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A System for Dispute Mediation: The Mediation Dialogue Game

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Abstract. We propose a dialogue game for mediation and its formalization in DGDL. This dialectical system is available as software through Arvina for automatic execution. This work expands the literature in dialectical systems, in particular those for more than two players, and shows the practical impact on mediation activity through the opportunity offered to mediators once implemented.

Keywords. dispute mediation, dialogue game, formal dialectical systems, DGDL, DGEP, Arvina

1. Introduction

In dialectical systems, dialogical interaction is viewed as a game with rules that players must follow. Rules of a game are explicited in a dialogue protocol which specifies how the discussion can or should unfold. These rules depend on the type of dialogue the participants are involved in (e.g. persuasion, negotiation or inquiry), and a variety of dialogue games has been proposed (e.g.[1,2]) that help us understand, improve or replicate argumentative interactions. Despite a large number of dialectical systems in the literature (see [3] for an overview), none has, to our knowledge, ever been developed specifically for dispute mediation. This is the challenge taken up here, with a motivation which is two-fold: first, formalizing mediation discourse promises a theoretical framework and a normative view of argumentative interactions; second, executing the game offers the opportunity to deliver a practical tool to support mediation, a conflict resolution process that has enjoyed little computational attention.

Research focused on discourse in dispute mediation such as [4] has proven the major role that arguments play in this activity. In mediation, disputants try to resolve a conflict with the help of a third-neutral, the mediator, who makes sure their discussion is efficient and reasonable so that agreement can be quickly reached. To do so, mediators encourage parties to make their positions clear and redirect the discussion whenever parties do not manage to agree on particular issues. Mediation discourse therefore possesses its own dialogical and argumentative character. Of crucial importance is the mediator's central place in the discussions. Most of their contributions in the discussion consists in asking parties to explicitly deliver and explain their position regarding an issue via pure

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questions and challenges. A certain type of question also allows mediators to directly seek the parties' agreement or disagreement on some issues: defined in [5] as assertive questioning, this type of question, is a convenient way of making them agree or disagree on propositions. Also, the neutrality of mediators does not prevent them from being assertive but, in contrast to parties who assert their points of view, mediators usually summarize or clarify the discussion [4]. As we will see in Section 2.2, these types of moves can be seen as *restating* (or reframing) the parties' positions.

If we consider that a typical mediation is a discussion in which parties must argue for or against a proposition and the mediator redirects the discussion or restates the disputants' standpoints whenever agreement cannot be quickly reached, then we can take advantage of a general framework where the dialogue can be easily modeled and formalized to define a mediation dialogue game. Implementing it in a system also promises a real application that could be used by trainee mediators to practice their skills.

In Section 2 we present the rules of the Mediation Dialogue Game (MDG), formalize and implement it in Sections 3 and 4, and then compare MDG to other existing dialectical systems in Section 5. We finally discuss future work in Section 6.

2. Specifying a Mediation Dialogue Game: MDG

In this section, we specify the rules of a generic mediation dialogue game (MDG). The definition of the rules relies on empirical knowledge of mediation interactions (such as [4]) and close analyses of the Dispute Mediation Corpus (DMC)[2] [6]. The rules capture the minimal characteristics of mediation dialogues. Keeping in mind that this game can be executed and used for mediation training, the rules provide strategic moves to the mediator e.g tackling new issues (see e.g rule SR9.3 in Section 2.4 below). Moreover, the game offers a normative framework guaranteed by rules that assure parties' reasonableness: they cannot have inconsistent commitments and are obliged to answer to questions and challenges (see e.g. rule SR7 below).

2.1. Players, Domain and General Considerations

MDG captures the opening and argumentative stages of a dispute which involves three players: P_1 and P_2, who play the role of disputing participants (or parties), and M who plays the role of the mediator. We also use P_x and P_y, where $x, y \in \{1, 2\}$ and $x \neq y$ when we are not interested in a party in particular, but nevertheless need to make a distinction between them. In MDG, P_1, P_2 and M engage in a dialogue to resolve a dispute on topic t by advancing a set of propositions p, q, and so on, that pertain to the domain t (e.g. divorce, child custody). t can be any topic that is tackled in civil case mediations, and propositions p, q etc. are any proposition about the dispute at stake.

2.2. Locution Rules

Locution rules define the types of moves that players can perform during the game. They are composed of two elements: the proposition (or propositional content) symbolized by lower-case letters (e.g. p) and its illocutionary force [7], forming a function of the type Illoc-Force(p). The locution rules of our game are given in Table 1.

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[2]Corpus available at `arg.tech/DMC`

Table 1. Locution rules

LR1	M can only question (Q), challenge (Ch) or restate (R):
	1. PQ(p) when he asks whether p is the case, i.e. if P_x believes p
	2. AQ(p) when he seeks P_x's agreement on p
	3. PCh(p) when he seeks P_x's ground for stating p
	4. R(p) when he reuses P_x's proposition p
LR2	P_x cannot question or challenge but will respond to Qs and Chs in one of the following ways:
	1. A(p) when he states an opinion
	2. W(p) when he retracts p
	3. Agr(p) when he agrees on p
	4. Disagr(p) when he disagrees on p

Mediator's typical moves i.e. questioning (Q) and restating (R) participants' locutions (see Section 1) must be available in our dialogue game rules: this is provided by LR1. We also constrain P_1 and P_2's moves by forbidding Q, Ch and R. If this game is indeed intended to mediators for practicing their techniques, M should be the only one to have 'strategic' moves available: PQs (pure questions) to launch the discussion and new issues to broach, AQs (assertive questions) to seek other players (dis-)agreement, PChs (pure challenges) to foster argumentation and, most importantly, R to be able to go back on a previous proposition; furthermore, we prevent M from asserting (A) to comply with the mediator's principle of neutrality.

P_1 and P_2 can make assertions (A) that allow them to give their opinion (LR2.1). With LR2.2 parties can withdraw (W) a proposition, a feature needed in particular to keep commitments updated and which usefulness is elicited by structural rules (see Sections 2.3 and 2.4). Finally, P_x can Agr (agree) and Disagr (disagree) to show his position regarding claims that he did not introduced (LR2.3 and LR2.4).

It is important to note that we do not specify a locution rule to permit players to *argue*. As stated in [8] and [9], 'arguing' is a complex illocutionary force that takes shape only by virtue of the interrelation between locutions: one can build an argument by asserting p and q and showing that there is an inference between p and q, e.g. "p because q". Hence, *arguing* is automatically created when support for a proposition is given and, in MDG, PCh allows for triggering inference.

2.3. Commitment Rules

Integrating commitment-stores is a convenient way for detecting when consensus on an issue is reached [2]. They allow for keeping track of which propositions speakers are committed to. Propositions are thus updated in function of the developments of the dialogue. In Table 2, Com$_x$ symbolizes P_x's commitment-store. Note that only P_1 and P_2 have commitment-stores; this is because we want to reflect the mediator's neutrality. Updating a store therefore only happens when P_x moves. As in most formal dialogue systems (e.g. DC [10], CB [11], or PPD [2]), MDG allows players to retract propositions: if a proposition is withdrawn, it is assumed that the players are no more in conflict about this proposition and consensus is reached on that particular proposition (CR2). Commitment rules in MDG however differ from those in other dialogue games in that propositions are added only if they have been asserted or agreed on: we do not assume that a proposition is accepted by all players until it is retracted. This is defined in CR1 and

Table 2. Commitment rules

CR1	After A(p), performed by P$_x$, p is added to Com$_x$
CR2	After W(p), performed by P$_x$, p is removed from Com$_x$
CR3	After Agr(p), performed by P$_x$, p is added to Com$_x$
CR4	After Disagr(p), performed by P$_x$, $\neg p$ is added to Com$_x$

CR3. CR4 specifies that if a proposition p is disagreed on, then the opposite proposition ($\neg p$) is added to a store.

2.4. Structural Rules

Structural rules regulate how the dialogue can proceed i.e. which move is permitted, by which player, after a particular move. These are presented in Table 3.

The beginning of the dialogue aims at revealing P$_1$ and P$_2$'s respective standpoints w.r.t. the topic of the dispute [4], that is why M must ask both parties about the topic t (SR3). To reflect the argumentative function of the dialogue game, P$_1$ and P$_2$ must argue but, given constraint SR1 and LR2, argumentation can only be performed by M advancing PCh and P$_1$ and P$_2$ answering the challenge, specified in SR4. SR5 specifies that M can ask a player whether she also believes p, agrees on p, or ask to the player whose commitment-store contains p grounds for stating such a proposition. SR6 specifies that P$_1$ and P$_2$ must make their positions clear on a proposition p when M poses a PQ: they are either committed to p (SR6.1) or not (SR6.2). After an AQ, a player can withdraw p or (dis-)agree on p (SR7). SR8 allows a player to argue for a standpoint (SR8.1) or retract a proposition (SR8.2). If a player withdraws a proposition p, M can ask whether the player is then committed to $\neg p$ (SR9.1) or, he can explore new issues by asking questions on other propositions (SR9.2 and SR9.3). M can also explore other propositions with SR10. If a player disagrees on a proposition p, M can redirect the discussion on another issue (SR11.1), or check if the player is then committed to $\neg p$ by restating $\neg p$ (SR11.2), and either trigger the player's (dis-)agreement on $\neg p$ (SR12.1) or ask him grounds for $\neg p$ (SR12.2). With the last three rules, we can see the importance of the technique of restating: we have seen that when a player disagrees on a proposition p, the opposite proposition is added to its commitment store (rule CR4). This proposition $\neg p$, however, has never been asserted by the player, and M may want to make sure that the player actually believes $\neg p$. There are two possibilities for this: either seek for (dis-)agreement on $\neg p$ via an AQ, or challenging $\neg p$, in which case the player will give a support for $\neg p$ or withdraw it. These rules therefore allow M to clarify the players' standpoints: if they disagree on a proposition p, it does not necessarily mean that they believe the opposite, and this must be made clear in the game so that all positions are explicitly provided.

2.5. Termination and Outcome Rules

Termination rules define how and when the dialogue must end. In mediation, the process ends when a final agreement between disputants has been reached or when, after a certain time, disputants and mediators reckon that agreement is not possible. In MDG, the dialogue can terminate at any point, provided that the last player to move is not M i.e. when M's questions or challenges have been responded to.

Outcome rules should specify, at the end of a dialogue, who wins and who loses. In MDG, only P$_1$ and P$_2$ can win. At the start of the game, P$_1$ is committed to p and P$_2$ to

Table 3. Structural rules

SR1	P_1 and P_2 can only perform one move per turn
SR2	M can perform a maximum of two moves per turn iff the first move consists of restating (R)
SR3	The dialogue starts with M seeking P_1 and P_2's respective points of view regarding *t*, therefore: 1. M moves first with PQ(*t*) addressed to P_1 2. After that, P_1 must answer with A(*p*) 3. Then, M moves with PQ(*t*) addressed to P_2 4. Next, P_2 must answer with A(*q*)
SR4	The second step of the opening stage is to discover P_1 and P_2's grounds for *p* and *q*, therefore: 1. M performs PCh(*p*) addressed to P_1 2. After that, P_1 must answer with A(*r*) 3. Then, M performs PCh(*q*) addressed to P_2 4. Next, P_2 must answer with A(*s*)
SR5	After P_x performed A(*p*), M can perform: 1. PQ(*p*) addressed at P_y 2. AQ(*p*) addressed at P_y 3. PCh(*p*) adressed at P_x
SR6	After M performed PQ(*p*) addressed at P_x, P_x can perform: 1. A(*p*) 2. A($\neg p$)
SR7	After M performed AQ(*p*) addressed at P_x, P_x can: 1. W(*p*) 2. Agr(*p*) 3. Disagr(*p*)
SR8	After M performed PCh(*p*) to P_x, P_x can: 1. A(*q*) 2. W(*p*)
SR9	After P_x performed W(*p*), M can:, 1. AQ($\neg p$) addressed to P_x 2. PQ(*q*) addressed either to P_x or P_y 3. AQ(*q*) addressed either to P_x or P_y
SR10	After P_x performed Agr(*p*), M can: 1. PQ(*q*) addressed either to P_x or P_y 2. AQ(*q*) addressed either to P_x or P_y
SR11	After P_x performed Disagr(*p*), M can, 1. PQ(*q*) addressed to any player 2. R($\neg p$) addressed to P_x and P_y
SR12	After M performed R($\neg p$), M must either: 1. AQ($\neg p$) addressed to P_x i.e. the player who previously disagreed on *p*, or 2. PCh($\neg p$) addressed to P_x i.e. the player who previously disagreed on *p*

q and, in order to win, the players must be committed to their initial proposition, and: (i) have this proposition accepted by the opponent or, (ii) have the opponent retract his initial proposition or, (iii) have the opponent committed to no proposition at all. In all other cases the winner of the game is left undecided. The 12 different final situations are summarized in Table 4.

Table 4. Final situations in MDG

Situation	P_1 is committed to	P_2 is committed to
	p	$\emptyset$
P_1 wins if	p	$\neg q$
	p	p
	$\emptyset$	q
P_2 wins if	$\neg p$	q
	q	q
	p	q
	$\neg p$	$\neg q$
undecided	$\neg p$	$\emptyset$
	$\emptyset$	$\neg q$
	$\emptyset$	$\emptyset$
	q	p

3. Formal Specification in DGDL

The Dialogue Game Description Language (DGDL) [12] is a language developed to cope with the diversity of dialectical systems, allowing for a standardized formalization of games. The formal specification of MDG consists in translating the rules presented in Section 2 so that the game can be executed. We do not include it here, however it is available to the reader at: `arg.tech/MDG`. In our DGDL specification, the first line explains that the system described is the mediation dialogue game, where there is not a predefined number of turns (line 2). Lines 3-11 specify the number of players, their role and identification (see Section 2.1), and their commitment stores (see Section 2.3). The *Interactions* (line 13 onwards) are the moves that each participant in the dialogue can make, along with the associated effects. Line 15 explains that the dialogue starts with M asking a PQ to P_1. Lines 20-22, 26-29 and 33-35 correspond to structural rules SR6, SR7 and SR4 respectively. Lines 38-51 specify rules SR5 and CR1 together, and the obligation for M to move next. Lines 57-67 correspond to rules SR9 and CR2. Lines 62-82 and 87-97 specify SR10 and CR3, as well as SR11 and CR4. Finally SR12 is given in lines 102-104.

4. Implementation and Product

The Dialogue Game Execution Platform (DGEP) was created to handle any DGDL specifications in order to implement a variety of systems, giving us the opportunity to automatically execute our game in a system to play it. Arvina is a dialogical support system for the execution of games [13,14] relying on both DGDL and DGEP. It allows users to play a dialogue game with virtual agents and or other humans on a user-friendly interface. The advantages of using Arvina in public deliberation contexts has been shown in [13], and additional dialogue games (e.g. for debates) have been implemented. This flexibility therefore ensures the possibility to execute our MDG.

Figure 1 is a screenshot of MDG executed in Arvina. The users (three human players) advanced propositions that were extracted from a dialogue taken from DMC[3]. We

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[3]Available at `arg.tech/map9373`

can see the Mediator asking the first mandatory PQ and PCh to Viv (playing the role of a party) following the other party (Eric)'s response to the same questions. The bottom banner with "Select a move: No moves available" shows that after the PCh, Mediator is not authorized to perform a move until Viv answers. This figure shows that the game matches up reasonably well with natural discourse.
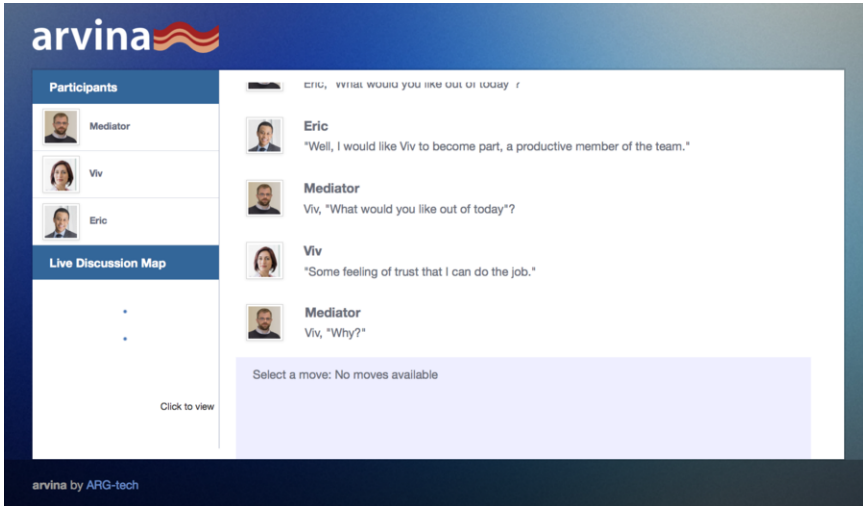

Figure 1. MDG in Arvina

5. Related Work

In [15], Prakken was one of the first to develop a formal system involving three players: he introduced an 'adjudicator' to persuasion dialogue systems to reflect the role of participants in legal settings. MDG is similar to Prakken's model in that we provided a specification for three players, including the mediator (M) whose role is in some way similar to Prakken's adjudicator in the argumentation phase. Similarly to Prakken's system, our game allows a fair and efficient resolution of the conflict. Structural rules are designed to encourage fairness thanks to a balance between P_1 and P_2's contributions (e.g. the first PQ and PCh are asked alternately to both players) and efficiency is facilitated by AQ that permits M to seek agreement on several points.

A significant difference between MDG and the state of the art lies in the way it handles argumentation. In [16] and [15] players argue via locutions of the type ϕ *since S* or *argue A*. In our system, argumentation is implicit and is the result of the interactions rather than an action per se. This more closely matches evidence from empirical studies that show that arguments are created by dialogical interactions [9].

6. Conclusion and future work

In this paper we proposed a dialectical system for dispute mediation dialogues: MDG. This game aims at providing a minimal and generic framework that can be derived to

grasp other mediation subtleties. As an example, in [17], the authors identified three types of discussions in mediation (critical, bargaining and therapeutic). It would be possible to further specify MDG to play these three different types of games. Also, it would be interesting to further constrain our game by allowing strategic moves to parties; that would not only make the mediator's task tougher, but would also be more representative of what mediation discussions actually look like. After exploring these tracks and bringing improvements to our game, it will be possible to deliver the tool to mediation practitioners for evaluation.

In conclusion, this paper offers advances on both theoretical and practical sides. It extends knowledge on dialectical systems and mediation discourse, while at the same time finding a real utility in supporting the ever-growing practice of dispute mediation.

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