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A domain specific language for describing diverse systems of dialogue

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ABSTRACT

This paper introduces the Dialogue Game Description Language (DGDL), a domain specific language for describing dialectical games. Communication is an important topic within agent research and is a fundamental factor in the development of robust and efficient multiagent systems. Similarly, argumentation has been recognised as a key component of an agent's ability to make decisions using complex, dynamic, uncertain, and incomplete knowledge. Dialectical games, a type of multi-player argumentative dialogue game, provide a mechanism for communication which incorporates argumentative behaviours. However there are very few tools for working with these games and little agreement over how they should be described, shared, and reused. The DGDL provides a grammar for determining whether a game description is syntactically correct and thus provides a foundation for new tools to support the future development and wider exploitation of dialectical games.

1. Introduction

Dialogue games have been proposed as a tool for modelling the interactions between participants during argumentative dialogues. One branch of dialogue game research is into the formal dialectical systems due to Hamblin [10, pp. 253–282]. Hamblin defines such systems, or *dialectical games*, as simple, two-player, turn-taking games in which the moves available to the players represent the locutional acts and utterances available to the participants in the dialogue.

Hamblin's motivation was to explore the circumstances under which certain logical fallacies, such as *petitio principii*, occur during dialogue. In response, Mackenzie subsequently developed DC [21], and Woods and Walton explored extensions to the rules of Hamblin's game as a technique for investigating fallacies [58]. Many more dialectical games have been formulated and proposed for application in a variety of dialogical situations occurring in a range of problem domains apart from fallacy research. Walton and Krabbe [52], for example, introduce the games PPD_0 [52, pp. 149–152], RPD_0 [52, pp. 158–161], and CPD [52, pp. 163–164] during an investigation of the interactions between parties during persuasion dialogues. Girle introduces a number of games which are aimed at modelling belief revision in A.I. systems [7–9]. McBurney and Parsons specify a number of games for use in communication between agents in multiagent systems (MAS) of which [31] is representative. Bench-Capon introduces the *Toulmin Dialogue Game* and its associated computational implementation which is particularly suited toward modelling legal argument [3]. More recently, Reed and Wells introduce a simple dialectical game for mediating debate between humans and agents in a semantic web based system to support exploration of complex and contentious subjects [45].

The attention paid to dialectical games in these domains is valuable, however that attention is usually confined to a particular game and its features rather than looking at the wider range of games and features available. For example,

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investigations of dialectical games applied to MAS usually confine their attentions to Mackenzie's DC before proceeding to formulate new games. However DC, whilst both popular and influential, does not contain all or even most of the available features found in other games within the literature. Perhaps this is because DC incorporates a good basic feature set which form a good foundation from which to explore specific questions about argument and dialogical interaction. The sheer variety of games and their features, across the many domains in which they are investigated, is rich and deserving of attention. One way to achieve this is to analyse distinct games from these domains in terms of their unique features, and to collate those analyses. The benefit of this approach is that the results of the game analysis can subsequently serve as a foundation for the construction of more generic frameworks for representing and implementing new and existing games, and as a starting position from which to explore the space of possible dialectical games. A recent trend in dialectical games, at least in the MAS domain, has been towards creating generic frameworks for representing dialectical games in general, within which particular games are instantiated as required. To this end there have been generic frameworks proposed by Maudet and Evrard [29], McBurney and Parsons [32,31], Bench-Capon et al. [4], and Wells and Reed [54]. Whilst a valuable foundation for the construction of agent communication systems which maximise reuse, a consistent deficiency of this approach has been the lack of a principled exploration of the features that such frameworks should incorporate or the range of rules that should be supported. Without determining the range of rules and features required, at the very least, by extant games, and examining how they can be combined to formulate new games, generic frameworks run the risk of being *too* generic because the amount of effort required to implement new games in the framework is not reduced over that required to implement new games from scratch. Furthermore, generic frameworks which do not support the description of existing games are less flexible and reduce the space of potential games that can be formulated to tackle domain specific problems.

Whilst much exploitation of dialectical games has been found in agent communication, these games are beginning to be deployed in online argumentation systems to specify the communicative interactions available for both computer and human players. MAgtALO [45] is an online argumentation system which uses agents to represent the positions of domain experts. Argumentation is used to control the interaction between MAgtALO agents and users. These interactions are structured using dialogue games which guide the resulting dialogues towards constructive ends such as the elicitation of new knowledge and public participation in complex real-world issues. MAgtALO features *mixed initiative argumentation*, a mixture of human users and intelligent software agents, which have competing requirements. From the software agent perspective the interaction protocols used by MAgtALO should be computationally tractable and supportive of many of the identified desiderata in agent communication protocols [33]. However the system must also support the human users with protocol attributes such as comprehensibility and simplicity [41].

Another online argumentation system, InterLoc [41], is an educational tool that uses simple dialectical games to support students in exploring a knowledge domain with their peers. One of the games used by InterLoc, the Creative Thinking Game (CTG), guides students in their selection of responses to earlier dialogue events by suggesting permissible responses. The CTG is designed so that the suggested responses are suited to the context of the dialogue, but does not *mandate* the set of legal responses as is found in many of the games applied to agent communication. There is no reason to suggest that MAgtALO agents could not interact with students through the InterLoc interface if the interaction protocols were shared. Indeed it is this kind of cross-over between individual systems that is the core of the nascent World Wide Argumentation Web (WWAW) [39] which envisages sharing of arguments, and interaction, between otherwise separate online argumentation systems. In the WWAW, tools such as MAgtALO and InterLoc provide a mechanism for direct online interaction between users and the system, enabling real-world arguments to be captured and shared.

Other tools, such as ArgDF[1] [40] and Avicenna,[2] enable arguments to be created, manipulated and displayed online. These systems are all developed by separate groups and one aspect underpinning them is the use of the nascent Argument Interchange Format (AIF) [6] to enable structured arguments to be represented and shared between different tools. The AIF, however, only supports interchange of monologic argument, whereas many, of the processes that expose or create monologic arguments are inherently dialogical. This has been recognised in O'Keefe's distinction between Argument_1 and Argument_2 [36], Kamlah and Lorenzen's use of dialogical definitions of logical connectives and quantifiers [14], and most recently made explicit by Reed and Budzynska in [43] which explores how the interactions between dialogue moves affect the structure of the constructed argument. A method is therefore required for sharing both the results of argumentation processes, in the form of structured dialogues, and the protocols by which the dialogues were constructed. This would directly support interaction between user-facing tools, such as the MAgtALO and InterLoc interactions, and between user-facing tools and the WWAW infrastructural tools, as well as enabling existing non-WWAW agent systems to interact with the WWAW. The proposed AIF+ [46] is envisaged as an enhanced AIF which includes support for both dialogue and protocol specification thus underpinning the dialogical aspects of the WWAW, but development of this interchange format is in its infancy and requires input from an array of stakeholders involved in the development and exploitation of argumentation software.

It is proposed that a unified framework for representing, implementing and deploying both existing and new dialectical games is needed and that a strong foundation for such a framework can be constructed based upon an analysis of a representative range of extant dialectical games across the range of problem domains. The remainder of this paper proceeds

[1] http://www.argdf.org/.
[2] http://www.research.buid.ac.ae:8080/Avicenna/.