On Formalising Burden of Proof in Legal Argument

Henry Prakken

Department of Computer Science, Utrecht University, The Netherlands
henry@cs.uu.nl, http://www.cs.uu.nl/staff/henry.html

Abstract

This paper investigates the modelling of burden of proof in AI & law models of legal argument. The main topic is how allocations of burden of proof determine the required strength of counterarguments. It is argued that the two currently available approaches both have some shortcomings. On the one hand, techniques for modelling burden of proof in nonmonotonic logics do not allow for shifts of a proof burden from one party to the other. On the other hand, current procedural models of legal argument are too rigid, in that every counterargument induces a shift of proof burdens, while in legal reasoning such shifts only occur in some cases. It is then shown how current dialectical models of defeasible reasoning can be adapted to overcome these shortcomings.

1 Introduction

One of the main research topics of AI & law is the modelling of adversarial legal argument. A concept that has so far received relatively little attention here is burden of proof. Yet it is one of the central notions of legal procedure, so a study of it is very relevant for the field. Both in AI & Law and in legal theory, burden of proof is usually connected with defeasibility, i.e., with the possibility that an argument is defeated by a counterargument (Hart 1949, Baker 1977, MacCormick 1995, Gordon 1994, Loui 1995, Sartor 1995). The supposed connection goes both ways: defeasibility would induce certain burdens of proof, and allocations of burden of proof would make the reasoning defeasible. The aim of this paper is to shed some further light on the connection between defeasibility and burden of proof. It will turn out that this connection is more subtle than is often thought.

Let me first describe the precise issues to be discussed. There are two aspects of having the burden of proving a claim: the obligation to come with an argument for that claim, and the obligation to uphold this argument against challenge in a dispute. The first aspect can be formally modelled in MacKenzie-style dialogue systems (MacKenzie 1979), which regulate such speech acts as claiming, challenging, conceding, withdrawing and arguing for a proposition. However, such dialogue systems do not allow for counterarguments and can therefore not formalise the second aspect of burden of proof. This can instead be formalised in dialectical protocols for dispute, which regulate the

Henry Prakken, 'On Formalising Burden of Proof in Legal Argument', in: H.Jaap van den Herik et al. (eds), *Legal Knowledge Based Systems, JURIX 1999, The Twelfth Conference*, Nijmegen: GNI, 1999, p. 85-97.

adducing of and adjudication between conflicting arguments (see e.g., Loui 1998, Vreeswijk 1995). Sometimes, these protocols are based on dialectical proof theories of logics for defeasible argumentation (see further Section 2). In AI & law, several models of legal procedures have been proposed that combine MacKenzie-style dialogue systems with the possibility of counterargument (notably Hage et al. 1994, Gordon 1994, Bench-Capon 1998, Lodder 1999). In this paper, I shall argue that these proposals still have some problems, and propose a new dialectical protocol that addresses these problems. I shall not define a full model of legal procedure, but only pay attention to the dialectical core of such procedural models (in the way Gordon's (1994) 'dialectical graphs' are the dialectical core of the pleadings procedure). I shall also abstract from the *process* of allocating the burden of proof (which is a task of a judge in a legal procedure) and from the *reasoning* involved. In other words, I shall not try to formalise rules for burden-allocating speech acts, nor shall I formalise the application of legislation, case law and principles to determine the proper allocation of burden of proof. I shall only look at the *result* of these activities, viz. a given allocation of burdens of proof to the plaintiff and defendant in a dispute.

In AI & law, earlier analyses of reasoning with burden of proof have been given by Freeman & Farley (1996) and Gordon & Karacapilidis (1997). Both proposals are very interesting, but, as explained in more detail below, Freeman & Farley capture only a simple form of burden of proof, while Gordon & Karacapilidis do not analyse the problem in an explicitly dialogical setting.

My discussion will take place at the background of a four-layered picture of legal argument, which I earlier proposed in Prakken (1997); see also Prakken & Sartor (1998). The first, *logical* layer, provides the logical structure of single arguments, i.e., it defines how pieces of information can be combined in order to provide basic support for a proposition. The second, *dialectical* layer, focuses on conflicting arguments: it introduces such notions as 'counterargument' and 'defeat', and it defines, given a set of arguments and their defeat relations, which arguments can be accepted as justified. Systems of this layer have been called 'logics for defeasible argumentation' (Prakken & Vreeswijk 2000). The third, *procedural* layer regulates how an actual dispute can be conducted, i.e., how parties can introduce or challenge new information and state new arguments. In other words, this level defines the possible speech acts, and the discourse rules for when and how these speech acts can be performed. The procedural layer differs from the first two in one crucial respect. While the logical and dialectical layer assume a fixed set of premises, at the procedural layer the set of premises is constructed dynamically, during a debate. This also holds for the final layer, the *strategic* or *heuristic* one, which provides rational ways of conducting a dispute within the procedural bounds stated at the third level. MacKenzie-style dialogue systems only have the logical and procedural layer, while the above-mentioned AI & law models of legal procedure also contain the dialectical layer.

I can now give a precise formulation of the problem statement. The problem is whether a given allocation of burden of proof and the way it influences the conclusions that can be drawn can be completely modelled at the second, dialectical layer, or whether the third, procedural layer is also needed. It should be noted that this question is the same as asking

whether reasoning with burden of proof can be modelled in nonmonotonic logics: this is since such logics have a natural translation into logics for defeasible argumentation; cf. Prakken & Vreeswijk (2000).

Sartor (1995) maintains that reasoning with burden of proof can indeed be modelled in terms of nonmonotonic logics, and he discusses several logical representation techniques for doing so. I shall argue that these techniques are insufficient, since they do not allow for a shift of the burden of proof from one party to the other. To model this, procedural notions are also needed. However, I shall also argue that the above-mentioned current procedural models of legal argument are too rigid, in that they make every counterargument induce a shift of proof burdens. This neglects the fact that in legal reasoning burden shifts only occur when indicated by procedural law.

However, to see this, a more detailed analysis of some examples is necessary. This will be given in Section 3. This analysis will be repeated in semi-formal style in Section 4, which will give clues for how reasoning with burden of proof can be formalised. This formalisation will be provided in Section 5, after which related research will be discussed (Section 6), and some conclusions will be drawn (Section 7). First, however, I informally present the logical tools used in this paper.

2 Logical preliminaries

The coming discussion will be in terms of logics for defeasible argumentation. Therefore, a brief description of such logics is now in order. As said above, they define such notions as counterarguments, or attack, and defeat among arguments.

Attack comes in several forms, only one of which will be used in our examples, viz. *conclusion-to-conclusion* attack, as in the arguments 'There is a valid contract since there was an offer and an acceptance', and 'There is no valid contract since the offeree was insane at the moment of acceptance.'

That an argument *defeats* another means that it attacks it and is not weaker; an argument *strictly defeats* another argument if it attacks it and is stronger, i.e., if it defeats and is not defeated by that argument. The criteria for strength of an argument are in general domain dependent, and can themselves be subject of debate.

Finally, taking all defeat relations into account, a logic for defeasible argumentation defines the dialectical status of the constructible arguments, in terms of three classes: the *justified* arguments, those with which a dispute can be 'won', the *overruled* arguments, with which a dispute should be 'lost', and the *defensible* arguments, which should leave the dispute undecided. (Note that these notions are relative to a given pool of premises from which arguments can be constructed.) A formula is a justified consequence of the premises if a justified argument for it can be constructed from the premises.

What for present purposes is very relevant is that logics for defeasible argumentation can be stated in the dialectical form of an argument game, where the proof that a formula has a certain status takes the form of a dialogue between a proponent and an opponent of the formula. For the purpose of this paper, proofs of justification are especially relevant. In such proofs, the proponent starts with an argument for the formula, after which the players take turns: each following move consists of an

argument that attacks the last move of the other player with a certain minimum force, depending on the dialectical role of the player. Since the proponent wants the initial argument to be justified, his moves have to be strictly defeating, while since the opponent instead wants to prevent the initial argument from being justified, her moves may be just defeating. Now the initial argument is provably justified if the proponent has a *winning strategy* in this game, i.e., if he can make the opponent run out of moves whatever moves she makes.

At the dialectical layer, this argument game serves as a logical proof theory. However, as argued in Prakken (1997) and Prakken & Sartor (1998), it can be reinterpreted as part of a procedure for actual disputes between real players, by dropping the assumption of a fixed pool of premises from which arguments can be constructed. This results in the 'dialectical protocols' mentioned above in the introduction. Thus a natural link can be established between the dialectical and procedural level of legal argument.

3 Informal analysis of reasoning with burden of proof

Let us now see whether the logical argument game can be used for modelling disputes with burden of proof. I shall discuss an example (from contract law) showing that in general the answer is negative. In legal systems it is generally the case that the one who argues that a valid contract exists has the burden of proving those facts that ordinarily give rise to the contract, while the party who denies the existence of the contract has the burden of proving why, despite these facts, exceptional circumstances prevent the contract from being valid. Now suppose that plaintiff claims that a contract between him and defendant exists because plaintiff offered defendant to sell her his car, and defendant accepted. Then plaintiff has the burden of proving that there was such an offer and acceptance (and usually some other conditions, which will be ignored here). Suppose plaintiff (π) does so with witness testimonies. In structured natural language:

π_1:
(1) Witnesses John and Bill say that there was an offer and acceptance
(2) John and Bill are reliable witnesses
(3) If reliable witnesses say that something happened, then it happened
So,
(4) there was an offer and acceptance
(5) If there was an offer and acceptance, then a valid contract was created
So,
(6) a valid contract was created

Suppose now that defendant (δ) wants to attack this argument by arguing that the witnesses are unreliable, since they lied on other occasions. So defendant wants to attack premise (2) of π_1. In structured form:

δ_1:
(7) John and Bill lied before
(8) If persons lied before, they are unreliable witnesses
So,
(9) John and Bill are unreliable witnesses

Note that (9) contradicts (2). Suppose now also that the judge has allocated the burden of proving the witnesses' reliability to plaintiff. How strong must defendant's counterargument then be? It seems that, since defendant's attack relates to a proposition that plaintiff must prove, her counterargument can be merely defeating. So thus far, the rules of our argument game apply. To state this in perhaps more familiar legal terms, it is not necessary that the judge becomes convinced that the witnesses are not reliable; it suffices that the judge is not convinced that they are reliable. (In argumentation systems the judge's convictions can be expressed in metalevel arguments about the strength of conflicting arguments; however, because of space limitations such metalevel arguments will be left implicit here.)

However, suppose now that defendant concedes plaintiff's claims concerning offer and acceptance, and instead attacks plaintiff's argument by claiming an exception, viz. that she was insane when she accepted plaintiff's offer.

δ_1':
(10) I was insane when accepting the offer
(11) If somebody is insane when accepting an offer, no valid contract is created

So,
(12) no valid contract was created

Note that (12) contradicts (6). In any legal system defendant has the burden of proving insanity. What does this mean for the relative strength of her argument? The rules of our argument game again say that this argument merely has to defeat plaintiff's first argument, but this time this seems too weak: since the defendant has the burden of proving this exception, it seems that her argument should *strictly* defeat plaintiff's main argument. In other words, it is not sufficient that the judge is not convinced of her sanity; instead the judge must be convinced of her insanity. So an allocation of a burden of proof to the defendant seems to induce a switch in the dialectical roles: as far as the issue of defendant's insanity is concerned, defendant is the proponent and plaintiff is the opponent.

We can draw a first conclusion from this example: burden of proof is usually distributed over the parties in a legal dispute, which means that both parties can be proponent on some issues but opponent on other issues. Clearly, this is not captured by the rules of our logical argument game.

The situation is even more complicated. Suppose that the defendant, in her role of proponent of insanity, attempts to prove her insanity with an official-looking document containing a judicial decision declaring her insane. So instead of with δ_1', she moves with

δ_1'':
(13) This document is a document of court *C*
(14) This document declares me insane at the time of the offer
(15) If a court's document declares someone insane, (s)he is insane

So,
(10) I was insane when accepting the offer
(11) If somebody is insane when accepting an offer, no valid contract is created

So,
(12) no valid contract was created

And suppose that the plaintiff then claims that this document is not real because it does not contain the right stamp of court *C*.

π_2:
(16) This document does not contain the correct stamp of court *C*.
(17) If a document does not contain the correct court's stamp,
it is not a real document of that court
So,
(18) this document is not a document of court *C*

Here, (18) contradicts (13). Now in Dutch law the burden of proving that a document with seemingly official legal status is not real, is on the one who claims this, so in Dutch law the dialectical roles would switch again: with respect to the authenticity of the document, plaintiff becomes the proponent while defendant becomes the opponent. In other words, the judge must become convinced that the document is not real, otherwise defendant's argument δ_1" remains uncontested, and plaintiff's main claim cannot be proven. So we can draw a second conclusion: allocations of burden of proof can be nested, and moreover, they can be reversed in such a nesting. Clearly, the above argument game cannot model this.
It is important to note that these problems do not only arise in argumentation logics, but in nonmonotonic logics in general. This follows from the above-mentioned fact that nonmonotonic logics are translatable into argumentation logics.

What must be added to our argument game to let it cope with these phenomena? Perhaps several solutions are possible, but in this paper I shall explore the following one. I shall assume an explicit allocation of burdens of proving certain propositions to the parties in a dispute, and I shall distinguish between the parties in a dispute (plaintiff and defendant) and the dialectical roles that they can have (proponent and opponent). If a party uses an argument for a conclusion which (s)he has to prove, then this party at that point in the dispute becomes the proponent, with the corresponding task to strictly defeat the other party's argument. The other party, now the opponent, then just needs to defeat the new proponent's argument. Clearly, this solution introduces a procedural notion into our model, so that we have shifted from the dialectical to the procedural level.

4 Semiformal analysis

Let us now discuss the above example in a formalised version, to see more clearly how the dialectical argument game must be adapted. The example is formalised in a simplified version of (Prakken & Sartor 1996). Its logical language as used here consists of rules of extended logic programming with only classical or strong negation ($\neg$). Facts are represented as rules with empty antecedents. Arguments can be formed by chaining rules into trees; the root of an argument is its conclusion. For simplicity I shall leave metalevel arguments on the strength of counterarguments implicit.

As for representing rules and exceptions, several techniques are possible (see e.g. Prakken 1997, Ch. 5, and Sartor 1995), and my model of dialogues with burden of proof will apply to all of them. In this paper I use the following convention. The absence of an exception *e* to a rule 'If *a* then *b*' is added to the rule as an ordinary condition, viz. as $a \,\&\, \neg e \Rightarrow b$. If desired, the exception clause can be general, saying no more than that there is no exception. Then if the burden of proving the exception is on

defendant, plaintiff may simply state its absence without grounds, i.e., as a rule with empty antecedent $\Rightarrow \neg e$. But if the burden of proving the absence of the exception is on plaintiff, he must give a nontrivial argument for $\neg e$.

Let us now look at a formalisation of our example. I shall express burdens of proof by labelling a formula with the player that has to prove it. Recall that in our dispute on *contract* plaintiff has the burden of proving *offer* and *acceptance,* and defendant has the burden of proving any special circumstance that, despite an offer and acceptance, prevents a valid contract from being created. We have seen that plaintiff attempts to fulfil his proof burden by referring to two witness statements.

π_1:
(1) $\Rightarrow$ witnesses, (2) $\Rightarrow$ reliable, (3) witnesses & reliable $\Rightarrow$ offer$^{\pi}$ & acceptance$^{\pi}$
So,
(4) offer$^{\pi}$ & acceptance$^{\pi}$
(4') $\Rightarrow \neg$Exc5, (5) offer$^{\pi}$ & acceptance$^{\pi}$ & $\neg$Exc5 $\Rightarrow$ contract
So,
(6) contract

The labels π attached to *offer* and *acceptance* express that plaintiff has the burden of proving these claims. Since defendant must prove any exception to rule (5), plaintiff is allowed to state the absence of exceptions without grounds, which is why rule (4') has an empty antecedent.

Defendant's first counterargument is now formalised as follows.

δ_1:
(7) $\Rightarrow$ *lied before*, (8) *lied before* $\Rightarrow \neg$*reliable*
So,
(9) $\neg$*reliable*

As argued above, defendant's first possible reply does not induce a role switch: an argument for $\neg$*reliable* can be merely defeating, since the burden of proving *offer* and *acceptance* rests with plaintiff and no burden of proving *lied* was allocated to defendant (indicated by the absence of a label δ).

However, I have also argued that defendant's second possible counterargument, that she was insane when accepting the offer, does induce a role switch, since defendant has the burden of proof for any exception to rule (5). So the following counterargument against π_1 should strictly defeat π_1.

δ_1'':
(13) $\Rightarrow$ *court-doc*, (14) *declares-insane*,
(15) *court-doc* & *declares-insane* $\Rightarrow$ *insane*
So,
(10) *insane*. (10') *insane* $\Rightarrow$ *Exc5*$^{\delta}$
So,
(11) *Exc5*$^{\delta}$

That defendant has the burden of proving any exception to rule (5) is indicated by labelling *Exc5* with δ.

Does this example give a clue for how a role switch can be formally defined? Yes: we must look at whether a subargument of the moved argument has a conclusion that must be proven by the mover (a subargument, since sometimes the claim to be proven is an intermediate conclusion of the argument, as in π_1). Only δ_1'' has such a conclusion, viz. *Exc5*$^{\delta}$, so only δ_1'' and not δ_1 induces a role switch.

Let us finally illustrate how the burden of proof can switch back to plaintiff. As explained above, this happens with plaintiff's attack on δ_1'' that the court's document is not real.

π_2:
(16) $\Rightarrow$ *incorrect-stamp*, (17) *incorrect-stamp* $\Rightarrow \neg$*court-doc*$^{\pi}$
So,
(18) $\neg$*court-doc*$^{\pi}$

The new switch of the proof burden is induced by the fact that plaintiff has to prove $\neg$*court-doc*, expressed by the labelling of this proposition with π.

5 A formalisation of argumentation with burden of proof

In this section I shall formalise my proposal of Section 3. I shall first present the proof-theoretical argument game for justification of (Prakken & Sartor 1996) and (Prakken 1999), and then extend it with notions concerning burden of proof. In the presentation I abstract from particular logics for defeasible argumentation, i.e., the structure of the arguments and the origin of the defeat relations are left undefined.

5.1 Dialectical proof theory

The following notions are assumed by the proof-theoretical argument game.

- A notion of *argument*. Each argument has a *conclusion*.
- A binary relation of *defeat* among arguments. *A strictly defeats B* if *A* defeats *B* but not vice versa.
- An *argumentation theory*, which is a set of arguments ordered by a defeat relation. Usually, this set is determined by a set of premises, which serves as the basis for discussion, i.e., from which the arguments can be constructed.
- Two players, a *proponent P* and an *opponent O*.

A dialogue is then defined as follows.

Definition 5.1 [dialogues.]
A *dialogue* is a nonempty sequence of moves $M_1,..., M_n,...$ where each M_i is of the form $(Player_i, Arg_i)$ and where
$Player_i = P$ iff i is odd; and $Player_i = O$ iff i is even
If $Player_i = P$ $(i > 1)$ then Arg_i strictly defeats Arg_{i-1}
If $Player_i = O$ then Arg_i defeats Arg_{i-1}
A dialogue is *based on* an argumentation theory AT iff AT includes all arguments moved in the dialogue, and all their defeat relations.

The first condition says that the proponent begins and then the players take turns, while the second and third condition state the required forces of *P*'s and *O*'s moves.
Winning and justification are then defined as follows.

Definition 5.2 [winning, justification.]
A player *wins* a dialogue iff the other player cannot move. An *argument A* is *justified* on the basis of an argumentation theory AT iff the proponent has a winning strategy in any dialogue based on AT that begins with *A*. A *formula* is *justified* iff it is the conclusion of a justified argument.

It can be shown that this notion of justification corresponds to so-called sceptical (grounded) semantics for defeasible consequence; see (Prakken & Vreeswijk 2000) for the details. Finally, it should be noted that Prakken & Sartor (1996) extend this argument game with the means to model debates about the defeat criteria. For legal applications this is very important, but for simplicity I shall ignore this here.

5.2 Dialectics with burden of proof

I shall now extend the dialectical proof theory with the means to deal with allocations of burden of proof. To this end, some more notions must be assumed.

- I now assume that each argument has *subarguments*, and I assume that defeat is defined such that if an argument is justified, all its subarguments are also justified.
- I now distinguish between the *players* in a dialogue (plaintiff and defendant) and *the dialectical roles* that they can have at the various stages of the dialogue (proponent or opponent). Plaintiff always starts a dialogue.
- Finally, and crucially, I assume an explicit *allocation of burden of proof* to the players. Each player is assigned a set of propositions to prove; no proposition is assigned to both players.

In the previous section, the burden of proving a certain proposition was indicated by labelling that proposition with the player that has the burden of proving it. Technically, an allocation of burdens of proof is a function from players to propositions. In legal procedures it is determined by the judge during a dispute, on the basis of procedural law and the arguments advanced by the parties. However, as said in the introduction, in this paper I abstract from this dynamic aspect of burden of proof.

Next I define the central notion of the extended argument game, viz. that of a *dialectical role* of a player. Without explicit allocations of burdens of proof things were simple: since plaintiff wants to prove his main claim as justified, while defendant wants to prevent this, plaintiff always has the proponent role (*P*), while defendant always has the opponent role (*O*). However, now the role of a player depends on the burden of proof, i.e., whether a move is an attempt to meet a burden or to prevent it from being met.

The idea of the definition is as follows. To determine the role of a player at any stage in a dialogue, we first check whether the moved argument has a subargument with a conclusion that the current player has to prove. If we find it, we assign the role *P* to the player. Otherwise, the role is the opposite of the role of the other player at the previous move. For this, we look recursively higher up in the dialogue, until we encounter another explicit allocation of burden of proof, or else the first move, which is moved by plaintiff, who always has the proponent role. Below I make one simplifying assumption, viz. that a formula to be proven is not reused by the same player in later moves. This leaves for future research the issue whether such a reuse should again induce a role switch.

These ideas are formalised as follows.

Definition 5.3 [dialectical roles.]
Let $M_1, \ldots, M_n, \ldots$ be any nonempty sequence of moves of the form $M_i = (Player_i, Arg_i)$ and consider any allocation of burden of proof. Then for any i the *role* of $Player_i$ in M_i, denoted by $Role(Player_i)$, is defined as follows.

1. If $i = 1$, then $Role(Player_i) = P$
2. If $i > 1$, then
   (a) $Role(Player_i) = P$ if some subargument of Arg_i has a conclusion that $Player_i$ has to prove
   (b) else $Role(Player_i)$ is the opposite of $Role(Player_{i-1})$ in M_{i-1}

All that is now left to do is defining that the defeating force of an argument moved in a dialogue depends on the dialectical role of its mover. I do this by defining the notion of a dialogue with burden of proof. It looks much like the definition of a dialogue, but it replaces proponent and opponent as players with plaintiff and defendant, and makes the required force of an argument dependent on the player's role.

Definition 5.4 [dialogues with burden of proof.]
A dialogue with burden of proof is a nonempty sequence of moves $M_1, \ldots, M_n, \ldots$ where each M_i is of the form $(Player_i, Arg_i)$ and where

1. $Player_i = \pi$ iff i is odd, and $Player_i = \delta$ iff i is even
2. If $Role(Player_i) = P$ $(i > 1)$ then Arg_i strictly defeats Arg_{i-1}
3. If $Role(Player_i) = O$ then Arg_i defeats Arg_{i-1}

The winning condition stays the same: a player has won a dialogue if the other player cannot move.

It is easy to verify that these definitions induce the wanted results in the example of Section 4. It can also be verified that the definitions do not depend on my particular way of representing exceptions, but that they also work if, for instance, nonprovability clauses or implicit exceptions (cf. Prakken 1997, Ch. 5) are used.

Finally, the reader will have noted that I have hardly stated any conditions on allocations of burden of proof. My definitions work fine with allocations as in the above examples, but perhaps examples can be found with labellings that induce strange results. My guess is that such examples will contain 'nonsensical' allocations of proof burdens and will therefore not occur in practice. I leave it to future research to formulate conditions for when allocations of proof burdens make sense.

5.3 Relation with logics for defeasible argumentation

Logics for defeasible argumentation have a well-studied argument-based semantics (see Prakken & Vreeswijk (2000) for an overview). Our dialectical proof theory corresponds to one such semantics, viz. grounded (sceptical) semantics. However, I have introduced a procedural notion into the dialectical proof theory, viz. an explicit allocation of burden of proof, which can make the dialectical roles switch. Does that make the argument-based semantics inapplicable, or is there still a link? A link would exist if we could prove that each time when plaintiff has won a dialogue with burden of proof, his main claim is justified on the basis of the arguments and defeat relations used in the dialogue. This would make insights and results from argument-based semantics available for our extended argument game.

However, it is easy to find a counterexample. Suppose π moves A, δ becomes proponent because of a shift of the burden of proof and accordingly strictly defeats A with B, after which π (now opponent) simply defeats B with C, and the dialogue terminates. The argumentation theory AT constructed during this dialogue consists of the arguments A, B and C and the defeat relations 'B defeats A', 'C defeats B' and 'B defeats C'. According to our new argument game (Definitions 5.3, 5.4 and 5.2) π is the winner. However, according to the old argument game without burden of proof (Definitions 5.1 and 5.2) A is not justified on the basis of AT: to make

A justified, *C* should strictly defeat *B*. Thus this example again illustrates why the original dialogue game of Definition 5.1 is not suitable for modelling disputes with burden of proof.

6 Related Research

Freeman & Farley (1996) incorporate various levels of proof in an implemented protocol for dispute. The initial claim of a dispute can have one of five levels of proof, ranging from a 'scintilla of evidence' (which in present terms is a defensible argument), via 'dialectical validity' (a justified argument) to even stronger notions. Each level of proof induces a different protocol. For instance, for a scintilla of evidence, all counterarguments of the defendant must be strictly defeating, while the arguments of the plaintiff can be merely defeating (this is equal to the dialectical proof theory for defensible arguments proposed by Prakken & Sartor 1996). For dialectical validity these rules are reversed (which essentially results in Prakken & Sartor's proof theory for justified arguments). Although this proposal is very interesting, it has two limitations: it does not allow for distribution of the burden of proof over both parties and not for recursive allocations of burdens of proof.

Gordon & Karacapilidis (1997) have incorporated variants of Freeman & Farley's notions in their 'ZENO argumentation framework'. This is the part of the ZENO argument mediation system that maintains a 'dialectical graph' of the issues, the positions with respect to these issues, and the arguments pro and con these positions that have been advanced in a discussion, including positions and arguments about the strength of other arguments. Arguments are links between positions. The dialectical status of a position ('in' or 'out') depends on its required level of proof. Since levels of proof can be assigned to arbitrary positions instead of only to the initial claim of a dispute, Gordon & Karacapilidis overcome both limitations of Freeman & Farley's proposal. However, in ZENO the proof standards are not incorporated in the protocol for dispute; they are only used after a dispute, to compute the status of the main claim.

For present purposes it was not necessary to make the more fine-grained distinctions between levels of proof made by Freeman & Farley (1996) and used by Gordon & Karacapilidis (1997). However, it seems relatively easy to add these distinctions to the present model; I leave this for future research.

7 Conclusion

We can now answer our problem statement. Reasoning with burden of proof cannot be completely modelled in logics for defeasible argumentation (nor in any other nonmonotonic logic). Procedural notions are also needed, viz. those of an explicit allocation of burden of proof, and of dialectical roles. These notions induce a new argument game, which has no clear correspondence with argument-based proof-theory and semantics.

Another conclusion is that in general not every counterargument induces a role switch. Whether it does, depends on the allocation of burden of proof. This is not accounted for in the models of Hage et al. (1994), Bench-Capon (1998) and Lodder (1999), where each counterargument induces a switch in dialectical role.

Finally, for logicians it is perhaps disappointing that, even if the new dialogue rules are clearly inspired by an argument-based semantics, there is no clear correspondence between the outcome of a dialogue with burden of proof and this semantics. However, for others this might count as support for the view that the semantics of defeasible reasoning is essentially procedural (cf. Loui 1998).

Acknowledgements

I thank Tom Gordon, Jaap Hage, Ronald Leenes, Arno Lodder and two referees for their useful comments on a draft of this paper.

References

Baker (1977)
G.P. Baker, 'Defeasibility and meaning', in: P.M.S. Hacking & J. Raz (eds.), *Law, Morality, and Society. Essays in Honour of H.L.A. Hart*, Oxford: Clarendon Press 1977, pp. 26-57.

Bench-Capon (1998)
T.J.M. Bench-Capon, 'Specification and implementation of Toulmin dialogue game', in: J.C. Hage et al. (eds), *Legal Knowledge-Based Systems. JURIX 1998: The Eleventh Conference*, Nijmegen: Gerard Noodt Instituut 1998, pp. 5-19.

Freeman & Farley (1996)
K. Freeman & A.M. Farley, 'A model of argumentation and its application to legal reasoning', in: *Artificial Intelligence and Law*, 4, 1996, pp.163-197.

Gordon & Karacapilidis (1997)
T.F. Gordon & N. Karacapilidis, 'The Zeno argumentation framework', in: *Proceedings of the Sixth International Conference on Artificial Intelligence and Law*, New York: ACM Press 1997, pp. 10-18.

Gordon (1994)
T.F. Gordon, 'The Pleadings Game: an exercise in computational dialectics', in: *Artificial Intelligence and Law*, 2, 1994, pp. 239-292.

Hage et al. (1994)
J.C. Hage, R.E. Leenes, & A.R. Lodder, 'Hard cases: a procedural approach', in: *Artificial Intelligence and Law*, 2, 1994, pp. 113-166.

Hart (1949)
H.L.A. Hart, 'The ascription of responsibility and rights', in: *Proceedings of the Aristotelean Society*, pp. 99-117, 1949. Reprinted in: A.G.N. Flew (ed.), *Logic and Language. First Series*, Oxford: Basil Blackwell 1951, pp. 145-166.

Lodder (1999)
A.R. Lodder, *DiaLaw. On Legal Justification and Dialogical Models of Argumentation*. Law and Philosophy Library, Dordrecht: Kluwer Academic Publishers 1999.

Loui (1995)
R.P. Loui, 'Hart's critics on defeasible concepts and ascriptivism', in: *Proceedings of the Fifth International Conference on Artificial Intelligence and Law*, New York: ACM Press 1995, pp. 21-30.

Loui (1998)
R.P. Loui, 'Process and policy: resource-bounded non-demonstrative reasoning', in: *Computational Intelligence*, 14, 1998, pp. 1-38.

MacCormick (1995)
N. MacCormick, 'Defeasibility in law and logic', in: Z. Bankowski, I. White, & U. Hahn (eds.), *Informatics and the Foundations of Legal Reasoning*, Law and Philosophy Library, Dordrecht: Kluwer Academic Publishers 1995, pp. 99-117.

MacKenzie (1979)
J.D. MacKenzie, 'Question-begging in non-cumulative systems', in: *Journal of Philosophical Logic*, 8, 1979, pp. 117-133.

Prakken (1997)
H. Prakken, *Logical Tools for Modelling Legal Argument. A Study of Defeasible Argumentation in Law*. Law and Philosophy Library, Dordrecht: Kluwer Academic Publishers 1997.

Prakken (1999)
H. Prakken, 'Dialectical proof theory for defeasible argumentation with defeasible priorities (preliminary report)', in: *Proceedings of the Fourth ModelAge Workshop on Formal Models of Agents*, Springer Lecture Notes in AI, Berlin: Springer Verlag, forthcoming.

Prakken & Sartor (1996)
H. Prakken & G. Sartor, 'A dialectical model of assessing conflicting arguments in legal reasoning', in: *Artificial Intelligence and Law*, 4, 1996, pp. 331-368.

Prakken & Sartor (1998)
H. Prakken & G. Sartor, 'Modelling reasoning with precedents in a formal dialogue game', in: *Artificial Intelligence and Law*, 6, 1998, pp. 231-287.

Prakken & Vreeswijk (2000)
H. Prakken & G.A.W. Vreeswijk, 'Logical systems for defeasible argumentation', in: D. Gabbay (ed.), *Handbook of Philosophical Logic*, second edition, Dordrecht: Kluwer Academic Publishers, to appear in 2000.

Sartor (1995)
G. Sartor, 'Defeasibility in legal reasoning', in: Z. Bankowski, I. White, & U. Hahn (eds.), *Informatics and the Foundations of Legal Reasoning*, Law and Philosophy Library, Dordrecht: Kluwer Academic Publishers 1995, pp. 119-157.

Vreeswijk (1995)
G.A.W. Vreeswijk, 'The computational value of debate in defeasible reasoning', in: *Argumentation*, 9, 1995, pp. 305-341.