

# A Verifiable Protocol for Arguing about Rejections in Negotiation

[Research Abstract]

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## 1. INTRODUCTION

Recently argumentation-based approaches to negotiation have become popular [3]. The idea is that if negotiating agents exchange reasons for their proposals and rejections, the negotiation process may become more efficient and the negotiation outcome may be of higher quality. This paper especially focuses on reasons given for rejections of proposals. If an agent explains why he rejects a proposal, the other agent knows which of her future proposals will certainly be rejected so she will not waste effort at such proposals. Also, if a reason for rejection can be disputed, the negotiation process may be of higher quality since flawed reasons may be revised as a result. Accordingly, the aim of this paper is to formulate a protocol for negotiation with embedded persuasion dialogues about the reasons for rejecting a proposal. The key idea is that the propositional commitments incurred by the agents in the embedded persuasion dialogue constrain their behaviour in the surrounding negotiation dialogue.

## 2. NEGOTIATION AND ARGUMENTATION

Our proposal is stated in a dialogue game form. It combines a negotiation protocol and language of [4] with a persuasion protocol based on [2], which adapts and extends

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Table 1: Speech acts and replies in negotiation with embedded persuasion.

Acts	Attacks	Surrenders
<b>negotiation</b>		
<i>request</i> ( $\varphi$ )	<i>offer</i> ( $\varphi'$ ) <i>withdraw</i>	
<i>offer</i> ( $\varphi$ )	<i>offer</i> ( $\varphi'$ ) ( $\varphi \neq \varphi'$ ) <i>reject</i> ( $\varphi$ ) <i>withdraw</i>	<i>accept</i> ( $\varphi$ )
<i>reject</i> ( $\varphi$ )	<i>offer</i> ( $\varphi'$ ) ( $\varphi \neq \varphi'$ ) <i>why-reject</i> ( $\varphi$ ) <i>withdraw</i>	
<i>accept</i> ( $\varphi$ )		
<i>why-reject</i> ( $\varphi$ )	<i>claim</i> ( $\neg\varphi$ ) <i>withdraw</i>	
<i>withdraw</i>		
<b>persuasion</b>		
<i>claim</i> ( $\varphi$ )	<i>why</i> ( $\varphi$ )	<i>concede</i> ( $\varphi$ )
<i>why</i> ( $\varphi$ )	<i>argue</i> ( $A$ ) ( <i>conc</i> ( $A$ ) = $\varphi$ )	<i>retract</i> ( $\varphi$ )
<i>argue</i> ( $A$ )	<i>why</i> ( $\varphi$ ) ( $\varphi \in \text{prem}(A)$ ) <i>argue</i> ( $B$ ) ( $B$ defeats $A$ )	<i>concede</i> ( $\varphi$ ) ( $\varphi \in \text{prem}(A)$ or $\varphi = \text{conc}(A)$ )
<i>concede</i> ( $\varphi$ )		
<i>retract</i> ( $\varphi$ )		

work of [1]. In formally realising the combination, the key idea is to reformulate the negotiation system so that the mechanisms of relevance and dialogical status from [1, 2] can also be applied to negotiation.

In [1, 2] each dialogue move except the first replies to an earlier move in the dialogue. A reply can either be an *attacker* or a *surrender*, as indicated in Table 1. Each move in a dialogue has a *dialogical status*, which is recursively defined in terms of its replies. A move is *in* if it is surrendered or else if all its attacking replies are out. A move is *out* if it has an attacking reply that is in. Each move must reply to a *relevant target*, and a move is a relevant target if making it *out* changes the status of the first move of the dialogue.

Table 1 shows the combination of the languages of [4] and [2], where the former is adapted to the reply structure of the latter and extended with the *why-reject* locution. This locution can be used to reply to a rejection; if in turn replied-to by claiming grounds for the rejection, the negotiation dialogue shifts into a persuasion subdialogue. In a persuasion dialogue agents commit themselves to (negations of) propositions by claiming, accepting or rejecting them. We assume that a persuasion dialogue concerns the reasons that

an agent has for rejecting an offer. Therefore the commitments of agents after persuasion reflect their preferences and can be used to constrain further negotiations.

The combined protocol guides the interaction of the dialogues. Briefly, a negotiation move is allowed only if there are no legal persuasion moves, so any persuasion dialogue should have terminated before negotiation can be resumed. Furthermore, an offer is allowed only if it is consistent with the commitments of both agents. Offers must respect the reasons for rejections given by a party when these reasons have successfully been defended in persuasion.

The main property of the new protocol is about the maximum number of negotiation moves needed to reach a certain agreement. For any proposal  $\varphi$  the maximum length of a negotiation dialogue to end with acceptance of  $\varphi$  is never higher and sometimes lower in the combined system than in the negotiation system.

### 3. AN EXAMPLE

We illustrate the combined protocol with an example. Paul ( $P$ ) wants to buy a new car and informs with Olga ( $O$ ) about price and brand.

◦ $P_1$ : *request*( $brand = ? \wedge price = ?$ )

◦ $O_2$ : *offer*( $brand = peugeot \wedge price = 10000$ )

◦ $P_3$ : *reject* ( $brand = peugeot \wedge price = 10000$ )

Olga now exploits the additional features of the protocol by asking Paul why he rejected the offer.

◦ $O_4$ : *why-reject*( $brand = peugeot \wedge price = 10000$ )

Paul meets Olga's challenge of his rejection so that the negotiation shifts into a persuasion. All persuasion moves below until  $P_{14}$  reply to their immediate predecessor.

• $P_5$ : *claim*  $\neg (brand = peugeot \wedge price = 10000)$

Paul is now committed to the content of his claim.

• $O_6$ : *why* ( $\neg (brand = peugeot \wedge price = 10000)$ )

• $P_7$ : *claim* ( $\neg brand = french$ )

It turns out that Paul rejected the offer since he does not want French cars. If Olga now simply concedes Paul's claim as an alternative reply to  $P_7$ , the persuasion dialogue terminates and the negotiation is resumed. Then Olga cannot reply to  $P_3$  by offering another French car. Olga could offer a non-French car but she chooses to try to persuade Paul that he is wrong in not wanting a French car.

• $O_8$ : *why* ( $\neg brand = french$ )

• $P_9$ :  $\neg brand = french$  since french cars are unsafe which is bad

Paul defends his claim with a defeasible argument based on the default rule "what experts say is normally true".

• $O_{10}$ : *why* ( $french cars are unsafe$ )

• $P_{11}$ : *french cars are unsafe since magazine mycar says so*

Using another default rule, Olga attacks Paul's argument on the ground that this expert is biased:

• $O_{12}$ : *magazine mycar is biased since magazine mycar is german  $\wedge$  german car magazines are usually biased against french cars*

• $P_{13}$ : *concede* (*magazine mycar is german*)

• $P_{14}$ : *concede* (*german car magazines are usually biased against french cars*)

Even though Paul has conceded the premises of Olga's argument, he can still move a counterargument, since Olga's argument is defeasible:

• $P_{15}$ :  $\neg$  *magazine mycar is biased since magazine mycar has a very high reputation  $\wedge$  car magazines with high reputation usually are not biased*

Note that  $P_{14}$  is a second and  $P_{15}$  a third reply to  $O_{12}$ .

• $O_{16}$ : *why* (*magazine mycar has a very high reputation*)

Assume that Paul now realises that he cannot plausibly defend his premise that the car magazine has a high reputation. At this point, all of Olga's persuasion moves are relevant targets for Paul. He could, for instance, move another counterargument to  $O_{12}$ , or another argument why French cars are not safe or why he does not want french cars. But suppose that Paul sees no plausible way of doing so and instead retracts that he does not want French cars by moving an alternative reply to  $O_8$  and then retracting his main claim as a second reply to  $O_6$ .

• $P_{17}$ : *retract* ( $\neg brand = french$ )

• $P_{18}$ : *retract* ( $\neg (brand = peugeot \wedge price = 10000)$ )

Now Paul has no legal persuasion moves any more since all targets have become irrelevant: since Paul has surrendered to  $O_6$ , his main claim  $P_5$  cannot be changed from *out* to *in*. So the persuasion dialogue terminates and the negotiation resumes with Olga to move after  $P_2$ . Since with  $P_{18}$  Paul has ended his commitment to his main claim, Olga is now allowed to offer another French car, perhaps even a Peugeot for a lower price.

### 4. CONCLUSION

In this paper we have presented a verifiable protocol for negotiation with embedded argumentation. In doing so, we have exploited the general format of [1, 2] of dialogue systems. In the resulting dialogue game reasons for rejections can be asked and, when given, can constrain further offers unless the offering agent can persuade the rejecting agent that the reason is not tenable. Thus a negotiation is sometimes more efficient since offers that will certainly be rejected can be avoided, and it is sometimes of higher quality since flawed reasons can be revised. The persuasion protocol is flexible in that it allows for different underlying logics, for alternative replies and for postponing replies, sometimes even indefinitely. Yet a strong focus of dialogues is maintained through the requirement of relevance.

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