert, either individually or in combination (but still individually addressable), the constituent parts of an argument within disparate locutions: (a) Conclusion (b) Major Premise (c) Minor Premise(s) .

Given these prerequisites we make the fundamental assumption that every argument, regardless of whether that argument is fully or partially expressed, is associated with an argumentation scheme. Furthermore this association may be either implicit of explicit. This gives rise to the question of which specific argumentation scheme captures the expressed argument? Without further information or processing, the scheme is undefined. In the OVA tool [15], which is underpinned by AIF, anonymous schemes are represented by unnamed RA-nodes until the user specifies the actual scheme. Conversely an explicit association occurs when an argument is defined as being an instance of a specific identified scheme, this can occur in three ways during a dialogue, firstly, through some automated function that identifies which scheme the argument corresponds to, secondly, by the speaker of the argument identifying which scheme their argument is part of, and thirdly, by the respondent deciding which scheme applies to the argument and thus which critical questions can be posed. The second and third approaches are of interest because they can lead to conflict, and subsequent argument about which scheme is most appropriate if the players disagree.

Dialogue games thus need to (1) enable the speaker to declare that an argument is part of a specific scheme, and (2) enable the respondent to declare that an argument is part of a specific scheme.

During a dialogue, arguments rarely exist in isolation, but are linked and chained with other arguments to form more complex structures. A given statement may therefore have multiple roles acting as the conclusion of one argument, but also acting as the minor premise in a further argument. This has a bearing on the relationship between arguments, as expressed during dialogue, and schemes. For example, it suggests that every argumentative statement uttered during a dialogue is associated with at least one argumentation scheme and that game engines which support play of dialogue games should support individual statements being recorded as occupying roles in 1 or more schemes.

Critical questions follow from the identification of an argument as being a part of a specific scheme. This licences the resulting utterance of the associated critical questions during the dialogue. A dialogue game should therefore support the utterance of relevant critical questions associated with a given scheme and an asserted argument. Once a scheme is identified, the associated critical questions should then become available using a similar mechanism to the pose locution of [8].

4 Extending the DGDL

The simplest method to extend the DGDL, taking into account the requirements introduced in section 3 is to introduce more structure into the content of moves whilst retaining the current flexibility of locution naming. Currently when a player makes a move they utter a locution and content, e.g. assert(p). Previous attempts to incorporate argumentation schemes have concentrated on the locution, however, by providing additional information into the content, we can enable the player to declare properties associated with the content during the dialogue. A simple way to achieve this is to use one or more, comma-separated key:value pairs to annotate asserted content during a dialogue, e.g. assert(k:v) where the keys and values are DGDL identifiers. A minimal requirement is that at least one value represents the locution's content variable, and the key indicates the type, e.g. one from the set {argument, conclusion, premise, rule}. Additionally a key:value pair can be used to declare that the content is associated with a specific scheme, e.g. ”scheme”:”slippery-slope”. As an example, to assert that the statement, p, is a conclusion and that the scheme associated with this assertion is an expert-opinion we can use the following expression: assert(“conclusion”:“p”, “scheme”:“expert-opinion”). The advantage of taking this approach is that we increase the ability of players to make explicit what they mean to say when they make a move, and by increasing the explicitness of exchanged utterances we simplify any subsequent computational processing.

5 Conclusions & Future Work

The author holds that argumentation schemes are a useful way to organise and collate arguments when attempting to deploy computational argumentation technologies within complex real-world domains. This holds even more strongly where mixed initiative systems are concerned in which groups of humans and agents may interact via dialogue games. To support this, dialogue games require better support for manipulating arguments, predicated upon tighter integration with argumentation schemes. This effort feeds into ongoing research that aims to align argumentative technologies with real-world problems as currently there can be quite a conceptual leap from a problem domain to deployment of argumentative tools within that domain. This paper has reported on preliminary efforts to provide tools to support the design of new games that exploit schemes to operate in this mixed human-agent arena, where the system is meant to support some combination of computational efficiency, scrutability and introspection, and alignment with human reasoning and interaction processes.

References

1. Katzav, J., Reed, C., Rowe, G.: Argument research corpus. In: Practical Applications in Language and Computers (Proceedings of the 2003 Conference). (2004) 229–239
2. Pollock, J.L.: Cognitive Carpentry. A Blueprint for How to Build a Person. MIT Press (1995)
3. Walton, D., Reed, C., Macagno, F.: Argumentation Schemes. Cambridge University Press (2008)
4. Ravenscroft, A., Matheson, P.: Developing and evaluating dialogue games for collaborative e-learning. Journal of Computer Assisted Learning **18** (2002) 93–101
5. Reed, C., Wells, S.: Using dialogical argument as an interface to complex debates. IEEE Intelligent Systems Journal: Special Issue on Argumentation Technology **22**(6) (2007) 60–65
6. Parsons, S., Sierra, C., Jennings, N.: Agents that reason and negotiate by arguing. Journal of Logic and Computation **8**(3) (1998) 261–292
7. Atkinson, K., Bench-Capon, T., McBurney, P.: Justifying practical reasoning. In Rahwan, I., Moraitis, P., Reed, C., eds.: First International Workshop on Argumentation in Multi-Agent Systems. (2004)
8. Reed, C., Walton, D.: Towards a formal and implemented model of argumentation schemes in agent communication. In Rahwan, I., Moraitis, P., Reed, C., eds.: First International Workshop on Argumentation in Multi-Agent Systems. (2004)
9. Walton, D.N.: Logical Dialogue-Games And Fallacies. University Press Of America (1984)
10. Wells, S., Reed, C.: A domain specific language for describing diverse systems of dialogue. Journal of Applied Logic **10**(4) (2012) 309–329
11. Rahwan, I., Zablith, F., Reed, C.: Towards large scale argumentation support on the semantic web. In: Proceedings of AAAI-07. (2007) 1446–1451
12. Chesnevar, C., McGinnis, J., Modgil, S., Rahwan, I., Reed, C., Simari, G., South, M., Vreeswijk, G., Willmott, S.: Towards an argument interchange format. Knowledge Engineering Review **21**(4) (2006) 293–316
13. Reed, C., Wells, S., Rowe, G.W.A., Devereux, J.: Aif+: Dialogue in the argument interchange format. In: 2nd International Conference on Computational Models of Argument (COMMA 2008). (2008)
14. Carnap, R.: On the application of inductive logic. Philosophy and Phenomenological Research **8**(1) (1947) 133–148
15. Reed, C., Wells, S., Snaith, M., Budzynska, K., Lawrence, J.: Using an argument ontology to develop pedagogical tool suites. In: Proceedings of the Third International Congress on Tools for Teaching Logic (TICTTL 2011). (2011)