DiaLaw
A dialogical framework for modeling legal reasoning

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Abstract This paper gives a formal elaboration of the theory of legal reasoning and argumentation that was described in Hage *et al.* [1994]. Legal reasoning is considered to be procedural, and the way this procedure is modeled is a two person dialogue. Basic elements of this two person dialogue are defined, such as moves, and rules are formulated that describe how dialogues run.

1. Introduction

The attractiveness of modeling law as a dialogue has recently been demonstrated in a number of papers [Aleven and Ashley 1992, Loui 1992, Nitta *et al.* 1993, Gordon 1994]. Hage *et al.* [1994] describe a procedural approach to legal reasoning, and model it as a dialogue. We give a formal elaboration of this approach. The resulting model is called DiaLaw.

We will briefly motivate the reasons for our approach of legal reasoning; for more discussion we refer to: Hage *et al.* [1992], where the theory behind DiaLaw was introduced; Leenes *et al.* [1994], where discourse rules including rules for commitment were formulated; and Hage *et al.* [1994], where the number of discourse rules was extended, and the theory was used to characterise hard cases. The aim of this paper is to work out the theory in more detail and make it sufficiently precise to serve as a model for implementation. We define basic elements of the dialogue, such as moves, and formulate rules that describe how dialogues run.

There are several reasons why legal reasoning is to be modeled as a dialogue.

- Dialogues fit in nicely with *legal practice*. Besides trials, even situations of which one does not immediately think about as dialogues, can be considered as such. For instance, the reasoning of a lawyer can be seen as a dialogue in which he defends his point of view against possible counter arguments of an imaginary opponent. In tackling attacks of his opponent, he strengthens his own plea [cf. Skalak and Rissland 1992].
- Dialogues make it easy to take the *division of the burden of proof* into account [Gordon 1993b, p. 4, and p. 120f]. For instance, the public offender has to show the guilt of a criminal suspect, and not the suspect himself. In a dialogue this has a natural translation: the one that makes a claim has the burden of proof.
- The nature of law is *purely procedural* [cf. Rawls 1971]. There is no law except as the result of applying legal rules, principles etc. to concrete cases. Consequently there is no independent criterium to evaluate the outcome of the application other than applying the same procedure again. Since legal procedures are not fully determinate, different applications of the same procedure may lead to different outcomes. As long as the procedure, that is best modeled as a dialogue [cf. Alexy 1978], is followed correctly, neither outcome is preferred above another one. Only institutionalized outcomes, as the verdict of a court, have special authority.

Material rules of law can be seen as procedural rules, but they do not exhaust the rules that govern legal procedures. We do not intend to model material rules of law. In this paper a general framework is offered, that can be filled with specific domain rules. The framework is meant to assist in analyzing legal decisions afterwards (e.g. of courts), and in constructing a rational justification for a solution of a legal conflict.

The remainder of the paper is structured as follows. First we give an informal overview of the setting of dialogues. Next the dialogical framework is presented, followed by an informal discussion of the language used during a dialogue. How the framework can be used is shown by

some examples. After a discussion of the rules that govern the example dialogues, the paper concludes with a discussion of related work, in particular Gordon's Pleadings Game.

2. The setting of dialogues

The dialogue is modeled as a two person game, in which both players can make moves. The players express in their moves an illocutionary act with a propositional content [Searle 1969]. The illocutionary acts a player has at his disposal are 'claim', 'question', 'accept', 'withdraw', and 'arbiter'. The propositional content can be any (legal) sentence. The first move of the dialogue is always a claim of a sentence by one of the players. Suppose the player Bert claims that Tyrell is a killer. At that moment Bert starts a dialogue.

Bert: Tyrell is a killer

In the consecutive moves players react to the sentences claimed by their opponent, or they adduce sentences pleading for or against earlier claimed sentences. For instance, Ernie can do several things in the second move. He can accept that Tyrell is a killer, ask why (question) Tyrell is a killer, or even claim that Tyrell is not a killer at all.

2.1 Levels in the dialogue

A dialogue have different levels. The initial level is 0. The level increases if a sentence is questioned. So after Ernie questioned Tyrell being a killer, the level becomes 1. On this new level sentences are adduced that are supposed to be arguments for or against the sentence on the previous level. For example:

Bert: Tyrell is a killer (0-level)
Ernie: What makes you think so (0-level)
Bert: His wife was shot (1-level)

The level decreases if a sentence is accepted, or withdrawn. In that case the dialogue returns to the level on which this sentence was claimed. So if after some moves Ernie accepts that Tyrell's wife was shot (which of course is not meant as a value judgment!), the dialogue continues at the first level.

Bert: His wife was shot (1-level)
some time later in the dialogue.....
Ernie: I accept his wife was shot (e.g. 3-level)
Bert: Tyrell stood next to the dead body
with a smoking gun (1-level)

Bert continues the dialogue by adducing a new argument why Tyrell is the killer, namely that Tyrell was found next to the dead body with a smoking gun. This new argument is needed, because the single fact that Tyrell's wife was shot is not sufficient for Ernie to accept that Tyrell is a killer.

2.2 Commitment

Commitment plays an important role in the dialogue. Commitment to a sentence originates from claiming a sentence, or from accepting a sentence claimed by the opponent. In the last example Bert is committed to "Tyrell is a killer", both Bert and Ernie are committed to "his wife was shot", and finally Bert is committed to the 'smoking gun'-argument. Commitment terminates by withdrawing a sentence. So if Bert withdraws "Tyrell is a killer", he is no longer committed to that sentence.

The commitments of a player limit the moves he can make. An example of such a limitation is that a player may neither claim, nor accept a sentence, when he is committed to the negation of that sentence. For example, Bert is not allowed to claim that Tyrell is *not* a killer.

The goal for each player is to convince his opponent of the correctness of the sentences he claims. To avoid that the dialogue remains an informal talk, a player needs some means to force his opponent to accept a sentence. This is what is called *forced* commitment, and plays a crucial role in the dialogue. Forced commitment is comparable to derivation in a monological logic, and occurs when a player is forced accept a sentence, due to the sentences he is already committed to.

3. The dialogical framework

In the next definitions dialoguemoves, the commitment store, and finally the dialogue itself are introduced. We use the following notation. If a variable V is used then $V \neq V'$, unless indicated otherwise. If the value of a variable is irrelevant, this is indicated with an underscore (_). In some cases it is necessary to make a distinction between a sentence and the negation of that sentence. If a sentence is S, the negation is ~S. When a sentence can be either S, or ~S, we use a bold face type: **S**. The reason for using **S** is that otherwise several rules would be twice longer. A double negation of a sentence (~~S) is considered to be the sentence itself, so ~~S = S.

3.1 The dialogue move

The central notion in a dialogue is a move. In a move a player performs an illocutionary act concerning some sentence. The move is on a particular level. Therefore a move consists of a term P for the player, a term A for the illocutionary act, a term S for the sentence, and a term L for the level. The level does not give enough information for a (computationally) efficient representation. Therefore an element B is needed that indicates which sentence the move is an argument for, or reaction to. Besides, because there can be more arguments for, or reactions to a statement they are counted by the final term T. For instance Bert's 'smoking gun'-argument is on the first level

the second argument for "Tyrell is a killer". This leads us to the following definition.

Definition 1 - the dialogue move

A dialogue move M_i (i>0) is (P, A, **S**, L, B, T), where
P ∈ {player1, player2},
A ∈ {claim, question, accept, withdraw, arbiter},
S, B ∈ Language,
L, T ∈ **N** (set of natural numbers).

The value of the variable 'i' is fixed by the dialogue (def. 3) and indicates the number of the move. So M_1 is the first move of the dialogue, M_2 the second, etc. As we can see a dialogue move M_i is a 6-tuple, where

- P identifies the player.
- A indicates the illocutionary act, being one of a five element set:
  a. claim: player P claims a sentence S;
  b. question: player P questions the sentence S;
  c. accept: player P accepts a sentence S;
  d. withdraw: player P withdraws a sentence S;
  e. arbiter: player P calls in the arbiter to decide about a sentence S.
- S is the propositional content of the illocutionary act. The language is the set of all (legal) sentences. The language is not formally worked out in this paper, but informally described in section 4.
- L is the level of the move. How these levels change is elaborated in the rules.
- B is the sentence the move M_i is a reaction to, or provides an argument for.
- T counts the moves about the sentence B, on a particular level L.

The smoking gun argument of Bert would thus be represented as: (Bert, claim, "Tyrell stand next to the dead body with a smoking gun", 1, Tyrell is a killer, 2).

3.2 The commitment store

Through certain moves players become committed to sentences. Commitment restricts a player in his moves, and commitment of the opponent can be used to force him to accept, or withdraw sentences. Therefore, it is important to store those commitments [cf. MacKenzie 1979]. The commitment of the players is stored in the commitment store, which is defined as follows.

Definition 2 - the commitment store

A commitment store C_i (i≥0) is a set of elements (P, **S**), where P ∈ {player1, player2} and **S** ∈ Language.

The set of disputed sentences O_i is the subset of C_i, with the property that
(P, **S**) ∈ O_i, iff (P, **S**) ∈ C_i and (P', **S**) ∉ C_i.

$C_0 = \varnothing$

The commitment store exists of elements (P, S), which means that a player P is committed to a sentence S. O_i is the subset of C_i that contains the sentences the players do not agree upon. As we will see later, the dialogue continues as long as there are still elements in O_i.

C_0 is defined empty. How the content of the commitment store is settled after each move is elaborated in rule 1.

3.3 The dialogue

Not only the effects of moves in terms of commitment are stored, but also the moves themselves. This record of moves is defined as the dialogue.

Definition 3 - the dialogue

A dialogue D_i is a totally ordered set of i (1 ≤ i ≤ last) elements M_i.

D_1 = {(player1, claim, S, 0, dialog, 1)}.

For 1 < i < last: $D_i = D_{i-1} \cup \{M_i\}$

The end of the dialogue is by definition reached, if after a move M_{last}, O_{last} becomes empty, so $D_{last} = D_{last-1} \cup \{M_{last}\}$, $O_{last} = \varnothing$.

D_{last} is called complete. D_i (i < last) is called incomplete.

A dialogue is defined as a set of moves. D_1 defines the first move of a dialogue: player1 claims a sentence (S), and the level is 0. Since this is the first move, B is not a reaction to, neither an argument for a previous sentence, but conventionally defined as "dialog". As a consequence T is 1.

Every dialogue set D_i (i >1) results from adding a move M_i to an already existing dialogue set D_{i-1}. Which moves exactly can be added to a particular dialogue set is laid down in the rules. The only dialogue set to which no moves can be added, is D_{last}. D_{last} originates if a move causes an empty set of disputed sentences (O_{last}). This occurs when there is agreement about the truth/falseness of the sentence that was claimed in the first move. Only then a dialogue is considered to be complete.

4. The language

The language of the dialogues are sentences comparable to fact-clauses in Prolog. Sentences are for instance: law, conference(icail), capital(State, City), participant(lodder, conference(icail)), but also "I did not shoot the deputy". An uppercase is a variable, a lowercase is a term. So in capital/2, State and City can be instantiated, while icail is fixed in conference/1.

The rules of the dialogue presented later contain some special sentences that are based on Reason Based Logic (RBL). [Hage and Verheij, 1995]. Only by using those sentences, it is possible to force the opponent to accept your point of view. So although sentences of FOPL are elements of the language, forced commitment (see 2.2) is not based on these sentences. Before introducing the

special RBL-sentences, we will briefly outline a slightly adapted version of the theory of RBL.

A sentence can be derived, if the reasons for the conclusion outweigh the reasons against the conclusion. In order to decide which reasons win, they have to be weighed. This weighing takes place on the basis of extra information: a weighing sentence 'outweighs'.

How does a reason originate? If a rule is valid and that rule's condition is satisfied, you have a reason to apply the rule. But there can also be reasons against applying the rule, for instance that applying the rule is against the rule's purpose. Furthermore, there is a special case in which a rule simply cannot apply, independent from existing reasons. That is when a rule is excluded. A rule is for instance excluded, if a case is without the scope of the rule.

When a rule applies, the rule's conditions constitute a reason for the rule's conclusion. When there are more rules about the same conclusion, or the negation of the conclusion, more reasons can originate. The former constitute reasons for the conclusion, the latter reasons against the conclusion.

This gives a short impression of how reasoning based on reasons works. The sentences discussed below are necessary to use this in a dialogue.

In the following holds that Cond, Concl ∈ Language, and that Procon ∈ {pro, con}:

- valid(rule(id, Cond, Concl)): a rule with a unique identifier 'id' is valid. Cond represents the rule's conditions, Concl the rule's Conclusion. Both Cond and Concl can contain free variables.
- applies(rule(id, Cond, Concl)): the rule 'id' applies. Cond is an instantiation of the rule's condition, Concl the corresponding instantiation of the rule's Conclusion.
- excluded(rule(id, Cond, Concl)): the rule 'id' is excluded. Cond, Concl are the same as in applies/1.
- reason(Cond, Concl, Procon): Cond is a reason pro or con Concl.
- outweighs({$Cond_1$, ..., $Cond_n$}, {$Cond_{n+1}$, ..., $Cond_m$}, Procon, Concl), where m >= n. {$Cond_1$, ..., $Cond_n$} is a set of sentences $Cond_i$, originating from all elements reason(Cond, Concl, Procon) both players are committed to; {$Cond_{n+1}$, ..., $Cond_m$} is a set of sentences $Cond_i$, originating from all elements reason(Cond, Concl, ~Procon) both players are committed to. For example, take the following reasons: reason(thief, penal, pro), reason(recidivist, penal, pro), and reason(minor, penal, con). Then the outweigh sentence is: outweighs({thief, recidivist}, {minor}, pro, penal).

Besides, there is one special 'dialogue'-sentence that says that it is impossible to make a particular claim. For instance, if a player claims a sentence based on illegally obtained evidence. In that case whether the sentence is true or false is not relevant, it is simply not allowed to adduce this sentence. This is modeled as follows.

- ~p(claim: X): it is not possible to claim X, where ~p stands for 'not possible'.

5. Sample dialogues

The rules describe constraints concerning the course of a dialogue in terms of allowed moves, and the consequences of moves in terms of commitment. To facilitate the understanding of the rules, we discuss some examples that are based on the following case.

Tyrell is visiting a football game with two fellow-gang members. Recently there was a shooting incident at a game, and because one of the gang (not Tyrell) is wearing a heavy, quilted coat --although the temperature is in the eighties-- the police suspects him. They are all searched, and on Tyrell marihuana is found. Tyrell had been placed on probation subject to amongst others the condition: "submit to a search of his person and property, with or without a warrant, by any law enforcement officer...". The searching officer was unaware of the probation condition. Is the evidence illegally obtained?

For the matter of convenience a sentence is referred to by the number of the move it was claimed. So a sentence claimed in the third move is represented as S_3. We use the common '>' to visually express the level.

Bert and Ernie are discussing the Tyrell case. Bert says that Tyrell is guilty, and Ernie fully agrees. This ends their discussion. It is the shortest possible dialogue, modeled as follows.

M_1 = (Bert, claim, guilty(tyrell), 0, dialog, 1)
M_2 = (Ernie, accept, guilty(tyrell), 0, guilty(tyrell), 1)

The dialogue starts as always with a claim by player1 (def. 3): Bert claims that tyrell is guilty; this is the first move on level 0 about what is defined as dialog. In the second move the level is still 0, and it contains the first reaction to the first sentence, which is that Ernie accepts guilty(tyrell). Since there is nothing in dispute anymore ($O_2 = \varnothing$), the dialogue is complete.

The other day after a good night sleep Bert wants to be affirmed once more in his opinion of Tyrell's guilt. Bert says: "Well Ernie, that Tyrell is guilty is not he". This time Ernie is not so easygoing and counter-attacks by stating that it is impossible to say that Tyrell is guilty. Bert is rather surprised and asks Ernie what makes him change his mind.

M_1 = (Bert, claim, guilty(tyrell), 0, dialog, 1)
M_2 = (Ernie, claim, ~p(claim: guilty(tyrell)), 0, S_1, 1)
M_3 = (Bert, question, ~p(claim: guilty(tyrell)), 0, S_2, 1)

In the second move Ernie claims the impossibility of Bert's claim. On level 0 this is the first reaction to

guilty(Tyrell). Bert questions Ernie's claim. On level 0 this is the first reaction to ~p(claim: guilty(tyrell)).

Ernie gave the whole case a second thought, and concluded that because the evidence for Tyrell's guilt is illegally obtained, you may not claim that Tyrell is guilty. Bert wants to know why. Ernie starts his defense by claiming the validity of a rule that says "if guilt is based on illegal evidence, it may not be claimed". Bert agrees to that rule. When Ernie continues to say that the evidence was in fact illegally obtained, Bert wants to know why.

M_4 = >(Ernie, claim, reason(illegally_ob_ev(tyrell), ~p(claim: guilty(tyrell)), pro), 1, S_2, 1)
M_5 = >(Bert, question, S_4, 1, S_4, 1)
M_6 = >>(Ernie, claim, valid(rule(1, illegally_ob_ev(Person), ~p(claim: guilty(Person)), 2, S_4, 1)
M_7 = >>(Bert, accept, S_6, 2, S_6, 1)
M_8 = >>(Ernie, claim, illegally_ob_ev(tyrell), 2, S_4, 2)
M_9 = >>(Bert, question, illegally_ob_ev(tyrell), 2, S_6, 1)

Ernie claims that illegally obtained evidence concerning Tyrell is a reason to forbid a claim stating that Tyrell is guilty. Bert questions the claimed sentence. On the second level Ernie claims the validity of a rule, which is accepted by Bert. In the second argument on level 2 Ernie claims that the condition of the rule is satisfied. Bert questions this claim.

Bert and Ernie continue their discussion. Ernie says: "Listen Bert, don't you think that because Tyrell was not a suspect, the evidence is not legal ". Bert admits this. This makes Ernie happy, because he thinks he won the dispute about the evidence. But then Bert reminds Ernie that because of Tyrell's probation condition, he had to allow a search any time. Ernie agrees, but still thinks that his argument is stronger than Bert's one.

M_{10} = >>>(Ernie, claim, reason(not_suspect(tyrell), illegally_ob_ev(tyrell), pro), 3, S_8, 1)
M_{11} = >>>(Bert, accept, S_{10}, 3, S_{10}, 1)
M_{12} = >>>(Ernie, claim, outweighs({not_suspect(tyrell)}, ∅, pro, S_8), 3, S_8, 2)
M_{13} = >>>(Bert, claim, reason(prob_cond(tyrell), illegally_ob_ev(tyrell), con), 3, S_{12}, 1)
M_{14} = >>>(Ernie, withdraw, S_{12}, 3, S_{13}, 1)
M_{15} = >>>(Ernie, claim, outweighs({not_suspect(tyrell)}, {prob_cond(tyrell)}, pro, S_8), 3, S_8, 3)

Ernie claims a reason, which is accepted by Bert. Successively Ernie claims that this reason outweighs the empty set of reasons. This claim of Ernie is decisive, unless Bert knows another reason. Bert wants to avoid commitment to S_8, , and therefore claims a reason against S_8. Ernie immediately withdraws 'outweighs'. A consequence of this withdrawal is that he becomes committed to Bert's reason (see rule 1). Then Ernie claims a new 'outweighs', with both reasons in it.

Bert wants to know why Ernie thinks his argument is stronger than Bert's. Ernie cites a similar case by the court of appeal of California. Bert is flabbergasted by this argument, and mumbles: "You really got me Ernie, I withdraw my initial claim about Tyrell's guilt".

M_{16} =>>>(Bert, question, S_{15}, 3, S_{15}, 1)
M_{17}=>>>>(Ernie, claim, reason(Cal9214(outweighs({not_suspect(P)}, {prob_cond(P)}, pro, illegally_ob_ev(P))), S_{15}, pro), 4, S_{15}, 1)
M_{18} =>>>>(Bert, withdraw, S_1, 4, S_{17}, 1)

After Bert's question, Ernie adduces a reason that states that in a verdict of the court of appeal of California in a similar case the outcome was the same as Ernie thinks it has to be. Although Bert is not forced to do so, he finds the reason convincing enough to withdraw his initial claim. This ends the dialogue, because the first claim is decided.

Most lawyers will agree with the decision of the court of appeal. Surprisingly the supreme court did not: they decided that the evidence was legally obtained. So if Bert would have been aware of this verdict, he could have won the dialogue.

6. The dialogue rules

The definitions provide a framework for a dialogue. How a dialogue actually runs depends on the player's moves. Recall (def. 1) that a move is: (P, A, S, L, B, T). The rules describe which player's turn to move it is (P), and how L, B, and T change. Within certain constraints the player of the move can choose an illocutionary act (A) and a propositional content (S). What exactly is allowed depends on commitment, and on previous moves.

6.1 Origin of commitment

The first rule works out by which moves and how the commitment store C_i alters. If a player claims or accepts a sentence, he becomes committed to that sentence. If a player withdraws a sentence his commitment ends. Moreover, both accept and withdraw can have further consequences for the content of commitment store.

Rule 1

a. $C_i = C_{i-1} \cup \{(P, \mathbf{S})\}$, if M_i = (P, claim, **S**, _, _, _)
b. If M_i = (P, withdraw, **S**, _, _, _) and
M_h = (P, claim, **S**, _, _, _) or;
M_i = (P, accept, **S**, _, _, _) and
M_h = (P', claim, **S**, _, _, _) (h<i)
then
let U be the set of elements to update the commitment store, so that $U = O_{i-1} \setminus O_{h-1}$,
let U_{del} be the subset of U, with the property that if (P, **Q**) ∈ U then (P, **Q**) ∈ U_{del},
let U_{add} be the subset of U, with the property that if (P', **R**) ∈ U, (P, **R**) ∈ U_{add},
so $C_i = C_{i-1} \cup U_{add} \setminus U_{del}$.
c. $C_i = C_{i-1}$ in all other cases than under a, b.

Rule 1a: If a player claims a statement S, an element (P, S) is added to the commitment store. Note that because the

first move is always a claim of a sentence by player1 (see def. 3), C_1 will contain the related element: (player1, S).

Rule 1b: The sentences claimed between the claim of a sentence **S** and its acceptance or withdrawal, are (considered to be) direct, or indirect arguments for (or against) **S**. The status of those (in)direct arguments that are still disputed at the moment of acceptance/withdrawal (defined as elements of U) is dealt with the following way. If the withdrawing player P claimed sentences after he claimed **S**, and those sentences are still disputed, then his commitment to all those sentences **Q** including S ends (the elements of U_{del}). Furthermore, he becomes committed to all disputed sentences **R** claimed by player P' after the claim of **S**. If player P' claimed **S**, and player P accepts **S** the same happens, except that (P, **S**) is now an element of U_{add} in stead of U_{del}.

Rule 1c: After any other move the commitment store remains the same.

6.2 General conditions

In the second rule necessary (but not always sufficient) conditions are formulated for all acts, except question. Every M_i which occurs in the rules with the exception of moves with the act question must obey rule 2. For instance, if a rule concerns withdraw, you should always keep in mind the conditions formulated here.

Rule 2

a. M_i = (P, claim, **S**, _, B, _) is only possible, if
(P, claim, **S**, _, _, _) $\notin D_{i-1}$,
(_, **S**) $\notin C_{i-1}$,
where **S** = ~S only if B = S.

b. M_i = (P, accept, S, _, _, _) is only possible, if
(P', S) $\in O_{i-1}$;

c. M_i = (P, withdraw, **S**, _, _, _) is only possible, if
(P, **S**) $\in O_{i-1}$;

d. M_i = (_, arbiter, **S**, _, _, _) is only possible, if
(_, **S**) $\in O_{i-1}$.

Rule 2a forbids repetition of arguments and contradiction [cf. Alexy 1978, p. 234f.]. First, it says that a player who claims a sentence, cannot claim the same sentence again. Second, it says that if at least one of the players is committed to a sentence, it is not possible to claim that sentence. Finally you can only claim the negation of S, if it is a reaction to S.

Rule 2b: A player P can only accept a sentence, if he is not committed to that sentence, and the other player is. It is not allowed to accept the negation of a sentence (~S), for the following reason. From rule 2a follows that ~S can only be claimed as a reaction to the claim of S. So, if a player was allowed to accept ~S, the commitment store would contain S and ~S for the same player.

Rule 2c: A player can only withdraw a sentence, if he is committed to that sentence, and the other player is not. Note: if P withdraws S and (P', ~S) $\in C_{i-1}$, P becomes committed to ~S.

Rule 2d: A player can call the arbiter, if only one player is committed to this sentence. This means that the arbiter only decides on issues there is no agreement about, which fit with what an arbiter does in real life situations.

6.3 Moves after a claim

The third rule is about what moves can follow after a claim. Any act can follow after a claim. Only the possibility of counter-claims is very restricted.

Rule 3

If M_{i-1} = (P, claim, **S**, L, B, T) then
M_i = (P', A, **S'**, L, **S**, 1), where
a. **S'** = **S** for A = question;
b. **S'** = **S** is possible for A $\in$ {accept, arbiter}
c. A = claim is only possible, if
1. **S'** = reason(_, _, B), and
S = outweighs(_, _, _, B);
2. **S'** = ~S, or **S'** = ~p(claim: S), and
S $\neq$ ~p(claim: B).

Rule 3a: The level remains the same, and the next move is the first reaction to what was claimed. Basically, the player P' can react with any act. If he questions a sentence **S**, the propositional content of the question must be the sentence S.

Rule 3b: If after a claim a sentence is accepted, this can be the same sentence (bear in mind rule 2b!), but can be as well an earlier claimed sentence.

Rule 3c: In only a few situations a claim can be the successor of a claim:
1. If the player P claims that the reasons so far dip the balance in his advantage, the other player P' can claim another reason in order to influence the balance.
2. After a claim of a sentence S (which is not of the form ~p(claim: B)), the other player can claim the negation of that sentence, or claim that it is impossible to claim S.

6.4 Moves after a question

This rule is about the only situation in which the level of the dialogue increases: when a sentence is questioned. The next move is the first argument for the questioned sentence. Any act, except question is allowed. Question is forbidden, because this would mean that a player questions a sentence he just claimed.

Rule 4

If M_{i-1} = (P, question, S, L, _, _), then
M_i = (P', A, _, L+1, S, 1), where A $\neq$ question.

6.5 Moves after an acceptance or withdraw

This rule is about what move comes after accept or withdraw. It is the only situation in which the level of the dialogue decreases. Accept and withdraw are taken

together, because their successors are largely similar. If a player accepts or withdraws a sentence, the dialogue returns to the level the sentence was claimed at. The next move is either a new argument for, or a new reaction to the same sentence as the accepted/withdrawn sentence was an argument for or reaction to.

Rule 5

a. Let (P, claim, S, L, B, T) $\in D_{i-2}$, and
M_{i-1} = (P', accept, S, L', _, _), (L' $\geq$ L) then
1. M_i = (P', withdraw, B, L, B, T+1) for
1. S = ~p(claim: B)
2. S = reason(_, X, _), where
B = outweighs(_, _, _, X);
2. in all other cases M_i = (P, A, _, L, B, T+1), where
A $\neq$ question

b. Let (P, claim, **S**, L, B, T) $\in D_{i-2}$, and
M_{i-1} = (P, withdraw, **S**, L', _, _) (L' $\geq$ L) then
M_i = (P, A, **S'** L, B, T+1), where:
1. A can be any act in the following cases
1. **S** = ~p(claim: B)
if A = claim then **S'** = ~B;
2. **S** = reason(_, B, _), and
(P', outweighs(_, _, _, B) $\in C_{i-1}$
if A = claim then **S'** = reason(_, B, _);
3. **S** = ~B
if A = claim then **S'** = ~p(claim: B)
2. A $\neq$ question in all other cases.

Rule 5a.1: If a player accepts that it is not possible to claim a sentence B, he is forced to undo his claim by withdrawing B. Similar is the case in which a player accepts a reason of his opponent that was claimed according to rule 3c.1. Since there are now more reasons, outweighs concerning X is no longer true and thus he must withdraw it. Rule 5a.2: If a sentence S is accepted the dialogue continues with a new claim, or any other act except question by the same player that claimed S.

Rule 5b.1: The three types of withdrawn sentences S were claimed as a reaction to a claim of the opponent. The player P is allowed to react again to the claim of his opponent. First, if a player withdraws that it is impossible to claim a sentence. Second, if he withdraws the reason that was meant to counterclaim outweighs Finally, if he withdraws the negation of a sentence (~S). (see rule 3c)

Rule 5b.2: If a sentence S (for ~S see 5b.1) is withdrawn, then the next move is the same as after S is accepted. (see under a.2)

6.6 Moves after a call for the arbiter

In this paper is not worked out on what grounds the arbiter decides. If the arbiter is called to decide about a sentence, the decision of the arbiter consist of one, or two consecutive moves. These moves have as a result that neither the sentence the arbiter is called upon, nor its negation is any longer disputed.

Rule 6

If M_{i-1} = (_, arbiter, **S**, L, B, T) then
a. M_i = (P', accept, S, L, B, T+1), or
b. M_i = (P, withdraw, S, L, B, T+1).

If the arbiter is called to decide about a sentence, he has two options:
- let the player P', whose opponent claimed S, accept S.
- let the player P, who claimed S, withdraw S.

6.7 Constraints related to Reason Based Logic

The rules 7 and 8 are about special conditions for the use of RBL-sentences. Rule 7 is about some cases of forced commitment because of RBL-sentences. Rule 8 formulates general conditions for using reason and outweighs.

Rule 7

Let (**Concl**, Y) $\in$ {(Concl, pro), (~Concl, con)},
then
a. M_i = (P, claim, excluded(rule(id, Cond, **Concl**)), _, _, _),
only if (P, applies(rule(id, Cond, **Concl**))), and
(P, reason(Cond, Concl, Y)) $\notin C_{i-1}$.
b. M_i = (P, claim, applies(rule(id, Cond, **Concl**)), _, _, _),
or M_i = (P, claim, reason(Cond, Concl, Y), _, _, _),
only if (P, excluded(rule(id, Cond, **Concl**))) $\notin C_{i-1}$.
c. If M_{i-1} = (P, claim, S, _, _, _), then
M_i = (P', accept, S, _, _, _) in the following cases:
1. S = reason(Cond, Concl, Y), and
(P', applies(rule(id, Cond, **Concl**)) $\in C_{i-1}$;
2. S = reason(Cond $\wedge$ valid(rule(id, Cond, **Concl**)), applies(rule(id, Cond, **Concl**)), pro), and
{(P', valid(rule(id, Cond, **Concl**))),
(P', Cond)} $\subset C_{i-1}$;
3. S = outweighs(_, $\emptyset$, _, Concl), unless
M_i = (P', claim, reason(_, Concl, _), _, _, _).
d. Let (P', **S**) $\in O_{i-2}$, and (P, **S**) $\in C_{i-1}$, then:
1. If **S** = excluded(rule(id, _ , _)), and
(P, applies(rule(id, _, _)) $\in C_{i-1}$, then
M_i = (P, withdraw, applies(rule(id, _, _)), _, _, _),
2. If **S** $\in$ {Cond, valid(rule(id, Cond, **Concl**))},
T = reason(Cond $\wedge$ valid(rule(id, Cond, **Concl**)),
applies(rule(id, Cond, **Concl**), pro)), and
{(P, **S**), (P, **S'**), (P', **T**) } $\subset C_{i-1}$,
then M_i = (P, accept, **T**, _, _, _)
3. If **S** = applies(rule(id, Cond, **Concl**), and
(P', reason(Cond, Concl, Y)) $\in C_{i-1}$, then
M_i = (P, accept, reason(Cond, Concl, Y), _, _, _)

Rule 7a: In this rule the claim of some special RBL-sentences is restricted. A player cannot claim that a rule is excluded, if he is committed to the fact that the rule applies, or to the reason based on that rule. Rule 7b is about the reversed case.

Rule 7c is about moves in which the player is forced to accept the sentence S, if S is claimed by his opponent. If a player is committed to the fact that a rule applies, he is forced to accept the reason based on the rule (c.1). If a player is committed to a valid rule and the initiation of the

condition of that rule, he is forced to accept that both sentences are a reason to apply the rule (c.2). Because a not empty set of reasons is weight against an empty set of reasons, player P is forced to accept outweighs, unless he claims a reason. (c.3; see Rule 3c)

Rule 7d is about forced accept/withdraw concerning some RBL-sentences that contradict each other. If player P becomes committed to that a rule is excluded, he must withdraw that the rule applies. This is because it is impossible that a rule applies, and at the same is excluded.(d.1) If player P became just committed to both sentences (he just accepted the other one) then he has to accept that both sentences are a reason for applying the rule. (d.2) If player P became committed to that a rule applies, then he must accept the reason originating from that rule. (d.3)

Rule 8

a. Let (P, claim, **S**, L, _, _) $\in D_{i-1}$ and L' = L + 1, then:
   1. M_i = (P, claim, reason(_, S, _), L', _, _) is possible
   2. M_i = (P, claim, outweighs(_, _, _, S), L', _, _) is only possible if (_, reason(_, S, _)) $\in C_{i-1}$.

b. M_i = (P, claim, outweighs(_, _, pro, S) _, _, _), and (P', claim, outweighs(_, _, con, S) _, _, _), are only possible if (P, S) $\in O_{i-1}$.

c. If (P', outweighs(_, _, _, S)) $\in O_{i-2}$, and (P, outweighs(_, _, _, S)) $\in C_{i-1}$, then:
   1. M_i = (P, accept, S, _, _, _), if (P', S) $\in O_{i-1}$
   2. M_i = (P, withdraw, S, _, _, _), if (P, S) $\in O_{i-1}$

In this rule is about the important sentences reason and outweighs.

Rule 8a. A reason or outweighs claim about S is only possible one level lower than S was claimed (so if S was questioned and still is disputed). In order to make the sentence outweighs significant, there must be at least one reason about S.

Rule 8b. The player that claimed S, can only claim that the reasons in favor of S outweigh the reasons against S. A player whose opponent claimed S, can only claim the opposite.

Rule 8c. If a player P becomes committed to an outweighs claim about S -other than after claiming it- the commitment of S is taken care of. Outweighs namely means that because of the available reasons you can conclude S (or ~S). For example, let's say player P claimed ~S, and later this player becomes committed to outweighs(_, _, _, S). Then player P must accept S, since he accepted the outweighs claim which says that the reasons for outweigh the reasons against S. The other rule is about the reversed case.

7. Related work

In this section we will briefly discuss some related research on arguments, philosophy, and dialogues. We end with a more extensive comparison with Gordon [1993b], because the Pleadings Game is most relevant to the present model.

There is a lot of research on (legal) argument. An early model of argument is that of Toulmin [1958, p. 99f], whose diagram to represent arguments is still very popular [e.g. Bench Capon et al. 1992, Cavalli-Sforza and Suthers 1994]. Although researchers on legal arguments [e.g. Ashley 1990, Skalak and Rissland 1992, Prakken 1993, Hage and Verheij 1995] agree, to put it simply, that legal reasoning is more than applying legal rules in a 'la bouche de la loi' way, they do not share the -in our eyes essential- procedural point of view.

In philosophy Perelman and Olbrechts-Tyteca [1971] introduced a rhetorical approach to reasoning. In their theory an attempt to justify a statement is rational if the speaker succeeds in convincing his public. In this rhetorical approach the public has a passive role. Habermas [1973] brought the public to life, and proposed to represent reasoning as a dialogue. Alexy [1978] picked up this idea. He formulated a set of rules for general discourse and additional rules for legal discourse.

Dialogue games have a long tradition. Already in the Middle Ages the Obligation Game [cf. Hamblin 1970] was used to test the knowledge of students. If during a dialogue with their teacher the students were capable to avert contradiction, they passed their exam. Lorenz [1961] designed a dialogue game in which the proponent has the burden of proving that his initial locution is a tautology. Rescher [1977, p. xiv] "... seeks to explain and substantiate ... the utility of dialectic as an instrument of inquiry". The resulting dialogue model was recently formalized by Brewka [1994]. In the Netherlands the linguists Van Eemeren and Grootendorst [1982] formulated rules that participants in discussions should observe, if their goal is to solve conflicts in a reasonable manner. There are legal elaborations of those rules, for instance for civil and penal procedures of jurisdiction [Feteris 1989]. Bench-Capon et al. [1991, 1992] explored dialogues not particular for the legal field, but used them to improve the way knowledge-based systems provide explanation. In a dialogue the user of the KBS can specify his interest, and therefore gets the information he particularly wants instead of a standard explanation. Loui [1992] defines four protocols for his dialogical framework with a climbing degree of complexity, allowing for instance meta arguments only in the highest level. Nitta et al. [1993] describe a knowledge-based system for trial reasoning. In this model, dialogues are between two agents (the plaintiff and the defendant) with different goals, views and reasoning strategies. St-Vincent and Poulin [1994] use interaction between groups of agents to determine (on the basis of majority of agents, unanimity, etc.) the meaning of vague legal concepts.

7.1 DiaLaw vs. The Pleadings Game

We do not precisely describe how the Pleadings Game works, rather we point out the differences between the Pleadings Game and DiaLaw on the following important items: purpose of the game, commitment, effectiveness and termination, arguments and questions.

purpose of the game

The purpose of the Pleadings Game is to identify the issues of a case, both legal and factual, by means of a dialogue between two players (the plaintiff and the defendant). The scope of the game is civil pleading, and to test the game a small domain (secured transactions) is used. DiaLaw is a general model of legal reasoning, meant to analyse legal verdicts and assist in constructing legal decisions in a procedure.

commitment

In DiaLaw rule 1 about commitment seems unfair. Why follows commitment to sentences you never wanted to become committed to? We mentioned the status of those sentences: (in)direct arguments. Nevertheless, this status - since irrelevant statements may be claimed- is not such a strong justification for that rule. Therefore we are working on a way to handle commitment more elegantly. Gordon handles commitment definitely better. After for instance conceding a claim, only the commitment to that claim originates.

Commitment in the Pleadings Game also includes all statements that are consequences of the player's statements. The reason that DiaLaw does not perform this strengthening of commitment is because derivation is solely based on special RBL-sentences. The derivation for strengthening commitment supposes demonstrative arguments, and the special RBL-sentences supply non-demonstrative reasoning. Once FOPL will be included (as it is in RBL), this strengthening can become relevant as far as formulas of FOPL are concerned.

effectiveness and termination

To focus discussion to only relevant statements, the Pleadings Game uses the concept "issue". A player may only make moves, if it is his first reaction to a statement of his opponent, and this statement is about an issue. In DiaLaw the sentences reason and outweighs can only be claimed, if they are about a sentence that is still disputed (see rule 8). Other sentences are not subject to a relevancy check. The reason for this is that it is often hard to determine whether an argument is relevant. What for one person is relevant, for another maybe is not. In that way the Pleadings Game maybe is to rigid.

The Pleadings Game ends if at the beginning of one's turn there are no relevant statements to be answered. If there are remaining issues, the parties go to trial. In the Trial Game players don't make moves. A judge decides each issue in favor of one of the players. DiaLaw ends only if the main claim is decided. As analyzing tool this raises no problem: a decision is reconstructed and the dialogue therefore is finite by definition. As a system that assists in constructing arguments, this can be considered ineffective. But, are real life discussions not often ineffective? The difference is that in real life a discussion often ends in an agreement to disagree. Maybe this possibility should be added to DiaLaw.

arguments and questions

In legal reasoning there are often more arguments that plead for, or against a statement, than only one. Gordon [1993a, p. 14] recognizes this, but gives the players only the possibility to adduce one, *preferably the best,* argument. Not only a player who by mistake produced an argument that could be defeated, although he might have more strings to his bow, looses the conflict. Moreover, the situation when one argument does not suffice to justify a conclusion, but several accruing arguments do, cannot be dealt with. [Verheij 1995; Hage and Verheij 1995] Both situations can be handled in DiaLaw, since in DiaLaw more arguments (reasons) can be adduced for a statement. If at one point the balance dips in favor of the opponent, new arguments can change this.

The players in the Pleadings Game *adduce a complete argument* (from premises to conclusion). The argument is allowed if a theorem prover has checked whether it is really an argument. In DiaLaw an argument is *built step by step* during the dialogue, and is as detailed as the opponent demands. This comes closer to a procedural approach of legal reasoning.

If you simply do not understand a statement, or do not have an opinion about it, the only proper reaction is to ask for an explanation. In that case you demand the opponent to clarify his statement, without giving your opinion about the statement. The Pleadings Game does not allow to question statements.

8. Conclusion

This paper for the first time offers a full formalization of allowed moves in legal discourse. Previously, Gordon [1993b, p. 119f.; 1994] and Hage *et al.* [1994] gave only the initial impetus towards a formalization.

The framework DiaLaw does not only allow 'normal' reasoning with legal rules. It is also possible to deal with the exclusion of rules, and with the weighing of reasons. Besides, both case-based and rule-based reasoning can be dealt with [Hage 1993].

The definitions and rules served as a model, that has been implemented in Prolog. This program (also called DiaLaw) checks whether the input of a player is allowed. If the move is valid, the move is added to the dialogue, and the commitment store is updated. Furthermore the level, and the level related terms are instantiated. The program

ends only if the first claim is decided. In the future the implementation could serve as a base for an intelligent tutoring system, in which a computer player will debate with a student [Hage *et al.* 1992; cf. Aleven and Ashley 1992]

Future research concerns the precise role of the arbiter, and addition of specific domain rules.

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