Knowing when to bargain:
The roles of negotiation and persuasion in dialogue

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Abstract. In this paper two formal dialectic systems are described, a persuasion protocol (PP_0) and a negotiation protocol (NP_0), together with a method for shifting from an instance of a persuasion dialogue to an instance of a negotiation dialogue. The rationale for this kind of shift is explored in the context of the fallacy of bargaining. Such a dialectical shift is proposed as a valuable way to enable the participants in an argumentative dialogue to proceed towards a practical settlement when they are otherwise unable to persuade each other and thereby bring about a resolution of their conflicts.

1 Introduction

A typical situation in argumentative dialogue occurs when one party attempts to persuade another party to accept some standpoint. This involves notions of attack and defence as the parties attempt to justify their own position whilst refuting that of their opponent. However, because the participants are autonomous entities they will each evaluate the proffered arguments on their own terms. An argument that party A believes is sufficient to persuade party B isn't necessarily the same argument that B would accept and would thus be persuaded. What should occur when A cannot persuade B? If getting B to accept the standpoint is important to A, then A should have available an alternative tactic for reaching agreement in those situations where a sufficiently persuasive argument cannot be brought to bear.

In real-world argument many people resort to bargaining when they are unable to persuade their opponent. For example, Harry and Sally are arguing about who should do the washing up. Both have stated that they will not do the washing up and that the other should do it. Sally tries to persuade Harry to do the washing up and defends her position, when it is inevitably attacked, by stating that she always does the washing up and asks why Harry can't do it for a change. Harry justifies his refusal to do the washing up with the defence that he has just hoovered the living room and so he shouldn't have to do both jobs. Domestic conflicts such as this are a common occurrence that are often resolved when an offer is made, for example, Harry concedes he will do the washing up if Sally will take the rubbish out. This is not a concession based upon Sally's superior persuasive argument but based upon a wider view of the situation and the need to reach a practical settlement. The fact that the rubbish needed to be taken out was not an issue that was raised in the preceding persuasion dialogue but was an issue that could be raised during a negotiation dialogue.

As demonstrated in the domestic strife example, when a party cannot get their standpoint accepted through justification of that standpoint an alternative tactic is to enter into some sort of negotiation over the issue to determine;

1. what it would take to get the standpoint accepted by the other party, and, failing that,
2. to determine what alternative (possibly reduced) standpoint B might accept if it turns out that the original standpoint is unlikely ever to be acceptable.

This kind of situation can be characterised as the movement within a dialogue from a persuasion-type sub-dialogue to a negotiation-type sub-dialogue. This paper introduces two formal dialectic systems named Persuasion Protocol $_0$ (PP_0) and Negotiation Protocol $_0$ (NP_0), together with a method for moving from a persuasion sub-dialogue carried out in accordance with PP_0 to a negotiation sub-dialogue carried out in accordance with NP_0. The aim is to demonstrate that this particular shift, from persuasion to negotiation, can be a useful way to proceed when a persuasion dialogue is unlikely to reach a stable agreement. These results can then be applied to computational models of argument such as those for use in multiagent systems. Agents may have many more capabilities than those that are relevant to the current persuasion dialogue. If $agent_1$ cannot persuade $agent_2$ then $agent_1$ may use the opportunity to shift to a negotiation dialogue in which a concession might be won.

2 Background

This paper deals with a number of topics in argumentation including the use of formal dialectic systems to model the interactions between participants in an argumentative dialogue, the recognition that dialogues conform to a number of distinct types, and that given a formal dialectic system which models the interactions in a particular type of dialogue, there will arise the need to shift from a dialogue of one type to a dialogue of another type, and hence transition from one dialectic system to another.

Formal Dialectic Systems Dialogue games have been proposed as a means to model the interactions between participants during argumentative dialogues. One branch of dialogue game research is into the formal dialectic system [5]. Formal dialectic systems are two-player, turn-taking games in which the moves available to the players represent the locutional acts or utterances made by the participants of a dialogue. Many dialectic systems have been proposed based on the characterisations of a range of dialogical situations, for example, Hamblin's system [5] and Mackenzie's DC [6] are targeted towards fallacy research whilst Walton and Krabbe's system PPD_0 [15] models the interactions between parties in a permissive persuasion dialogue. Girle introduces a number of systems which are aimed at modelling belief revision in A.I. systems [2, 3, 4]. McBurney and Parsons specify some games for use in communication between agents in multiagent systems [8]. Bench-Capon *et al.* introduce

a system for modelling dialectical argument called the Toulmin Dialogue Game [1] that is based upon the argument schema of Toulmin [12].

Dialogue Typologies   Dialogue can categorised into types and are distinguished based upon a range of characteristics such as initial situation, the overall goal and the participant's individual aims. An influential but partial typology of such dialogue types which includes information-seeking, persuasion, negotiation, deliberation, and inquiry can be found in [15]. This paper is concerned primarily with the negotiation and persuasion types of dialogue although the findings can be extended to incorporate the other dialogue types identified by Walton and Krabbe.

Negotiation Dialogues   In multiagent systems research, negotiation is often characterised as a means to distribute limited resources between competing agents. Negotiation dialogues can be used to determine the distribution of those resources between the conflicting parties. In the Walton and Krabbe typology negotiation dialogues are characterised by a conflict of interests and a need for cooperation leading to a practical settlement.

Persuasion Dialogue   Persuasion dialogues occur when there is a conflict and the participants attempt to reach a stable agreement or resolution of the issue that gave rise to the conflict. Walton and Krabbe specify a formal dialectic system to model the interactions during persuasion dialogues name PPD_0.

Progression Between Dialogue-types   The notion of embedding an instance of one type of dialogue within an instance of another type of dialogue was proposed in [15] and various other approaches have been proposed including Reed's Dialogue Frames [10], and the layer model of McBurney and Parsons [7]. The core idea is to enable the participants in a dialogue to move from a sub-dialogue of one type to a sub-dialogue of another type where each sub-dialogue has its own specification of rules governing how a dialogue of that type should progress. The notion of embedding persuasion sub-dialogues within an ongoing negotiation dialogue has been explored quite extensively by Sycara in relation to the PERSUADER system [11], and by Rahwan [9] in relation to argument-bsaed negotiation in multiagent systems. However the converse situation of embedding negotiation sub-dialogues within a persuasion dialogue has not been explored specifically except as a by-product of enabling embeddings and shifts in general.

3   The fallacy of Bargaining

Walton and Krabbe identify in [15] that shifts from one type of dialogue to another may be either licit or illicit. A licit shift occurs when the shift is constructive and agreed to by all parties. When a shift is concealed or otherwise inappropriate then it is illicit. Walton argues that a characteristic of many fallacies is that they occur where shifts in the dialogue are illicit [14]. In [15] the fallacy of bargaining is identified as occuring when participants are engaged in a dialogue which starts out as a persuasion but that at some point during the course of the dialogue an illicit shift occurs from persuasion to negotiation.

The example of the fallacy of bargaining used by Walton and Krabbe involves a government minister of finance who has been caught profiting from certain tax exemptions. The minister argues

that those tax exemptions should be allowed temporarily and not be penalized. The minister then goes on to propose to his critics that if they abstain from moving for penalties for the exemptions, then he will not oppose a bill that the critics will benefit from. In this case, instead of satisfying his burden of proof with respect to his position on the tax exemptions, the minister substitutes an offer for an argument, a move which is not permissible in persuasion dialogues. By making an offer during the persuasion dialogue the minister has reneged on his commitment to defend his position, *vis a vis* the tax exemptions, and caused an illicit shift to a negotiation dialogue.

However, the shift from persuasion to negotiation need not always be an instance of the fallacy of bargaining. As Walton and Krabbe recognise, illicit shifts occur when the shift is concealed or inappropriate and a fallacy can occur as a result, If the shift occurs in an open way, and is demonstrated to be appropriate then there is no need to characterise it as fallacious. Where conflicting participants in a dialogue have exhausted their persuasive arguments and are in a position that is unlikely to be resolved through continuation of the persuasion dialogue then it is acceptable for the participants to try some other way to break the deadlock. In this case, the persuasion dialogue has failed because a stable agreement has not been reached. Given that both participants actually wish to resolve the conflict, which is the reason why they are still engaged in the dialogue at this point, a shift to another type of dialogue enables the participants to continue. If the shift is from a persuasion dialogue to a negotiation dialogue then the participants may be able to reach a practical settlement and so be able to move forward.

The dialogue protocols presented in this paper together with the associated machinery to effect dialogue shifts are aimed at demonstrating two points. Firstly that not all shifts from persuasion to negotiation dialogues need be instances of the fallacy of bargaining, and secondly that these kinds of shifts can be utilised to enable participants who would otherwise have reached an impasse to continue.

4   The systems: PP_0 and NP_0

The two formal dialectic systems, PP_0 and NP_0 are represented using the unified specification format introduced in [16]. This representation is part of a unified framework for representing, rapidly implementing and deploying formal dialectic systems called the Architecture for Argumentation (A4A). To facilitate this, the framework incorporates a range of general machinery for representing dialectic systems. This machinery is then tailored to the needs of a specific dialectic system. The dialectic system itself is designed to model the interactions between participants during a particular dialogical situation. In this case PP_0 is formulated to model persuasion dialogues and NP_0 is formulated to model negotiation dialogues.

The reason for the A4A representation is twofold; to simplify and unify the representation of formal dialectic systems and to enable the construction of a common engine for running those systems so represented. The traditional layout of formal dialectic involves specifying a number of groups of rules that govern a range of capabilities of the system such as commitment store updates and legal sequences of moves. This approach is adequate but can obscure comprehension of which moves are legal at any given point in a dialogue and the exact effect of playing any of those moves. The A4A approach specifies the range of rules which can be used to layout a dialectic system. These rules are grouped together to facilitate understanding and transparency of the overall system. The gross structure of an A4A layout involves specification of the type and capabilities of a number of basic components, followed by a prescription of global

rules. Finally a collection of moves is laid out. Basic components include a unique identifier for the system, a turn-structure, identifiers for the participants and the setting up of stores for any artifacts created during the dialogue. Global rules are used to identify a range of conditions that can arise during a dialogue and specify what should be done when those conditions arise. In the case of PP_0 and NP_0 these include rules that hold when a new dialogue is entered, rules that govern transitions between sub-dialogues, e.g. from a PP_0 sub-dialogue to an NP_0 sub-dialogue, and rules that specify when a dialogue should terminate. The rules that concern individual moves are grouped together so that it is immediately apparent when the move can legally be played and what the effect of playing that move is.

PP_0 is a protocol tailored towards persuasion-type dialogues.

System Name PP_0

Turn Structure $= \langle$Determinative, Single-Move$\rangle$

Participants $= \{$init, resp$\}$

Artifact Stores :
$\quad \langle$CStore, init, Mixed, Set, Light, Global$\rangle$
$\quad \langle$CStore, resp, Mixed, Set, Light, Global$\rangle$

Global Rules :

    Initiation
        Requirements:
            $T_{current} = 0$
        Effects:
            $T_{next\_move}^{init} = \langle$Request, (goal)$\rangle$

    Progression
        Requirements:
            $S \in CStore_1^{init} \wedge S \in CStore_{current}^{init} \wedge$
            $T_{last}^{resp} = \langle$ Reject, (S) $\rangle$
        Effects:
            $(System=NP_0) \vee (System=PP_0)$

    Termination
        Requirements:
            $S \in CStore_1^{init} \wedge (S \notin CStore_{current}^{init} \vee$
            $S \in CStore_{current}^{resp}) \vee$
            $T_{last\_move} = \langle$Withdraw$(-)\rangle$
        Effects:
            $Dialogue_{status} = $ complete

Moves :

    $\langle$**Request, (S)**$\rangle$
        Requirements:
            ∅
        Effects:
            $T_{next\_move}^{listener} = \langle$ Accept, (S) $\rangle \vee \langle$ Reject, (S) $\rangle \vee$
            $\langle$ Challenge, (S) $\rangle \wedge$
            $CStore_{current}^{speaker} + S$

    $\langle$**Accept, (S)**$\rangle$
        Requirements:
            $T_{last\_move}^{listener} = \langle$ Request, (S) $\rangle$
        Effects:
            $CStore_{current}^{speaker} + S \wedge CStore_{current}^{speaker} - \neg S$

    $\langle$**Reject, (S)**$\rangle$
        Requirements:
            $T_{last\_move}^{listener} = \langle$ Request, (S) $\rangle$
        Effects:
            $T_{next\_move}^{listener} = \langle$ Challenge, (S) $\rangle \vee \langle$ Withdraw, (–) $\rangle \wedge$
            $CStore_{current}^{speaker} + \neg S \wedge CStore_{current}^{speaker} - S$

    $\langle$**Challenge, (S)**$\rangle$
        Requirements:
            $T_{last\_move}^{listener} = \langle$ Request, (S) $\rangle \vee \langle$ Reject, (S) $\rangle \vee$
            $\langle$ defence, (S'$\rightarrow$S) $\rangle$
        Effects:
            $T_{next\_move}^{listener} = \langle$ defence, (S'$\rightarrow$S) $\rangle \vee \langle$ Reject, (S) $\rangle \vee$
            $\langle$ Withdraw, (–) $\rangle$

    $\langle$**defence, (S'$\rightarrow$S)**$\rangle$
        Requirements:
            ∅
        Effects:
            $T_{next\_move}^{listener} = \langle$Challenge, (S)$\rangle \vee \langle$Challenge, (S')$\rangle \vee$
            $\langle$Challenge, (S'$\rightarrow$S)$\rangle \vee \langle$reject, (S'$\rightarrow$S)$\rangle \vee \langle$reject, (S)$\rangle \vee$
            $\langle$reject, (S')$\rangle \vee \langle$accept, (S'$\rightarrow$S)$\rangle \vee \langle$accept, (S)$\rangle \vee$
            $\langle$accept, (S')$\rangle$
            $CStore_{current}^{speaker} + S \wedge CStore_{current}^{speaker} + S' \wedge$
            $CStore_{current}^{speaker} + S' \rightarrow S$

    $\langle$**Withdraw, (–)**$\rangle$
        Requirements:
            $T_{last\_move} = \langle$Challenge(S)$\rangle \vee \langle$Reject(S)$\rangle$
        Effects:
            ∅

PP_0 enables two players named *init* and *resp* to engage in a persuasion dialogue. Players can make one move per turn, starting with init. The turn structure means that turns procede automatically, after one player makes their move, the next player has their turn and so on, such that it can be seen from examination of the current turn index which players move it is. The actual moves that are played cannot influence which player is assigned the speaker role in the next turn and thus cannot influence whose turn it is. Each player is assigned an artifact store named CStore. The remaining parameters specify that the store can contain a mixture of commitment types, for example a player can incur commitment to just the content of a move or to the entire move, that the store is a light side store [13] which stores a set of commitments and that the stores are to be shared between sub-dialogues of differing types. PP_0 incorporates three types of global rule. These rules specify the requirements for starting a new instance of a PP_0 sub-dialogue, the requirements for initiating a progression from an instance of a PP_0 sub-dialogue to a new instance of another sub-dialogue type, and the conditions for terminating a PP_0 dialogue.

When a new sub-dialogue of type PP_0 is begun the initiation rules require only that the very next move, in this case the first move of the new sub-dialogue, must be a request. For a progression to to be legal it is required that the player who initiated the PP_0 instance still be committed to their initial thesis and that the last move played in the immediate previous turn was a rejection of that initial thesis by the respondent. These conditions establish that a progression is legal at this point in the dialogue, and that the next move may be from the set of moves allocated to the NP_0 system. The current player may elect to continue in the current dialogue without progressing to another dialectic system. For example, the progression rules of PP_0 only establish that a transition is legal, not that it must occur. To actually initiate a progression at this point requires the player to make a legal move from the NP_0 move set according to the initiation rules for NP_0.

It should be noted that the particular formulation of progression rules in PP_0 could be folded into the effects of the reject move but that in the wider context of the A4A this approach increases the flexibility of the overall system. This flexibility allows systems to be created in which the conditions for a legal progression between sub-dialogues

can occur based on the state of the system's components regardless of the actual move which has just been played.

It is important that a computational model of argument include a clear formulation for when the system should terminate. This helps avoid the implementational problems that can occur when adopting a dialectic system which has no formulation for termination rules.In these case the implementors must add rules to the core system to determine when a dialogue should terminate. This can lead to many variations on the core system. The termination rules of PP_0 require that either the withdraw move has been played, or that the initial thesis of the initiator has either been withdrawn by the initiator or accepted by the respondent.

PP_0 allows six distinct moves. Each move specification incorporates a formulation of requirements for when the move is legal, and a formulation of effects that must be applied when the move is played. The request move is an utterance of the form "Will you S?", and has no requirements. The effects of playing the request move are that the content of the move is added to the speaker's commitment store and that the legal responses are the accept, reject and challenge moves. The accept move enables a player to agree to a request and is of the form "OK S". Conversely the reject move enables a player to disagree with a request and is of the form "Not S". The challenge move is formulated to enable a player to get justification for a previous request, reject or defence move and is of the form "why S?". The defence move enables a player to defend their challenged position by providing a supporting statement of grounds and by stating an inferential link between the challenged position and the justifying statement. The withdraw move is essentially an utterance of the form "I withdraw from this dialogue", and the rationale is to allow either player the opportunity to withdraw from the dialogue. If either player determines that the dialogue is unlikely to end successfully then it is more computationally efficient to leave the dialogue cleanly at the first subsequent opportunity rather than continue.

PP_0 only allows a player to incur commitment on their own behalf. This is achieved through the formulation of effects for each move which only update the commitment store of the speaker. The only moves which incorporate a commitment effect are the request, accept, reject and defence moves. The challenge move does not incorporate a commitment effect, like the commitment to challenges of DC [6], but rather allows the receiver of the challenge to immediately withdraw from the dialogue without penalty. This enables the participants to produce a number of different justifications in response to a challenge by engaging in several iterations of the challenge-defence sequence. This enables some tactical play to emerge in PP_0 persuasion dialogue whereby a player can repeatedly challenge a statement to uncover the underlying justifications for that statement, but if the player is too persistent then their opponent may choose to withdraw from the dialogue entirely. To avoid withdrawal, it is incumbent upon the challenging player to determine when they are unlikely to be able to persuade their opponent and may have more success engaging in a negotiation dialogue instead. As established earlier, the progression rules set out only when it is legal to transition to a new sub-dialogue, not that that transition must occur.

This particular formulation of progression rules does not wholly alleviate the possible charge of a fallacy of bargaining being committed. However some effort is made to avoid that situation. A progression is only legal, at the very earliest, after a request has been made and that request has been rejected outright by the respondent. The respondent could have challenged the request and the initiator would have been obliged to provide a defence to justify their initial request. It may actually be in the interests of the initiator for the persuasion

dialogue to continue because, so long as they have some argument to support their position they may be able to persuade the respondent whereas conversely it can be in the interests of the respondent to enter into negotiation to get some concessions from the initiator. It is only in the event that the initiator has no argument to justify their position and must make an offer in lieu of a defence or withdraw from the dialogue, that it is in the initiators interests to move straight to a negotiation dialogue. A stronger formulation of progression rules would require that the initiator had previously provided at least one defence of their initial thesis before a progression could become legal. This would require the progression rules to check that $CStore^{init}$ contains at least one defence of the initial thesis. This would avoid the kind of fallacy of bargaining attributed to the minister of finance in the Walton and Krabbe example discussed earlier because the initiator would have actually provided a defence in support of their request so the initiator is fulfilling the commitment to defend their position rather than resorting immediately to bargaining.

NP_0 is a protocol tailored towards negotiation-type dialogues. PP_0 is aimed at persuading a player to accept a request through successive rounds of challenge and justification. This type of dialogue requires that arguments be brought to bear which hold direct relations to the issue in question. For example, it is assumed that the defence of a challenged request lends at least some support to the request which was challenged in the first place. Likewise, an argument that is extended in defence of a request should provide relevant support for why that request should be accepted. In a negotiation the players may make offers in support of their goal. The offers however need not pertain directly to the goal. Walton and Krabbe recognise in [15] that the swapping of one concession for another is a characteristic of negotiation. In the context of a multiagent system implementation, the agents may have many different capabilities, many of which are not pertinent to the issue at hand but which may be offered as part of a deal in order to get the goal accepted. This kind of dialogue is characterised by offer-counter offer sequences. The rules of NP_0 are as follows;

System Name NP_0

Turn Structure $= \langle \text{Determinative, Single-Move} \rangle$

Participants $= \{\text{init, resp}\}$

Artifact Stores :
  $\langle \text{CStore, init, Mixed, Set, Light, Global} \rangle$
  $\langle \text{CStore, resp, Mixed, Set, Light, Global} \rangle$

Global Rules

  Initiation
    Requirements:
    $S \in CStore_1^{init} \wedge S \in CStore_{current}^{init} \wedge S \notin CStore_{current}^{resp}$
    Effects:
    $T_{next\_move}^{speaker} = \langle \text{Offer, (S, proposal)} \rangle$

  Termination
    Requirements:
    $S \in CStore_1^{init} \wedge (S \notin CStore_{current}^{init} \vee S \in CStore_{current}^{resp}) \vee$
    $T_{last\_move} = \langle \text{Withdraw(–)} \rangle$
    Effects:
    $\text{Dialogue}_{status} = \text{complete}$

Moves

  $\langle \text{Offer, (goal, proposal)} \rangle$
    Requirements:
    $\langle \text{Offer, (goal, proposal)} \rangle \notin CStore_{current}^{speaker}$
    Effects:
    $(T_{next\_move}^{listener} = \langle \text{Accept, (proposal)} \rangle \vee \langle \text{Reject, (proposal)} \rangle \vee$

$\langle$Offer, (goal, proposal$'$)$\rangle$ $\vee$ $\langle$Offer, (goal$'$, proposal)$\rangle$ $\vee$
$\langle$Offer, (goal$'$, proposal$'$)$\rangle$ $\vee$ $\langle$Withdraw, (–)$\rangle$) $\wedge$
$CStore^{speaker}$ + goal $\wedge$
$CStore^{speaker}$ + proposal $\wedge$
$CStore^{speaker}$ + offer(goal, proposal)

$\langle$Accept, (goal, proposal)$\rangle$
   Requirements:
   $T^{listener}_{last\_move}$ = $\langle$Offer, (goal, proposal)$\rangle$
   Effects:
   $CStore^{speaker}$ + goal $\wedge$
   $CStore^{speaker}$ + proposal $\wedge$
   $CStore^{speaker}$ + offer(goal, proposal)

$\langle$Reject, (goal, proposal)$\rangle$
   Requirements:
   $T^{Hearer}_{last\_move}$ = $\langle$Offer, (goal, proposal)$\rangle$
   Effects:
   ($T^{listener}_{next\_move}$ = $\langle$Offer, (goal, proposal$'$)$\rangle$ $\vee$
   $\langle$Offer, (goal$'$, proposal)$\rangle$ $\vee$ $\langle$Offer, (goal$'$, proposal$'$)$\rangle$)

$\langle$Withdraw, (–)$\rangle$
   Requirements:
   T_{last_move} = $\langle$Offer(goal, proposal)$\rangle$ $\vee$
   $\langle$Reject(goal, proposal)$\rangle$
   Effects:
   Ø

The initial setup for an NP_0 dialogue is similar to that for a PPC_0 dialogue. Both systems utilise the same number of and types of commitment store, the contents of which are preserved between progressions from one sub-dialogue to another. Both players retain their participant identifiers in an NP_0 sub-dialogue that were established in the preceding PP_0 sub-dialogue. The similar setups are necessary to enable a clean progression from one sub-dialogue to the next, and a possible subsequent return to the original dialogue type. This approach also enables a consistent representation of supporting machinery between the two systems as required by the A4A.

The global rules for NP_0 specify initiation and termination rules. The initiation rules establish that the initiator has some initial thesis in their commitment store and that that same initial thesis is not present in the respondent's commitment store. The initiation rules also establish that an NP_0 dialogue must begin with an offer move in which the initiator states the goal that they are trying to achieve, in this case the goal is actually the initial thesis which was established at the very beginning of the encompassing persuasion dialogue, along with a proposal that they are willing to concede to get the goal accepted. An NP_0 dialogue can terminate when either the initiator has withdrawn their initial thesis, or the respondent has accepted the initial thesis, or the withdraw move is uttered.

Because of the formulation of the initiation rules, the profiles of dialogues carried out according to NP_0 are slightly assymetrical. Although all the moves are conceivably available to all participants, i.e. there are no moves that can only be played by either the initiator or the respondent, an NP_0 dialogue will always start with the initiator making an offer that is based upon the initial thesis instantiated at the beginning of the prior PP_0 dialogue.

NP_0 incorporates four moves which enable basic bargaining behaviour. The offer move, in the context of a negotiation over action, can be assumed to have the following form, "If you accept X, I will concede Y", where X is some goal that the offerer wants the offeree to achieve and Y is the concession that the offerer is willing to make

to achieve X. The offer move requires that the speaker has not previously made the same bid. In the case above, all of X, Y, and the utterance *offer(X, Y)* will be added to the speakers commitment store, so NP_0 allows commitment to offers as well as commitment with respect to the individual statements that comprise the offers. The requirements for this move stop the speaker from repeating a bid that they have already offered.

The offer move is designed to be recursive and can be followed in a subsequent turn by a counter offer. NP_0 recognises four varieties of offer. The first is the initial offer in a negotiation. The remainder are various types of counteroffer in which either, the goal remains the same and the proposal is altered, the goal is altered and the proposal remains the same, or the goal and the proposal are both altered. In the two instances of counteroffers where the goal is altered, it is assumed that the goal is a reduced or related version of the initial goal but the rules do not enforce this. Given the initial offer, "If you accept X, I will concede Y", it should be noted that in the counter-offers the participants are inverted so that the offer should be read as the inversion of the previous offer; for example the first variety of counteroffer is of the form, "I will accept X, If you concede Y$'$", the second variety is of the form, "I will accept X$'$, if you concede Y", and lastly the final type of counteroffer is of the form, "I will accept X$'$, If you concede Y$'$". Notice that because NP_0 dialogues are not entirely symmetrical it is always the case that the goal refers to something that the respondent should accept and that the proposal refers to something that the initiator is conceding. After an initial offer is made the next move can be either outright acceptance or rejection of the offer, or one of the varieties of counteroffer. The accept move enables a player to agree to a given offer and adds the components of the offer and the offer itself to the speakers commitment store so that a player actively commits themself to accept an offer. The reject move enables a player to not accept a proposed offer. Finally the withdraw move is similar to that for withdraw in PP_0.

It should be noted that NP_0 includes no progression rules to govern either return to the parent persuasion dialogue or to enter a new instance of persuasion or negotiation dialogue as a child of the current NP_0 dialogue. This was a purposeful omission partly to aid clarity and partly because although a nice capability it is not required to demonstrate either the use or the utility of the progression from persuasion to negotiation during a dialogue. The machinery of the A4A architecture is sufficiently flexible to enables such transitions to be specified as required either in a manner similar to that used for PP_0 or by specification of a particular move which leads to a progression as part of the effects of playing that move.

5 Example Dialogue

The following dialogue fragment illustrates the canonical embedding of an NP_0 sub-dialogue within a PP_0 dialogue. The dialogue is situated within a multiagent distributed computation scenario. Each agent has various capabilities, tasks that it can perform. A key aspect is that no single agent knows all other agents within the system or has complete knowledge of the system. The dialogue fragment is as follows:

The fragment involves two agents, $agent_1$ and $agent_2$. The dialogue is initiated by $agent_1$ who becomes the initiator and requests of $agent_2$ who becomes the respondent to perform task S_1. S_1 is added to the initiator's commitment store. In turn 2 the respondent challenges the request which, because of the burden of proof required by a persuasion dialogue, means that the initiator must defend the standpoint established in turn T_1. At T_3 the initiator defends their stand-

Turn	Player	Move	CStore^{init}	CStore^{resp}
1	init	Request(S_1)	S_1	–
2	resp	Challenge(S_1)	–	–
3	init	Defence($S_2 \rightarrow S_1$)	$S_2, S_2 \rightarrow S_1$	–
4	resp	Challenge(S_1)	–	–
5	init	defence($S_3 \rightarrow S_1$)	$S_3, S_3 \rightarrow S_1$	–
6	resp	Reject(S_1)	–	–
7	init	Offer(S_1, S_4)	S_4, Offer(S_1, S_4)	–
8	resp	Offer(S_5, S_6)	–	S_5, S_6, Offer(S_5, S_6)
9	init	Offer(S_1, S_7)	S_7, Offer(S_1, S_7)	–
10	resp	Accept(S_1, S_7)	–	S_1, S_7, Offer(S_1, S_7)

point and the defence is added to the initiator's commitment store. At T_4 the respondent is not pursuaded by the initiator's defence and again challenges S_1. The initiator responds at T_5 with another defence of S_1 and the initiator's commitment store is again updated. In T_6 the respondent rejects the initiator's standpoint S_1. At this point the requirements of the progression rules of PP_0 are met and a shift can legally occur from the PP_0 dialogue to an NP_0 dialogue. The initiator need not utilise this progression however. If the initiator, for some reason, still has an argument that it can use to support S_1 then the PP_0 dialogue can continue. In this case though the initiator does not have a further argument to support S_1 so takes the opportunity to shift to an NP_0 dialogue. The initiator achieves this by playing the offer move at T_7 in accordance with the initiation rules of NP_0. Following the shift to the NP_0 dialogue and the initiatory offer move, the respondent responds in T_8 with a counter-offer which includes both a different goal and a different proposal to that offered in T_7. At T_9 the initiator makes another counter-offer again involving the initiators original standpoint, but this time including a new concession S_7. the concessions extended in the offer moves may, in the context of the multiagent system scenario, correspond to particular capabilities of the participating agents who offer to perform certain actions in exchange for acceptance of the initial standpoint. At T_{10} the respondent accepts the offer extended in T_9 which incorporates the standpoint originally established in T_1. At this point the termination rules of NP_0 are met and the status of the dialogue is complete.

This fragment illustrates the use of PP_0 to engage in a persuasion dialogue followed by a shift to a negotiation dialogue when the arguments of the initiating player are rejected. This is a very useful capability because it means that once the participant's persuasive arguments are exhausted they still have techniques which can allow them to reach an agreement. Without the negotiation protocol and the mechanism for shifting from a persuasion dialogue to a negotiation dialogue the dialogue would have ended much sooner without an acceptable outcome.

6   Conclusions

In this paper a situation was characterised in which the participants in an argumentative dialogue are unable to resolve their conflict through persuasive arguments. The notion of the fallacy of bargaining was introduced as a real-world tactic that is used to get agreement whereby instead of defending their standpoint from attack, the defendent makes an offer to their challenger which involves some unrelated concession. Such a fallacy involves an illicit shift from a persuasion dialogue to a negotiation dialogue. The proposal was made that so long as the shift is licit, i.e. that the shift is clearly and transparently made, and that the shift is not made in order to escape the burden of proof of defending a standpoint, then such a shift does not lead necessarily to a fallacy of bargaining ocurring.

Given this, then in the failed persuasion scenario the participants could shift from a persuasion dialogue to a negotiation dialogue once they ran out of arguments, either to persuade their opponent or to justify their own position. Once in the negotiation dialogue the participants could make offers to each other in relation to the original issue. Such offers, instead of involving persuasive justifications of their standpoints, involve proposing concessions that could be made which aren't necessarily related to the issue at hand. To illustrate the situation, a pair of formal dialectic systems named PP_0 and NP_0 were introduced along with a mechanism for facillitating the required dialogue shift.

The next step is to refine the formulations of PP_0 and NP_0 into PP_1 and NP_1 to enable bi-directional shifts between PP and NP dialogues as well as shifts to sub-dialogues of other types.

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