A Formal Model of Adjudication

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Abstract

This article presents a formal dialogue game for adjudication dialogues. Existing AI & law models of legal dialogues and argumentation-theoretic models of persuasion are extended with a neutral third party, with the aim to give a more realistic account of the adjudicator's role in legal procedures. The main feature of the model is a division into a pleadings phase, where the adversaries plea their case and the adjudicator has a largely mediating role, and a trial phase, where the adjudicator decides the dispute on the basis of the claims, arguments and evidence put forward in the pleadings phase. The model allows for explicit decisions on admissibility of evidence and burden of proof by the adjudicator in the pleadings phase. Adjudication is modelled as putting forward arguments, in particular undercutting and priority arguments, in the trial phase. It is claimed that the model reconciles logical aspects of burden of proof induced by the defeasible nature of arguments with dialogical aspects of burden of proof as something that can be allocated by explicit decisions on legal grounds.

1   Introduction

This article[1] studies the formal modelling of the role of third parties in procedures for dispute resolution. The procedural aspects of legal reasoning have been a main research topic in AI & Law since the early nineties, when researchers started to realise that legal reasoning is bound not only by the rules of logic and rational inference but also by those of fair and effective procedure. This 'procedural turn' was initiated by two papers, Gordon (1993) and Hage et al. (1994), and further pursued in e.g. (Bench-Capon; 1998; Prakken and Gordon;

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[1]This article extends, revises and simplifies Prakken (2001b).

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1998; Lodder; 1999; Hage; 2000; Vreeswijk; 2000; Leenes; 2001; Prakken; 2001b); see also Brewka (2001). The main focus of this area is the integration of logical models of legal reasoning (especially those using tools from nonmonotonic logic) with dialogue game models of argumentation. The resulting models regulate the use of argumentative speech acts, such as making, disputing and conceding claims and putting forward argument and counterarguments, and they define the outcome of a dispute in terms of the effects of these speech acts on the 'information state' of the dispute. The main guiding idea is that of procedural justice, according to which the quality of a legal decision not only depends on its content but also on how it was reached. This is partly inspired by the analogous idea of procedural rationality, defended by e.g. Toulmin (1958); Rescher (1977) and Loui (1998) (who interestingly were in turn inspired by the analogy with legal procedures).

Although all this work has been very valuable, further research is needed. Most AI & Law work so far has concentrated on two-part dialogues between two adversaries. If the judge's role is modelled at all, it is limited to some very simple activities, such as regulating turntaking Bench-Capon (1998); Bench-Capon et al. (2000) or determining the truth of the parties' claims by simply saying "true" or "false" Hage et al. (1994); Brewka (2001). Yet in actual legal procedures judges have a much more elaborate role. The main aim of the present paper is to show how procedural models of legal argument can give more realistic accounts of the judge's role in legal disputes. I will focus in particular on aspects that are directly relevant for the outcome of a dispute, viz. rulings on burden of proof and admissibility of evidence, and the adjudication of the conflict in the judge's final decision. Thus I hope to clarify the relation between the logical and procedural aspects of legal reasoning.

More generally, this paper will contribute to the study of dialogue in argumentation theory. So far most studies of the dialogical aspects of legal reasoning have, either explicitly or implicitly, applied the model of so-called persuasion dialogue as developed in argumentation theory (Mackenzie; 1979; Walton and Krabbe; 1995; Prakken; 2006). In persuasion dialogues two self-interested parties aim to persuade each other that they are right and the other is wrong. Although this is clearly what happens between a plaintiff and defendant in a civil case and between prosecutor and accused in a criminal case, the persuasion model leaves no room for an adjudicator. In persuasion as modelled in argumentation theory the disagreeing parties are in full control of the outcome: if they do not want to admit that they are wrong, they cannot be forced to do so. In legal procedures, by contrast, the outcome ultimately depends on the judge's decision, so in legal procedures the disagreeing parties should not persuade each other but the adjudicator. In other words, legal procedure does not fully fit the model of persuasion dialogue. Accordingly, one aim of this paper is to add a model of so-called adjudication dialogues to the study of formal dialectics in argumentation theory.

This paper is organised as follows. In Section 2 the characteristics of adjudication processes will be described in more detail, after which in section 3 the formal tools used in this paper will be introduced, viz. formal dialectics, logics

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for defeasible argumentation and my own framework for persuasion dialogues. Section 4, which forms the heart of this paper, extends and instantiates my persuasion framework to a three-player dialogue game for adjudication. This game is illustrated with some examples in Section 5 and more generally discussed in Section 6.

2 Characteristics of adjudication

In this section the characteristics of adjudication procedures will be discussed as far as they are relevant for present purposes.

2.1 Overview

A typical adjudication process takes part between two adversaries who have a conflict of opinion and a neutral third party who moderates and adjudicates the conflict. The adversaries and third party will below be called *proponent*, *opponent* and *adjudicator*, respectively. Typically, a process consists of two parts, a *pleadings phase* in which the adversaries plea their case before the adjudicator and respond to each other, and a *trial phase* in which the adjudicator decides the conflict. In the pleadings phase the adversaries make, dispute, concede and retract claims, and provide arguments for their claims or against arguments of the other adversary. The adjudicator can have various roles during the pleadings phase, such as monitoring whether the adversaries obey the procedural rules, defining the scope of the dispute by deciding what may and may not be taken into account (such as whether evidence is admissible), allocating the burden of proof and regulating turntaking and termination.

Burden of proof is one of the central notions of legal procedure. In the literature it has been argued that the burden of proof can be allocated by formalising legal rules with the proper knowledge representation techniques from nonmonotonic logic; see e.g. Sartor (1995). Although this approach works under certain assumptions, it fails to capture that in legal procedure the allocation of the burden of proof is ultimately a matter of decision by the judge, and therefore cannot be determined by logical form alone. Any full model of reasoning under burden of proof should leave room for such decisions, and this is what I shall do, by incorporating a special speech act for allocations of the burden of proof.

As I discussed earlier in Prakken (2001a,b), the burden of proof involves two elements. The first is what is sometimes called the *burden of production*, which is the burden to provide grounds in support for a claim, or in present terms an *argument* for the claim. The second is sometimes called the *burden of persuasion*, which is the task to successfully defend this argument in dispute. This in turn involves two aspects: whether the argument is strong enough to support the claim in the absence of counterarguments (*internal validity*) and whether it survives the competition with its counterarguments (*dialectical validity*). The idea of this paper is that the burden of production is allocated in the pleadings

phase by special speech acts, while the burden of persuasion is verified in the trial phase by moving arguments, including priority arguments.

Of course, adjudication procedures can vary considerably. Turntaking and termination can be regulated in many different ways, retracting claims can be allowed or not, the adjudicator can be more or less free in assessing the evidence, and so on. Also, procedures can differ on whether the adversaries are allowed to make statements pertaining to admissibility of evidence, procedural correctness or burden of proof. The purpose of this paper is to model a fairly typical but not too complicated procedure and to focus in particular on rationality aspects of procedures instead of on their contingent legal aspects. This procedure will now be illustrated with an example.

2.2   A motivating example

Our formal model of adjudication should capture dialogues like the following one (which, although imaginary, is in some elements based on Dutch civil law). It contains an initial claim, decisions about the burden of proof and admissibility of evidence, arguments, counterarguments and a priority argument. References to legal rules will for convenience be abbreviated as r_i.

- *Plaintiff*: I claim that defendant owes me 500 euro.
- *Defendant*: I dispute plaintiff's claim.
- *Plaintiff*: Defendant owes me 500 euro by r_1 since we concluded a valid sales contract, I delivered but defendant did not pay.
- *Defendant*: I concede that plaintiff delivered and I did not pay, but I dispute that we have valid contract.
- *Plaintiff*: We have a valid contract by r_2 since this document is a contract signed by us.
- *Defendant*: I dispute that this is my signature.
- *Plaintiff*: Why?
- *Judge* By r_3 the party who invokes a signature under a document which is not an avidavit has the burden to prove that it is authentic when this is disputed, so plaintiff must prove that this is defendant's signature.
- *Plaintiff*: This is defendant's signature since it looks just like these three signatures of which we know they are defendant's.
- *Defendant*: But it does not look like this signature, which is also mine. Besides, another reason why we have no contract is that I was insane when I agreed so r_4 applies, which makes Section r_2 inapplicable).
Plaintiff: I dispute that you were insane.
Defendant: My insanity is proven by this court's document, which declares me insane.
- *Plaintiff*: I dispute that this is a court's document.
- *Judge* Plaintiff, since the document looks like a court's document, i.e., like an avidavit, by r_5 the burden is on you to prove that it is not.
- *Plaintiff*: This lab report proves that the document is forged.
Judge: This report is inadmissible as evidence by r_6 since I received it after the

written pleadings phase.

Plaintiff: Nevermind, even if defendant was insane, this could not be known to me during the negotiations, so r_4 does not apply by r_7.

Defendant: Why could my insanity not be known to you?

Plaintiff: Since you looked normal all the time.

Judge (deciding the dispute): I am convinced by plaintiff's evidence that defendant's signature under the contract is authentic. Yet I cannot grant plaintiff's claim since the fact that defendant looked normal during the negotiations is insufficient to conclude that defendant's insanity could not be known to plaintiff: he might have known if he had checked the court's register. Therefore I deny plaintiff his claim.

It is beyond the scope of this paper to give a precise account of all natural-language aspects of such dialogues. The formal model will largely abstract from the formalisation of the arguments, counterarguments and priority arguments. This is not a serious limitation, since it is by now well-known in the literature on nonmonotonic logic how these things can be formalised (see e.g. Prakken and Sartor (2002) for an overview). Furthermore, it is not my aim to account for the fact that often elements of arguments are left implicit. I believe that this issue is far from trivial and therefore deserves a separate study. Accordingly, I will in this paper assume that all arguments are fully explicit.

2.3   Aspects to be modelled

I now list in more detail the activities to be modelled.

The adversaries' acts:

- Stating, disputing, retracting and conceding claims.

- Stating arguments and counterarguments.

The adjudicator's acts:

- Deciding about procedural correctness of moves (which includes admissibility of evidence).

- Deciding about the burden of production.

- Deciding about termination of a dispute.

- Deciding whether a party has met its burden of persuasion. This involves deciding about the following issues.

  - Whether an argument is able to support its conclusion even in the absence of counterarguments (internal validity);

  - Whether the argument survives competition with its counterarguments (dialectical validity).

Some of these acts will be modelled with special speech acts (viz. ruling moves legally inadmissible, allocating the burden of production and terminating the dialogue), while the internal and dialectical assessment of arguments will be modelled as specific ways to move arguments.

3   An overview of the formal tools

In this section the formal tools used in this paper will be introduced.

3.1   Formal dialectics and dialogue games

Procedural AI & Law models have largely been based on a branch of argumentation theory and philosophical logic called 'formal dialectics' (Hamblin; 1971; Mackenzie; 1979; Walton and Krabbe; 1995), which formalises rules for dialogues involving argumentation, in particular persuasion dialogues. The main aim of dialogue systems is to define conventions for coherent discourse, where an utterance in a dialogue is regarded as coherent if it contributes to the goal of the dialogue (Carlson; 1983). The goal of adjudication dialogues can be described as fair and effective dispute resolution.

Most work on formal dialectics takes a game-theoretic approach to dialogues, where speech acts are viewed as moves in a game and rules for when these moves are allowed are formulated as rules of the game. More specifically, formal dialogue games have a *topic language L_t* with a *logic $\mathcal{L}$*, and a *communication language L_c* with a *protocol P*. The protocol specifies the allowed moves at each point in a dialogue. A dialogue system also has *effect rules*, which specify the effects of utterances on the participants' commitments, and *termination* and *outcome rules*.

AI & Law models have extended dialogue games for persuasion with the possibility of counterargument. While in the systems of formal dialectics the only way to challenge an argument is by challenging its premises, in the AI & Law models a party can challenge an argument even if s/he accepts all premises, viz. by stating a counterargument. In other words, while in the argumentation-theoretic models the underlying logic is deductive, in the AI & Law systems it is defeasible.

A formal underpinning for the latter is provided by the study of *argument games* in artificial intelligence, to which I now turn.

3.2   Logics for defeasible argumentation

The idea that legal reasoning is defeasible is generally accepted in AI & law and is increasingly accepted in legal philosophy (Peczenik; 1996; Hage; 1997; Sartor; 2005). Here I will simply take this idea for granted. In formalising it, I will take an argumentation approach, since the dialectical flavour of this approach fits well with protocols for dialogue and procedure. Providing grounds and evidence will be modelled as constructing arguments for a claim, and attacking grounds and

providing counterevidence will be modelled as constructing counterarguments. Three ways of attacking arguments will be assumed, viz. attacking a premise with an argument for its negation (*premise attack*), attacking the conclusion with an argument for its negation (*rebutting attack*) and attacking the support relation between the premises and the conclusion (*undercutting attack*). The latter two attacks can also be targeted at intermediate conclusions or inference steps of an argument. Finally, adjudication will also be modelled as constructing arguments, typically as constructing *priority arguments*, which are arguments that break ties between conflicting arguments.

Formal systems for defeasible argumentation, or argumentation systems for short, have been developed in the past twenty years in artificial intelligence as models of common-sense reasoning. (See e.g. Prakken and Vreeswijk (2002) for an overview.) These systems formalise defeasible reasoning as the construction and comparison of arguments for and against certain conclusions. They define how arguments can be constructed from a given body of information, how such arguments can be attacked by counterarguments, and how conflicting arguments can be compared in terms of given criteria for comparison. To all arguments that can be constructed a so-called dialectical status is then assigned. Typically this status is defined in terms of three classes: the 'winning' or *justified* arguments, the 'losing' or *overruled* arguments, and the 'ties', i.e., the *defensible* arguments, which are involved in an irresolvable conflict. In this paper I will especially be interested in determining whether an argument is justified, since the main aim of an adjudication procedure is to decide whether a justified argument exists for proponent's main claim.

Argumentation logics can be defined with fixpoint definitions but also in the dialectical form of argument games (cf. Loui; 1998). Such games model defeasible reasoning as a dispute between a proponent and opponent of a claim. In this paper the argument game of Prakken and Sartor (1997) will be used, which also allows for priority arguments. Let '*A* defeats *B*' stand for '*A* attacks *B* and is not worse than *B*' and note that two conflicting arguments defeat each other if they are equally strong or their strength is not known. In the game proponent starts with an argument that he wants to prove justified and then each player must either defeat the other player's previous argument or move a priority argument that stops the previous argument from defeating its target. Moreover, proponent is not allowed to repeat an argument in attack on the same argument, since if opponent had a reply the first time, she will also have a reply the next time. A player wins if the other player has run out of moves. The initial argument is provably justified if the proponent has a winning strategy in this game.

Clearly, the idea of argument games fit well with formal dialectics. However, for present purposes they also have an important limitation: they are static in that, being proof theories for logics, they operate on a fixed body of information from which conclusions are drawn. By contrast, in argumentation dialogues the information on which the outcome of a dialogue is determined is usually created dynamically during a dialogue. For this reason I showed in Prakken (2005) how argument games can be embedded in dialogue systems for persuasion. The

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present task is to extend the (two-player) persuasion model of that paper to a (three-player) model of adjudication. To this end the main elements of Prakken (2005) will be summarised next.

3.3 A framework for two-player persuasion dialogue

In Prakken (2005) a framework for specifying two-party persuasion dialogues is presented, which is then instantiated with some example protocols. Below the main elements of the instantiation used in this paper are summarised. Readers in need of illustration may wish wish to look ahead to Section 5.2, where the example of Section 2.2 is visualised.

A main motivation of the framework is to ensure focus of dialogues while yet allowing for freedom to move alternative replies and to postpone replies. This is achieved with two main features of the framework.

The first is an explicit reply structure on the communication language. Each dialogue move except the initial one replies to one earlier move in the dialogue of the other party (its *target*). Thus a dialogue can be regarded in two ways: as a sequence (reflecting the order in which the moves are made) and as a tree (reflecting the reply relations between the moves). Each replying move is either an *attacker* or a *surrender*. For instance, a *claim p* move can be attacked with a *why p* move and surrendered with a *concede p* move; and a *why p* move can be attacked with an *argue A* move where A is an argument with conclusion p, and surrendered with a *retract p* move. When s is a surrendering and s' is an attacking reply to s'', we say that s' is an *attacking counterpart* of s.

The second idea is that at each stage of a dialogue, each dialogue move has a *dialogical status*, which is either *in* or *out*. It is recursively defined as follows, exploiting the tree structure of dialogues. A move is *in* if it is surrendered or else if all its attacking replies are *out*. (This implies that a move without replies is *in*). And a move is *out* if it has a reply that is *in*. (Actually, this has to be refined to allow that some premises of an argument are conceded while others are challenged; see Prakken (2005) for the details). This allows the definition of the *current winner* of a dialogue: a dialogue is (currently) won by the proponent if its initial move is *in* while it is (currently) won by the opponent otherwise. Figures 1 and 2 in Section 5.2 illustrate the reply structure of dialogues and the dialogical status of moves.

As for dialogue structure, the framework allows for all kinds of variations. The instantiation used here is very liberal in its structural aspects: essentially, both players can speak whenever they like, except that they cannot speak at the same time. Also, they may reply to any earlier move of the other player instead of having to reply to the last such move, and they may move alternative replies to the same move, possibly even in the same turn (a turn is a sequence of moves of one player). Other protocols defined in Prakken (2005) impose restrictions on these points; since dialogue structure is not our present concern, they will not be discussed here.

The framework largely abstracts from the **topic language** and its **logic** but the logic is assumed to conform to Dung (1995)'s grounded semantics and

arguments are assumed to be trees of deductive and/or defeasible inferences. To keep things simple, formal details of language and logic will be omitted.

Dialogues are between a *proponent* P and *opponent* O of a single *dialogue topic* $t \in L_t$. The protocol is based on the following ideas.

The **communication language** L_c assumed in this paper is specified in Table 1. In this table, φ is from L_t and arguments A and B are well-formed

Acts	Attacks	Surrenders
claim φ	*why* φ	*concede* φ
why φ	*argue* A $(conc(A) = \varphi)$	*retract* φ
argue A	*why* φ $(\varphi \in prem(A))$, *argue* B	*concede* φ $(\varphi \in prem(A)$ or $\varphi = conc(A))$
concede φ		
retract φ		

Table 1: A communication language for persuasion

arguments from $\mathcal{L}$.

A protocol for L_c is defined in terms of the notion of a **dialogue**, which in turn is defined with the notion of a **move**.

Definition 3.1 (Dialogues)

- The set M of *moves* is defined as $\mathbb{N} \times \{P, O\} \times L_c \cup \{\delta\} \times \mathbb{N}$, where the four elements of a move m are denoted by, respectively:

  - $id(m)$, the *identifier* of the move,
  - $pl(m)$, the *player* of the move,
  - $s(m)$, the *speech act* performed in the move,
  - $t(m)$, the *target* of the move.

- The set of *dialogues*, denoted by M, is the set of all finite sequences $m_1, \ldots, m_i, \ldots$ from M such that

  - each ith element in the sequence has identifier i,
  - $t(m) = 0$ iff $m = m_1$ or for no $s \in Lc$ it holds that $s(m)$ is a reply to s in L_c;
  - If $t(m) \neq 0$ then $t(m) = i$ for some m_i preceding m in the sequence.

  For any dialogue $d = m_1, \ldots, m_n, \ldots$, the sequence $m_1, \ldots, m_i$ is denoted by d_i, where d_0 denotes the empty dialogue.

When $t(m) = id(m')$ I say that m replies to m' in d and that m' is the target of m in d. Abusing notation I sometimes let $t(m)$ denote a move instead of just its identifier. When $s(m)$ is an attacking (surrendering) reply to $s(m')$ I also say that m is an attacking (surrendering) reply to m'.

Protocols are in Prakken (2005) defined as follows.

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Definition 3.2 (Protocols) A *protocol* on M is a set $P \subseteq M$ satisfying the condition that whenever d is in P, so are all initial sequences that d starts with.

A partial function $Pr : M \longrightarrow \mathcal{P}(M)$ is derived from P as follows:

- $Pr(d) =$ undefined whenever $d \notin P$;

- $Pr(d) = \{m \mid d, m \in P\}$ otherwise.

The elements of $dom(Pr)$ (the domain of Pr) are called the *legal finite dialogues*. The elements of $Pr(d)$ are called the moves allowed after d. If d is a legal dialogue and $Pr(d) = \emptyset$, then d is said to be a *terminated* dialogue.

These protocol rules for move legality should not be confused with the rules of legal procedure that are checked by a judge. The protocol rules are rational rules for any adjudication dialogue while a judge only checks the contingent rules of a specific procedure, such as the rules on admissibility of evidence. See Vreeswijk (2000) for a dialogue protocol in which the protocol rules can themselves be debated within the protocol.

All protocols are further assumed to satisfy the following basic conditions for all moves m_i and all legal finite dialogues d.

If $m \in Pr(d)$, then:

- R_1: $pl(m) \in T(d)$;[2]

- R_2: If $t(m) \neq 0$ then $s(m)$ is a reply to $s(t(m))$ according to L_c;

- R_3: If m replies to m', then $pl(m) \neq pl(m')$;

- R_4: If there is an m' in d such that $t(m) = t(m')$ then $s(m) \neq s(m')$.

- R_5: For any $m' \in d$ that surrenders to $t(m)$, m is not an attacking counterpart of m'.

Rule R_1 says that the player of a move must be to move. (T returns for each dialogue the player(s) to move.) Rules R_2-R_4 formalise the idea of a dialogue as a move-reply structure that allows for alternative replies. Rule R_5 says that once a move is surrendered, it may not be attacked any more. Note that these five protocol rules only state necessary conditions for legality of moves. They can be completed in many ways with further conditions, for instance, to prevent circular dialogues (Mackenzie; 1979; Walton and Krabbe; 1995) but to focus on the essence such rules will be left undiscussed here. However, two additional rules are assumed in this paper. The first says that each dialogue begins with either a claim or an argument and the second constrains the moving on arguments.

- R_6: If $d = d_0$ then $s(m)$ is of the form *claim* φ or *argue* A.

- R_7: If an *argue* A move replies to an *argue* B move then

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[2]$T(d)$ denotes the player whose turn it is to move in d.

1. If proponent moves A then proponent has not already moved A in the same line of dialogue; and

2. A defeats B or B replies to an *argue C* move and A is a priority argument that stops B from defeating C.

In rule R_7 a dialogue line is a single branch of the dialogue tree induced by the reply relations between moves. The purpose of this rule is to build the argument game of Prakken and Sartor (1997) into the protocol.

The **commitment rules** of a dialogue system define the effects of a move on the players' propositional commitments. For instance, a claim makes a player committed to its content and a retraction terminates such commitment. In several dialogue games commitments are an important ingredient (see e.g. Walton and Krabbe (1995)). However, in the present approach their role is largely performed by the reply structure on the communication language and the notion of dialogical status. Therefore, they will not be further discussed here.

As for **turntaking** it was noted above that both players can speak whenever they like, except that they cannot speak at the same time. **Termination** was in Definition 3.2 implicitly defined as the situation where the player(s) to move cannot make a legal move. In Section 4 this 'mathematical' definition of termination will be reconciled with the nature of adjudication.

The link with the underlying argumentation logic is made in terms of a so-called *dialectical graph*, which records all the arguments moved by the parties and their defeat relations. The idea is that during a persuasion dialogue this graph is extended by stating arguments for claims, by stating counterarguments and by extending arguments with arguments for their premisis. The full definitions can be found in Prakken (2005). Figure 3 in Section 5.2 provides an illustration.

Ideally, the outcome of the dialogue and of the dialectical graph correspond in the following way. The initial move of a dialogue is *in* just in case the 'defended part' of the dialectical graph, that is, the set of arguments of which no premise is challenged, makes an argument for the initial claim justified. In Prakken (2005) it is proven that this holds on two conditions: that no surrenders are moved (since a player can, for instance, concede or retract a claim even if he logically does not have to) and if the dialogue is 'logically completed', i.e., if no new relevant arguments can be moved in the dialogue without stating new premises.

4 Adapting the dialogue system to adjudication

In this section the above framework for two-player persuasion dialogues will be extended to adjudication. A third player, the adjudicator, will be added, some new speech acts introduced and the protocol, terntaking and termination rules will be adapted.

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4.1 Overview

I first sketch how an adjudication dialogue according to the new framework generally evolves. Each dialogue starts in the pleadings phase, with a claim of the proponent. During the dispute about this claim the adversaries together implicitly build an argument graph in the manner defined above. More precisely, when a claim is disputed, the adversaries can exchange arguments and counterarguments and can dispute their premises. Sometimes, disagreements are resolved peacefully by conceding or retracting claims. The adversaries can also try to shift the burden of proof on the other adversary by replying to a challenge of φ with a challenge of the opposite of φ. When an adversary has ended his turn, the turn shifts to the adjudicator. The adjudicator first decides on the procedural correctness of the moves made in the previous turn. Then he can allocate the burden of proof of propositions that have been challenged and finally he decides whether to terminate the pleadings phase. If the dialogue continues, then the turn shifts to the current loser at the end of the adjudicator's turn. In the trial phase only the adjudicator can move and until termination he can only move arguments, including counterarguments and priority arguments. When the trial phase terminates, the winner is determined by the dialogical status of proponent's main claim.

4.2 The new dialogue game

A dialogue now takes place between three **players**. The set $Players = \{P, O, J\}$, where P and O are the *adversaries* and J the *adjudicator*. Below the variable p ranges over all three players, while the variable a ranges over the adversaries. If a is an adversary, then $\overline{a}$ denotes the other adversary. So $\overline{P} = O$ and $\overline{O} = P$.

As for the the **communication language**, the addition of an adjudicator requires some new speech acts. Firstly, as for turntaking the idea now is that after a turn of an adversary the turn shifts to the adjudicator, who must decide whether the moves made by the speaker were legally admissible and whether there is reason to allocate the burden of proof. Therefore, the end of an adversaries' turn must now be recognisable by the adjudicator so all turns must now end with a *pass* speech act. Secondly, the adjudicator has the power to terminate a dialogue, which he can do with a *terminate* speech act. These two speech acts do not reply to and cannot be replied-to by other speech acts. According to Definition 3.1 above their target therefore is the dummy value 0.

Next, from now on the speech act *why* φ can also be used in attack of a *why* $\neg\varphi$ move, to express that the speaker claims that the burden of proving the opposite of φ is on the hearer (an idea taken from Prakken et al. (2005) and originally due to Chris Reed). More generally, the second *why* move can challenge the 'complement' of the first challenge. To capture this the notation $-\varphi$ is introduced, which denotes the complement of φ: when φ is not a negation its complement is $\neg\varphi$, otherwise, its complement deletes the negation sign. So, for instance, the complement of p is $\neg p$ and the complement of $\neg p$ is p.

Finally, new speech acts are needed for deciding about the burden of proof

and about procedural correctness of a move, viz. $burden(\varphi, p)$ and *illegal m*. Here $burden(\varphi, p)$ means that player p has the burden of proving φ and *illegal m* means that move m violates the rules of legal procedure. Recall that these rules are not the same as the one of the dialogue game. An *illegal* move can be made in reply to any other move while a $burden(\varphi, p$ move can only be made in reply to a $wy -\varphi)$ move.

The resulting communication language is displayed in Figure 2. Next, the

Acts	Attacks	Surrenders
claim φ	*why* φ *illegal m*	*concede* φ
why φ	*argue A* $(conc(A) = \varphi)$ *why* $-\varphi$ $burden(-\varphi, a)$ *illegal m*	*retract* φ
argue A	*why* φ $(\varphi \in prem(A))$, *argue B* *illegal m*	*concede* φ $(\varphi \in prem(A)$ or $\varphi = conc(A))$
concede φ	*illegal m*	
retract φ	*illegal m*	
illegal m		
$burden(\varphi, p)$		
pass		
terminate		

Table 2: A communication language for adjudication dialogues

following **protocol rules** are added to rules R_1-R_7. They distinguish two phases of a dialogue: the *pleadings phase* is the phase before a *terminate* move has been moved and the *trial phase* is the remaining phase.

- R_8: A *terminate*, *burden* and *illegal* move may only be moved by the adjudicator. In the pleadings phase the adjudicator only moves *burden*, *illegal*, *pass* and *terminate* moves. In the trial phase the adjudicator only moves *argue* and *terminate* moves.

- R_9: In the pleadings phase each adjudicator's move replies to a move from the previous turn, except when R_{10} applies.

- R_{10}: If the previous turn contains a *why* $-\varphi$ attack m on a *why* φ move m' and the adjudicator does not rule m illegal then he attacks either m or m' with a *burden* move.

- R_{11}: Each *burden* move assigns the burden of proof to the speaker of the move's target.

- R_{12}: Each *burden* move leaves the burdens of a player consistent and is such that if one player has to prove φ, no other player has to prove either φ or $\neg\varphi$.

- R_{13}: A move with an *illegal* or *burden* reply may not be replied-to any more.

- R_{14}: After the first *terminate* move no move by an adversary is legal. After a second *terminate* move no move is legal.

- R_{15}: If the current winner cannot become the current loser at a later stage, the adjudicator can only move a *terminate* move.

Rule R_8 captures the differences between the pleadings and the trial phase. Rules R_9 and R_{10} implement the idea that issues of move legality and burden of proof are dealt with as soon as they arise. Rules R_{11} and R_{12} formulate obvious coherency constraints for allocations of the burden of production. Rule R_{13} captures that decisions on move legality and the burden of production are irreversible and undisputable. Rule R_{14} is obvious while R_{15} in fact captures that if the adversaries have peacefully resolved the dispute, the adjudicator cannot change the outcome and has to terminate the dispute. This is so since the only way in which proponent, respectively, opponent can become the permanent current winner is if opponent concedes, respectively proponent retracts the main claim.

The new **turntaking rules** are as follows.

- T_1: Proponent starts a dispute.

- T_2: In the pleadings phase the turn only shifts after a *pass* move.

- T_3: After a *pass* move by an adversary the turn shifts to the adjudicator.

- T_4: After a *pass* move by the adjudicator the turn shifts to the current loser.

- T_5: In the trial phase it is always the adjudicator's turn.

Termination was in Definition 3.2 implicitly defined as the situation where the player(s) to move cannot make a legal move. However, in legal settings a dispute is often arbitrarily ended after a fixed number of turns or by the adjudicator's intervention. This is why the locution *terminate* was added to L_c and two further protocol conditions were added that only the third party can move this locution and that after such a move no other move is legal.

Finally, the **outcome rule** says that the winner of a dispute is the current winner at termination of the trial phase.

4.3 The adjudicator's options in the trial phase

Technically speaking the trial phase does not fit the framework of this paper and Prakken (2005) since it is a monologue and since the adjudicator can reply to his own moves. (This makes sense since sometimes a decision takes the form of an internal debate, such as "in general, in cases like these p holds but in this case there is an exception".) However, most rules of our framework will also be assumed to hold for the trial phase. To this end the requirement of the general framework that players cannot reply to their own moves is dropped for the trial phase. Next, recall that the purpose of the trial phase is to decide the dispute. This involves deciding about a number of issues. Let us see how the new dialogue game enables the adjudicator to express these decisions.

- Deciding whether a non-challenged and non-attacked premise of an argument holds. If not, the adjudicator moves a premise-attacking counterargument, otherwise no response to the premise is needed.

- Deciding whether an argument is internally valid, that is, if it is acceptable if not attacked by counterarguments. If it is not, then the adjudicator expresses this by moving an undercutting counterargument, otherwise the following decisions must be made.

- Deciding whether there is reason to move additional counterarguments to internally valid arguments.

- Deciding whether an argument is dialectically valid, i.e., whether it survives the competition with its internally valid counterarguments. This is typically decided by priority arguments.

Note that all these decisions can be made by either remaining silent or moving an argument.

5 Examples

In this section the new dialogue game will be illustrated with some examples. As for notation, the target of a move will be indicated in square brackets and *argue* moves will be displayed as 'conclusion *since* premises'.

5.1 Abstract examples

Let us first illustrate the working of the system with a few symbolic examples.

P_1: *claim p*
P_2: *pass*

The turn shifts to the adjudicator, whose only legal moves are to rule P_1 illegal, to terminate the dialogue or to pass. Initial claims are hardly ever illegal

and it does not make much sense to terminate a dialogue after the first move, so the adjudicator passes. Since proponent then trivially is the current winner since his initial moves has no replies, the turn shifts to opponent.

J_3: *pass*
$O_4[P_2]$: *why p*
O_5: *pass*

The adjudicator must now decide about legality of O_4. He implicitly rules it legal by moving no *illegal* O_4 reply. Next the adjudicator must decide whether there is reason to reverse the burden of proof for p. Note that at this point P_1 is *out* so proponent is the current loser, which means that 'by default' the burden of production is on him. The adjudicator sees no reason to shift the burden to opponent nor to terminate the dialogue, so he passes. (Note that if opponent had not challenged but conceded p, move P_1 would have been made in for ever, so if the adjudicator had ruled the concession legal, he would have been forced to terminate the dialogue by rule R_{15}).

J_6: *pass*

Proponent now has the choice to accept the default burden of production and defend p with an argument or to try to shift the burden on opponent. Let us assume he accepts the default burden of proof.

$P_7[O_4]$: *p since q*
P_8: *pass*
J_9: *pass*

Now an interesting situation has arisen. Since proponent now is the current loser, proponent has managed to shift the default burden of proof on her by moving his arguments for p. At the very least, opponent must challenge P_7's premise (cf. also Walton (2003)), but she may also decide to move a counterargument against P_7's argument. In both cases the default burden shifts back to the proponent. These shifts in the burden of proof are built into the dialogue rules and the (defeasible) logic, unlike the explicit shifts motivated by procedural law illustrated in the example of Section 2.2.

$O_{10}[P_7]$: *why q*
O_{11}: *pass*

Let us now examine the various ways in which the burden of proof can become the subject of explicit dispute. As explained after O_5, proponent now is the current loser so the burden of production for q is by default on him. However, there are two ways in which the burden can be reversed by explicit decision. The first is that the adjudicator directly decides that the burden to prove $\neg q$ is on opponent.

$J_{12}[O_{10}]$: *burden*$(\neg q, O)$
J_{13}: *pass*

Since J_{13} has made O_{10} out, opponent is the current loser. To become the current winner she can move an undercutting or rebutting counterargument to P_7 or she can accept the burden of proof for $\neg q$ by moving a premise attack on P_7 with an argument for $\neg q$.

Assume next that the adjudicator instead wants to wait and see if proponent accepts the default burden of proof for q.

J'_{12}: *pass*

Suppose proponent instead tries to shift the burden of proof onto opponent.

$P_{13}[O_{10}]$: *why* $\neg q$
P_{14}: *pass*

Then the adjudicator can still decide to shift the burden to opponent with

$J_{15}[O_{10}]$: *burden*$(\neg q, O)$

after which opponent has the same options as after J_{13}.

This example illustrates that if the burden of proof shifts to the other party, that party can only fulfill it by moving a premise-attacking counterargument.

5.2 The motivating example formalised

Let us next formalise the example of Section 2.2. For simplicity, the *pass* moves are left implicit.

P_1: *claim* owe 500
$O_2[P_1]$: *why* owe 500
$P_3[O_2]$: owe 500 *since* contract and delivered and $\neg$ paid and r_1
$O_4[P_3]$: *concede* delivered
$O_5[P_3]$: *concede* $\neg$ paid
$O_6[P_3]$: *why* contract

Again the turn shifts to proponent. Since he knows the general rule of Dutch civil procedure that the one who claims that a legal relation exists has to prove it, he again accepts the default burden of production.

$P_7[O_6]$: contract *since* document and signed and r_2
$O_8[P_7]$: *why* signed

Now proponent tries to shift the burden of proving that there is something wrong with the signatures to opponent.

$P_9[O_8]$: *why* ¬ signed

The adjudicator implicitly rules P_9 legal by moving no *illegal* reply and is then forced by rule R_{10} to decide about the burden of production with respect to 'signed by us', since the burden is now in dispute. If he wants to assign it to opponent then he must reply to O_8 with a $burden(\neg$ signed by us, $O)$ move. But in agreement with Dutch civil procedure he instead allocates the burden to proponent, which makes proponent the current loser so the turn shifts back to him.

$J_{10}[P_9]$: $burden(\text{signed}, P)$

Note that the present formalism does not allow the adjudicator to express his reasons why the burden of proof is on proponent. Such a possibility could be added but for simplicity I will not pursue this here.

$P_{11}[O_8]$: signed *since* similar-to-3

Proponent has fulfilled his burden of production so the burden now implicitly shifts to opponent, who has to provide counterevidence in the form of a rebutting counterargument.

$O_{12}[P_{11}]$: ¬ signed *since* ¬ similar-to-1

Afer this rebuttal opponent also plays out her second attack on proponent's main argument, backtracking to P_7:

$O_{13}[P_7]$: ¬ r_2 *since* insane and r_4
$P_{14}[O_{13}]$: *why* insane
$O_{15}[P_{14}]$: insane *since* court's doc and declares insane
$P_{16}[O_{15}]$: *why* court's doc

At this point the adjudicator allocates the burden of proof to proponent, since by Dutch law something that looks like an avidavit is resumed to be an avidavit. This presumption can only be overturned by counterevidence.

$J_{17}[P_{16}]$: $burden(\neg$ court's doc, $P)$

Proponent provides counterevidence by stating a premise attack on O_{15}.

$P_{18}[O_{15}]$: ¬ court's doc *since* lab report and says that forged

The adjudicator now rules the lab report inadmissible, after which the turn

shifts back to proponent.

$J_{19}[P_{18}]$: *illegal* P_{18}

Proponent now backtracks to O_{13}, arguing that there is an exception to the exception.

$P_{20}[O_{13}]$: $\neg\, r_4$ *since* could not know and r_7
$O_{21}[P_{20}]$: *why* could not know
$P_{22}[O_{21}]$: could not know *since* looked normal
J_{23}: *terminate*

The adjudicator terminates the pleadings phase of the dispute and enters the trial phase, in which he must decide about the internal and dialectical validity of the various arguments. The adjudicator now first rules that proponent has met his burden of proof for 'signed by us' by moving a priority argument against O_{12}.

$J_{24}[O_{12}]$: $P_{11} > O_{12}$ *since* convinced by P_{11}

This priority argument stops O_{12}'s argument from defeating P_{11}'s argument, so the latter has been ruled dialectically valid. Next the adjudicator rules proponent's argument that he could not know about opponent's insanity internally invalid by moving an undercutter.

$J_{25}[P_{22}]$: P_{22} is not conclusive *since* check register

Then the adjudicator terminates the trial phase, thus implicitly ruling all remaining arguments internally valid by moving no undercutters and ruling them dialectically valid by moving no other counterarguments.

J_{26}: terminate

Opponent is the current winner so the adjudicator has in fact ruled that opponent wins the dispute.

Figures 1, 2 and 3 display, respectively, the dialogue in reply form (in two parts) and the dialectical graph created during the dialogue. A solid box means that a move is *in* and a dotted box that it is *out*.

The dialectical graph displays a winning strategy for proponent, since he wins both his lines of defence and opponent cannot construct other counterarguments without introducing new premises. At first sight, this would seem to be at odds with the outcome of the dialogue. However, proponent's argument why r_4 does not apply was ruled illegal by the adjudicator so it should be disregarded in verifying correspondence. The remaining graph instead displays a winning strategy for opponent, which agrees with the outcome of the dialogue.

P_1: *claim* owe500

O_2: *why* owe500

P_3: owe500 *since* contract, delivered, ¬ paid, r_1

O_4: *concede* delivered

O_5: *concede* ¬ paid

O_6: *why* contract

P_7: contract *since* document, signed, r_2

O_8: *why* signed

O_{13}: ¬ r_2 *since* insane, r_4

P_9: *why* ¬ signed

P_{11}: signed *since* similarto3

See Figure 2

J_{10}: *burden*(signed,P)

O_{12}: ¬ signed *since* ¬ similarto1

J_{24}: $P_{11} > O_{12}$ *since* convinced
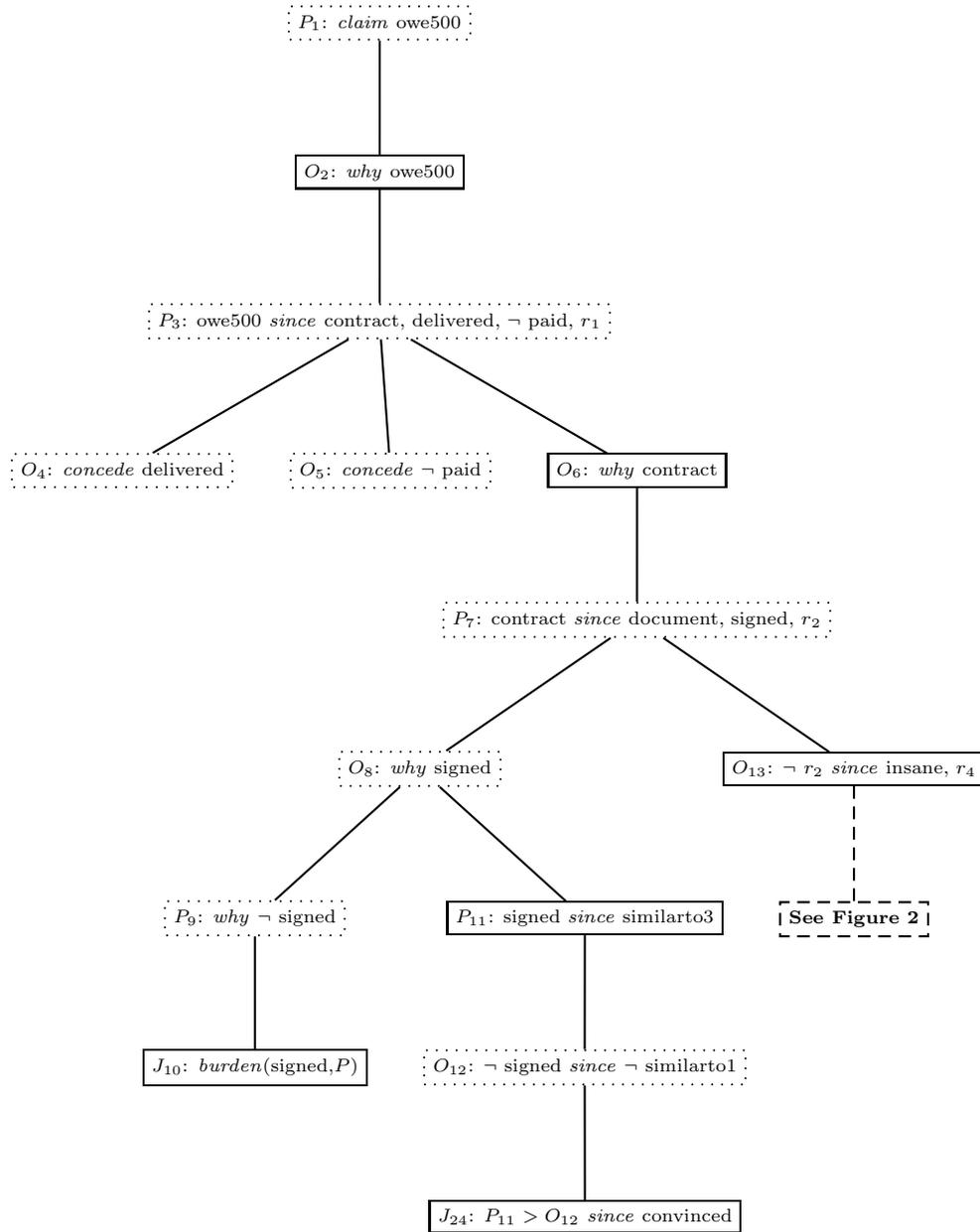
Figure 1: A dialogue tree (part 1)

20

```
                    ┌ ─ ─ ─ ─ ─ ─ ─┐
                    | See Figure 1 |
                    └ ─ ─ ─ ─ ─ ─ ─┘
                           │
              ┌────────────────────────────┐
              │ O₁₃: ¬ r₂ since insane, r₄ │
              └────────────────────────────┘
                   ╱                    ╲
      ┌ ─ ─ ─ ─ ─ ─ ─ ─┐      ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
      : P₁₄: why insane :      : P₂₀: ¬r₄ since couldnotknow, r₇ :
      └ ─ ─ ─ ─ ─ ─ ─ ─┘      └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
              │                              │
   ┌─────────────────────────────┐   ┌──────────────────────┐
   │ O₁₅: insane since court, declares │   │ O₂₁: why couldnotknow │
   └─────────────────────────────┘   └──────────────────────┘
        ╱              ╲                         │
  ┌ ─ ─ ─ ─ ─ ─┐  ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─┐  ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─┐
  : P₁₆: why court :  : P₁₈: ¬ court since lab, 'forged' :  : P₂₂: couldnotknow since normal :
  └ ─ ─ ─ ─ ─ ─┘  └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─┘  └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─┘
        │                        │                              │
 ┌──────────────────┐   ┌─────────────────┐   ┌────────────────────────────┐
 │ J₁₇: burden(¬ doc,P) │   │ J₁₉: illegal P₁₈ │   │ J₂₅: undercut since register │
 └──────────────────┘   └─────────────────┘   └────────────────────────────┘
```

Figure 2: A dialogue tree (part 2)

similarto3
signed   document r_2
            contract   delivered   ¬paid r_1
                              owe500

court   declares
        insane r_4
              ¬r_2

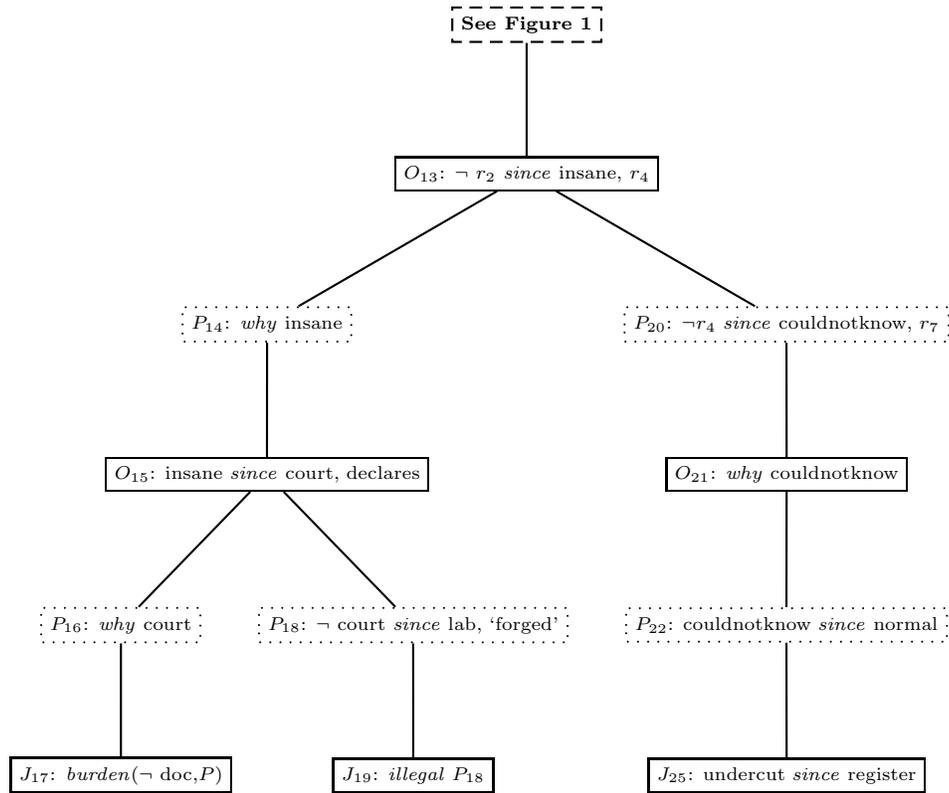similarto1
¬signed

normal
couldnotknow r_7
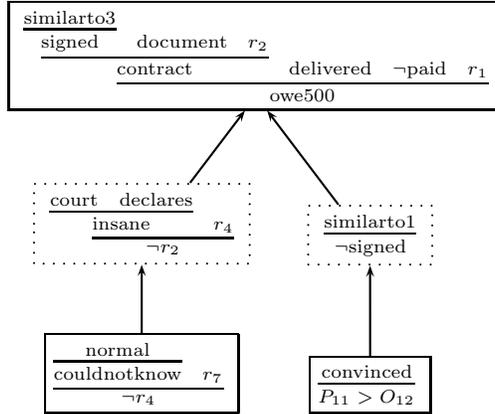   ¬r_4

convinced
$P_{11} > O_{12}$

Figure 3: A dialectical graph

6   Conclusion

The main purpose of this paper was to show how current dialogical models of legal procedure and persuasion dialogue can be extended to models of adjudication dialogue with a realistic role of the adjudicator. To this end, a formal model has been developed of an artificial but fairly typical adjudication procedure, using tools from argumentation theory (dialogue games) and artificial intelligence (logics for defeasible argumentation). The main feature of the model is a division into a pleadings phase, where the adversaries plea their case and the adjudicator has a largely mediating role, and a trial phase, where the adjudicator decides the dispute on the basis of the things put forward in the pleadings phase.

The model allows for decisions on legal-procedural correctness of dialogue utterances in the pleadings phase, such as on admissibility of evidence. The model also allows for explicit decisions on the burden of proof in the pleadings phase while respecting principles of logical and dialogical rationality. Burden of proof can be incurred implicitly and 'by default' in two ways. Firstly, it is imposed by the built-in dialogical principle that the one who states a proposition must upon challenge support it with an argument. Secondly, it is enforced by the defeasible nature of the underlying logic, since the utterance of a defeasible argument shifts the burden to the other party to defeat it with counterarguments. Such implicit built-in allocations of the burden of proof can be reversed by explicit decisions of the adjudicator on legal grounds: such a decision makes a premise of an argument hold by default and shifts the burden to the other party to find a premise-attacking counterargument.

All this pertains to the burden of production, i.e., the burden to provide grounds for a claim. The burden of proof also involves the burden of persuasion, which is the task to successfully defend these grounds in dispute. The latter was modelled as an aspect of the trial phase, where the adjudicator assesses the

internal and dialectical strength of all arguments put forward by the party.

The reader may wonder what is the point of developing formal models of adjudication procedures. As said above in Section 3.1, the main aim of dialogue systems is to define and study conventions for coherent discourse, where in adjudication dialogues coherence can be defined as contributing to fair and effective dispute resolution. The point of this is partly analytical: by formalising and studying artificial procedures, insight can be obtained in their properties, in their relation with logic, in how differences in procedures can be understood as variations on certain elements, and so on. But this also has a normative point. Desirable properties can be formulated, i.e., properties which make procedures fair and/or effective, and procedures can be tested on whether they have these properties. Also, the rules of a specific procedure can be used to assess the quality of an adjudicator's decision from this point of view.

Acknowledgement

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