ArgPROLEG: A Normative Framework for The JUF Theory

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Abstract. In this paper we propose, ArgPROLEG, a normative framework for legal reasoning based on PROLEG, an implementation of the the Japanese "theory of presupposed ultimate facts" (JUF). This theory was mainly developed with the purpose of modelling the process of decision making by judges in the court. Not having complete and accurate information about each case, makes uncertainty an unavoidable part of decision making for judges. In the JUF theory each party that puts forward a claim needs to be able to prove this claim, due to associated *burden of proof*. Not being able to provide such a proof for a claim, enables the judge to discard that claim although she/he might not be certain about the truth. The framework that we offer benefits from the use of argumentation theory as well as normative framework in multi agent systems, to bring the reasoning closer to the user. The nature of argumentation in dealing with incomplete information on the one hand and being presentable in the form of dialogues on the other hand, has furthered the emergence and popularity of argumentation in modelling legal disputes. The use of multiple agents allows more flexibility for the behaviour of the parties involved.

Keywords: Legal Reasoning, Normative Framework, Argumentation, Agents

1 Introduction

Legal reasoning is a rich application domain for argumentation in which exchanging dialogues and inferencing are combined [16]. On the other hand, legal reasoning is a rich domain for agent modelling in which parties can be modelled as individual agents [13]. In the past two decades, combining argumentation and agents technology has provided a great modelling tool for legal disputes in which multiple parties are involved in a dispute and they each try to prove their own claims [3, 15].

In this work, we offer a normative framework for the JUF theory by means of argumentation and multi-agent systems. This allows an easier presentation of this theory, compared to the previous implementation, PROLEG [21]. The

JUF theory is a decision making tool that has already been successfully used in modelling civil litigation [20]. However, having the users - lawyers and judges - of the system in mind, some of the semantics of logic programming does not seem to be fully accessible to the users. We, therefore, have changed the architecture and algorithm of PROLEG in a way that brings the reasoning process closer to the users. For this purpose, we have used the dialectical proof procedure as a reasoning mechanism for parties involved in an argumentation-based dialogue [23]. The advantage of this mechanism is being close to the human reasoning process as well as being representable in form of dispute trees.

This paper is organised as follows. In Section 2 we give an overview of the JUF theory and PROLEG, followed by a brief introduction to argumentation theory and norms. Section 3 provides the main contribution of this paper, which is a normative architecture, called ArgPROLEG, for reasoning about JUF including an argumentation based implementation of PROLEG. The architecture and algorithm of ArgPROLEG are both included in this section. This section also includes an example of a legal dispute modelled by ArgPROLEG. We then provide a survey of related work in Section 4. Finally we conclude and point out some directions for future work in Section 5.

2 Background

We provide a brief introduction to JUF, PROLEG and the paper's key concepts.

2.1 PROLEG: An Implementation of The Ultimate Fact Theory of Japanese Civil Code

PROLEG [20] is a legal reasoning system based on the Japanese theory of presupposed ultimate facts (JUF). This theory is used for interpreting the Japanese civil code. It was mainly developed to assist judges to make decisions under the incomplete and uncertain information they face in the court. This uncertainty is mainly the result of one party asserting a claim, which is unable to prove due to the lack of evidence. In such a situation the judge cannot deductively decide whether the claim is true or false since the "deductive" civil code is based on the complete information [21].

The JUF theory helps the judge to handle these cases by attaching a *burden of proof* [16] to each claim. The *burden of proof* is assigned to the party that makes the claim not the judge. Thus, if a party makes a claim that is unable to prove, the judge can discard the claim without trying to assign a certain true or false value to it. This way the judge can evaluate the correctness of a legal claim under a set of incomplete information.

PROLEG was introduced in an attempt to replace an existing translation of the JUF theory into logic programming [21]. The reason of this shift was the unfamiliarity of the users, namely judges and lawyers, with logic programming and *negation as failure* [5] in particular. According to *negation as failure*, if a claim is unknown or not known to be true, it is considered to be false. By definition,

negation as failure makes a perfect choice for a mathematical formalisation of the JUF theory in which failing to provide a proof for a claim results in discarding the claim. However, the fact of not being conceptually accessible for the users, lead to a new implementation of JUF called PROLEG.

Instead of *negation as failure*, PROLEG uses the Ito's explanation of JUF which is based on the openness of the ultimate facts [20]. In openness theory, facts are divided into two categories; those that result in a conclusion and those that represent an exceptional situation. The latter category are open to challenge meaning they do not have a certain truth value and are therefore undecided form the judge point of view. The *burden of proof* of these facts is on the party claiming them. Judges are therefore able to make decisions based on known facts and exceptions that are explicitly proven by one of the parties.

PROLEG consists of a rulebase and a factbase. The former stores the rules and the exceptions while the later stores the performed actions of both parties as well as the judge's judgement about their truth value. Equations (1), (2) and (3) are examples of a rule, an exception and a fact in PROLEG, respectively.

$$deliver\_good(X, Y, Good) \quad <= \quad purchase\_contract(X, Y, Good, Price) \quad (1)$$

$$exception(deliver\_things(X, Y, Good, Price), \\ claim\_of\_simultaneous\_performance(Y, X, Price)) \quad (2)$$

$$allege(claim\_of\_simultaneous\_performance, plaintiff) \quad (3)$$

Rule (1) states that party X can expect party Y to deliver a *Good* if there is a purchasing contract between them including the agreed $Price$ and *Good*. However there could be an exception to this expectation, which is defined in rule (2). The exception is as follows: if there is a contract between two parties, one may refuse to perform her/his obligation until the other party performs her/his obligation. Moreover, equation (3) shows a performed action by the plaintiff party, which is claiming an exception to $deliver\_things(X, Y, Good, Price)$ by, $claim\_of\_simultaneous\_performance$.

According to the claims and proofs that two parties - Plaintiff and Defendant - assert, PROLEG produces a trace of derivation in the form of an dialogue between them. The plaintiff tries to prove a claim while the defendant tries to find an exception for that claim. If the exception is proven successfully, the plaintiff has to find another exception for the former exception and so on.

2.2 Argumentation

Argumentation theory was initially studied in philosophy and law. During the past two decades it has been extensively researched in distributed systems. Argumentation Frameworks (AF) have particularly gained a popularity in multi-agent systems as an aid for the agents' reasoning and decision making process.

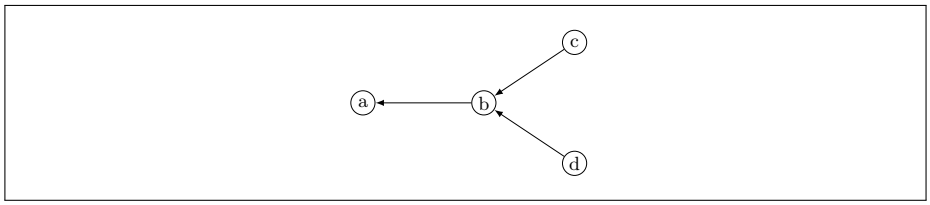

Fig. 1. A Graphical Representation of AF

The first AF was introduced by Dung [7] and it is known as Dung's Argumentation Framework (DAF)[1]. According to DAF, an AF is a pair $AF = \langle Ar, R \rangle$ where $R \subseteq Ar \times Ar$. Ar is a set of arguments and R is a set of attack relations between arguments. We assume a attacks b if $(a, b) \in R$. Figure 1 displays an AF with four arguments and three attack relations between them. Nodes represent the arguments while edges represent the attack relations among them.

$$AF = \langle \{a, b, c, d\}, \{(b, a), (c, b), (d, b)\} \rangle$$

The evaluation of arguments in an AF depends on the argumentation semantic of choice. The purpose of argumentation semantics is to determine a set of justified and coherent arguments based on the arguments' interactions. If two arguments attack each other then an entity - which could be an agent for example - cannot believe in both of them at the same time. Therefore, the role of argumentation semantics is to examine the acceptability of a set of arguments.

The most basic argumentation semantic is the conflict-free semantics [7] in which none of the arguments attack each other. This is the minimum criteria for a set of arguments to be considered as coherent. The rest of argumentation semantics (e.g. complete extension, preferred extension, stable extension and etc.) are a version of conflict-free semantic that satisfy some form of optimality [6]. As an example, the conflict-free extensions of Figure 1 are provided below:

$$C\_F : \{\{\} \{a\} \{b\} \{c\} \{d\} \{a, c\} \{a, d\} \{c, d\} \{a, c, d\}\}$$

One of the reasons of developing argumentation theory in multi-agent society is being able to present interactions in the form of dialogues, specially among participants with potentially conflicting viewpoints. Dung [8] states argumentation as a form of reasoning for dispute resolution in which two parties, proponent and opponent, engage in a discussion as a form of proof for their claims. In fact, dialectical proof procedure can be viewed as a reasoning mechanism for parties involved in an argumentation-based dialogue [23]. In such a dialogue, the proponent puts forward an argument with the purpose of proving it. However, the

[1] DAF can also be referred to as an Abstract AF because it abstracts away the internal structure of arguments and instead, it merely focuses on attack relations among arguments.

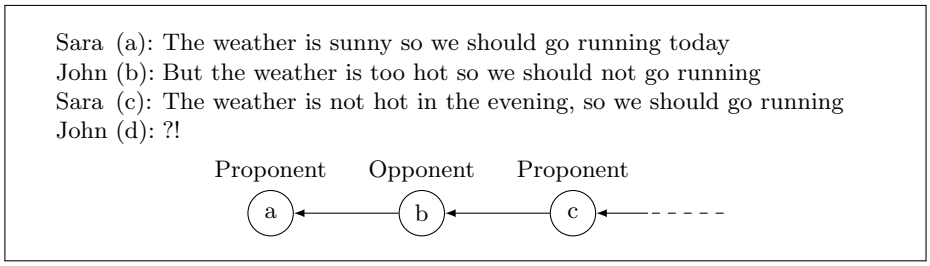

Fig. 2. Dialectical Proof Procedure

opponent tries to attack this claim. The dispute goes on by the proponent and opponent alternating in attacking each others previous arguments until one of them runs out of arguments. The winner of the dispute is the party who speaks last. Therefore, the original claim by proponent is proved if the dialectical proof procedure ends with an argument by proponent. Figure 2 shows an example of this nature in which the proponent claim is accepted due to the opponent running out of arguments.

2.3 Norms

Norms are defined as social rules which control the agent society of by regulating agents' behaviour [24]. Each norm is a rule of form (4) consisting of literals Li.

$$L_0 \leftarrow L_1 \wedge \cdots \wedge L_m \qquad m \geq 0 \tag{4}$$

The left hand side of the arrow L_0 is called head or conclusion of the rule and the right hand side $L_1 \wedge \cdots \wedge L_m$ is called body or premises of the rule. L_0 holds if $L_1, L_2, \cdots$, and L_m are all true. Take for example the norm:

$$payfine(AgX) \leftarrow delay(AgX, Y) \wedge reserved(Y) \tag{5}$$

This norm can be read as: Agent AgX has to pay fine if it delays returning book Y to the library and the book is reserved by someone else.

Since we aim to use norms in a legal reasoning context, using the JUF approach presented by PROLOG, we require a second type of norm called an exception norms. These are denoted as:

$$Exception(Q, P) \tag{6}$$

Stating that there is an exception, namely P for Q which is the head of another norm. Exception norms substitute the facts representing exceptional situations in PROLEG (see Section 2.1). For example the norm:

$$Exception(payfine(AgX), available(Y^{'})) \tag{7}$$

Assuming $Y^{'}$ is a second version of book Y, norm (4) reads as AgX does not have to pay fine if another version of book Y is available.

3 ArgPROLEG: A Normative Framework for Legal Reasoning

The JUF theory was first implemented in logic programming followed by an implementation in prolog called PROLEG. The main advantage of PROLEG over the original system is its accessibility to lawyer and judges. In this section we propose a normative framework to model the JUF theory which is even closer to the natural human reasoning process. This framework uses multi-agent systems and argumentation theory to represent a legal dispute between two parties, namely plaintiff and defendant. We first introduce the overall architecture followed by the algorithm.

3.1 The Framework Architecture

We suggest an architecture (see Figure 3) in which the two parties in a legal dispute, plaintiff and defendant, are presented by two agents A and B, respectively. The arbitrator plays the role of the judge in the court and the set of norms models the law book. The arbitrator receives the claims and evidences of each parties and judges them by referring to the set of norms.

Below is a narrative on how the communication works between the various parties:

- The session starts by agent A submitting a claim to the arbitrator.
- The arbitrator checks the set of norms to find out how agent A should support this claim. In other words, what are the requirements of this claim from the legal viewpoint.
- The arbitrator passes the requirements to agent A.
- If agent A fails in providing the requirements, the claim is rejected.
- If it succeeds then, the arbitrator contacts the set of norms to see if there are any exceptions for this claim. If not, the claim is accepted.
- Otherwise the arbitrator passes the exceptions to agent B to see if it can provide any of them.
- If agent B has any of those exceptions, it will then pass it to the arbitrator.
- Subsequently, the arbitrator tries to find out how this exception can be supported from the law viewpoint by referring to the set of norms.
- The arbitrator informs agent B about the required support.
- If agent B cannot provide the necessary support for any of the exceptions, agent A's claim is accepted.
- But if agent B can prove at least one of the exceptions, the arbitrator tries to find out what are the exceptions for that by checking the set of norms.
- If there is any they will be passed to agent A and the same procedure will be repeated.
- This procedure is repeated until either an exception to the original claim cannot be ignored (the plaintiff cannot counteract) or all exception to the original claim turn out to be unsupported by the defendant.

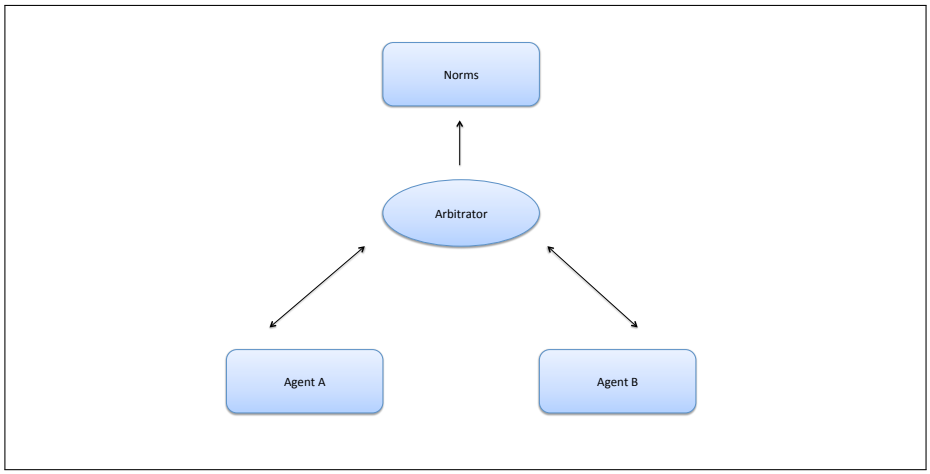

Fig. 3. The Framework Architecture

3.2 The ArgPROLEG Algorithm

The ArgPROLEG algorithm (Figure 4) consists of six functions: **Main(C)**, **prove(S,P)**, **provide-evidence(M)**, **claim(A,B)**, **reverse(X)** and **except(F,Q)**. The task(s) that each function fulfils is explained below.

The **Main(C)** function returns the output of **prove(S,P)** function for the plaintiff's original claim C. The **prove(S,P)** function is used to prove a claim or the support of an exception by either party. If a party **P** puts a claim or an exception forward, the arbitrator will check the the set of norms to see how the claim or exception can be proven. The arbitrator then asks the agent for the proof by showing evidence. If the agent can provide the necessary evidence by means of **provide-evidence(M)** function, the evidence is passed to the **claim(A,B)** function to see if there is any indirect attack to the original claim **C**. By indirect attack, we mean an exception to any part of the evidence of **C**.Therefore, the proof is successful if evidence is provided and all claims agaist it rejected. The **provide-evidence(M)** function is a function that is used by each single agent collecting all the rules that have **M** as their head. It then recursively, traces back each rule to find all its atoms. The output of this function is a set of sets. Each set provides a possible way to proof the claim. For example in the case provided below, the agent has to provide $\{p1, p2, p3, p4, p5, p6, M\}$ or $\{q1, M\}$.

$$
\begin{array}{lll}
R1 : M \Leftarrow p1, p2 & R4 : p2 \Leftarrow p4, p5 & R7 : p3 \Leftarrow \\
R2 : M \Leftarrow q1 & R5 : p4 \Leftarrow p6 & R8 : p5 \Leftarrow \\
R3 : p1 \Leftarrow p3 & R6 : q1 \Leftarrow & R9 : p6 \Leftarrow
\end{array}
$$

Function **claim(A,B)** takes the responsibility of the rest of the dispute after the first claim by plaintiff is proven to be true. This function then give chances to the defendant and the plaintiff to attack each others last announcement. If any of

the exceptions against an argument remains unattacked by the other party, that means that the dispute is over and the winner is the claimer of this argument. The output of this function is **true** if **B** who made the first claim/argument **A** is the last who speaks. Otherwise the output is **false**. The **reverse(X)** function takes one of the parties, either the plaintiff or the defendant as input and returns the opposite party as output. This function will be called in **claim(A,B)** function, when the parties have to take turn in attacking each other. The **except(F,Q)** function tries to find the exceptions for a certain claim or exception, **F**. If **F** is provided by one party, the opposite party **Q** needs to show evidence and consequently prove the exceptions for **F**. Thus, the arbitrator checks the set of norms to see whether there is any exceptions for **F**. In case of existence, the exceptions will be passed to **Q**. This party has to firstly show an evidence of such an exception and secondly prove it by calling **prove(S,P)** function. If it fails either of them, then the exception is rejected. The output of this function is either $\emptyset$, which means there is no exception or not any proven one for **F**; or it is set **provenE** which is a set of proven exceptions for **F**.

3.3 Contract Scenario

In this scenario, we aim to model a legal dispute between to parties by means of the architecture and the algorithm we introduced in Sections 3.1 and 3.2. Imagine a situation in which a lessor wants to cancel his property contract with the lessee. She claims that the lessee has subleased the property to somebody else and therefore, she wants to end the contract. Both the lessor and the lessee agree that there was a contract between them in first place and subsequently the property was handover to the lessee. The lessee also admits her contract of sublease with a third person which was followed by handing over some parts of the property to the sublessee. The lesser believes that the sublease has used the property to make profit, thus she maked the announcement of cancelling the contract. However, the lessee believes that she already informed the lessor and she has approved of the sublease before she made the announcement of cancelling the contract. Moreover, the period of subleasing was so short that this does not count as abuse of confidence of the owner. However, the owner considers the case as abuse of confidence since she has received some complaints from the neighbours regarding the noise during the subleasing period. Figure 5 displays the formalisation of this case based on the AnsProleg architecture.

Figure 6 illustrates the graphical representation of Contract Scenario based on the ArgPROLEG algorithm. The plaintiff claims that she wants to cancel the contract . The arbitrator then check the set of norms to find out the support for this claim. N1 provides this information which will be passed to the plaintiff. Plaintiff is able to provide the required support. Thus the first argument (a) appears. the arbitrator checks the set of norms to see if there is any exception for this claim. Exceptions 1 and 2 provide two options for the defendant to make an attack against the plaintiff's claim. The options obtained from the exceptions are $b : get\_approval\_of\_sublease$ and $c : nonabuse\_of\_confidence$. N2 and N3 contains the necessary supports for each of the exceptions, respectively. The

```
Plaintiff-Arbitrator: Main(C)
begin
    return(prove(C, Plaintiff))
end

prove(S,P)
begin
    Arbitrator-P: Provide evidence for S
    V = provide − evidence(s)
    if V = Ø then return(false);
    for every v ∈ V
        begin
            proven = true
            for every v_i ∈ v
                begin
                    if claim(v_i, P)
                    proven = false
                    break
                end
            if proven = true
            return(true)
        end
    return(false)
end

provide-evidence(M)
begin
    Result = {}
    R_u = {M ⇐ D ∈ R}
    if R_u = Ø then return(Ø)
    for every R_i ∈ R
        begin
            if D = Ø then add {} to all sets in Result
            else if for all D_i ∈ D
                begin
                    add provide − evidence(D_i) to all sets in Result
                end
                add {D} to all sets in Result
        end
        return(Result)
end

claim(A,B)
begin
    e = except(A, reverse(B))
    if e = Ø then return(true)
    else for all e_i ∈ e
        begin
            result = claim(e_i, reverse(B)
            if result = true then return(false)
        end
    return(true)
end

reverse(X)
begin
    if X = Plaintiff then return(Defendant);
    else return(Plaintiff);
end

except(F,Q)
begin
    Arbitrator-Norms: collect all the exceptions for F
                          exception(F, E_i) in E
    if E = Ø then return(Ø)
    else for every E_i ∈ E
        begin
            Arbitrator-Q: evidence(E_i)
            if Q can provide the evidence
                then Arbitrator-Q: prove(E_i, Q)
                    if prove(Q, E_i) = true
                        then provenE = provenE ∪ E_i
                            return(provenE)
            else return(Null)
        end
    end
end
```

Fig. 4. The ArgPROLEG algorithm

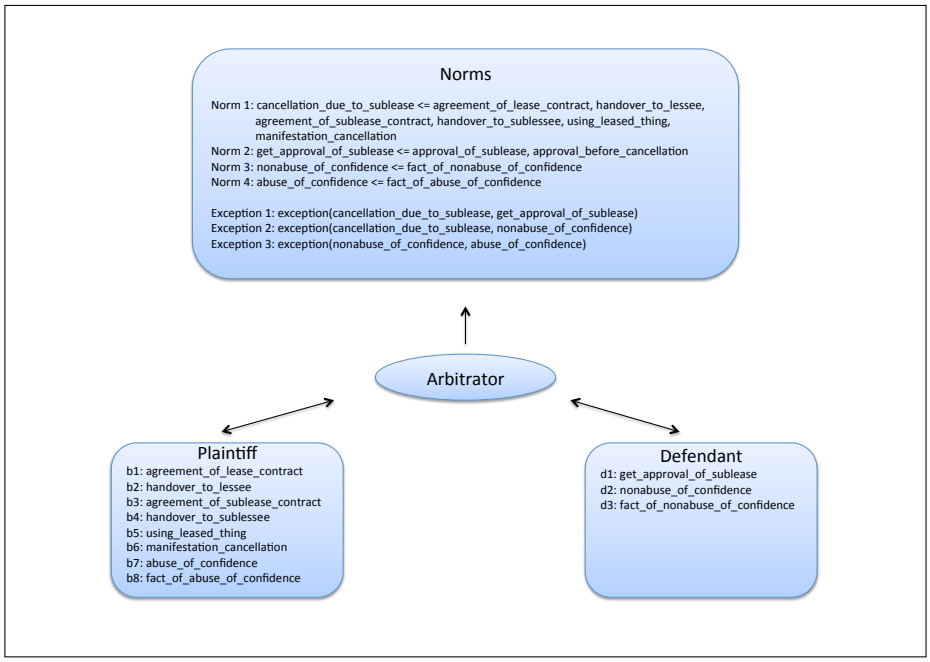

Fig. 5. Contract Scenario

attack (b) and (c) to (a) remains as a potential attack unless the defendant can provide the requested support for them. Defendant can only provide this support in case of argument (c). Therefore, the defendant attacks argument (a) by argument (c). Now, based on the algorithm, the arbitrator checks the set of norms to find an exception to this exception. This is going to make a potential case for the plaintiff to perform an attack to the defendant. There is one exception available, namely Exception 3, $abuse\_of\_confidence$. N4 states the requirement for this argument which is $fact\_of\_abuse\_of\_confidence$. The plaintiff successfully support this arguments which results in an attack from argument (d) to argument (c). The arbitrator looks for another exception to this later exception. Since such an exception is not available the dispute is over. The last graph in Figure 6 shows the final argumentation framework for this dispute. Going back to Section 2.2, in a dialectical proof procedure, the party who makes the last utterance is the winner which similarly makes the plaintiff the winner of this case.

4 Related Work

The closest work to ours is PROLEG [20] which is an implementation of JUF theory by means of the *burden of proof*. ArgPROLEG has fulfilled two future

plans of PROLEG discussed and listed in [20]. These two features are, bringing the knowledge representation closer to the natural language and also including a diagrammatic representation of reasoning in the JUF theory. Using argumentation in designing ArgPROLEG has served both these purposes.

Apart from PROLEG and ArgPROLEG, another translation of the JUF theory is also available in logic programming [21]. It uses, in contrast to PROLEG and ArgPROLEG, *negation as failure* instead of the *burden of proof*. *Negation as failure* is a non-monotonic form of negation that enables logic programming to formulate problems of non-monotonic reasoning. Kakas [14] had already used *negation as failure* for default reasoning. The idea of using negative literals as abductive hypotheses has also been pointed out by Eshghi and Kowalski [9]. However, among *burden of proof* and *negation as failure*, the concept of the former seems to be easier to grasp for lawyers and judges.

In terms of formalisation of the *burden of proof*, other works exist [12, 17, 19, 25]. Gordon et al. offer an argumentation-based system, called Carneades [12], which implements the *burden of proof* as well the *burden of persuasion*. The main difference of this approach to ours that the *burden of proof* for a premise can be assigned to a different party rather than the one who has uttered the claim. The plaintiff has the *burden of production* for the facts of its claim, whereas the defendant has the *burden of production* for exceptions. The same applies to the *burden of persuasion*.

Another example of logic programming being used for expressing and applying legislation is [22]. This work however, focusses on specific legal cases related to British Nationality Act. They describe how complicated regulations such as British Nationality Act can be translated into simple form of logic so that the consequences of each act can be determined.

5 Conclusion and Future Work

In this paper we introduced ArgPROLEG, a normative framework for legal reasoning, using a dialectical proof procedure to support legal parties to resolve their conflict. It offers an alternative approach to PROLEG [20]. We believe that ArgPROLEG is closer to natural language compare to PROLEG. Additionally, ArgPROLEG is able to offer a diagrammatic representation of the plaintiff's and the defendant's reasoning which enhances the ability of non-expert users to follow the procedure as it unfolds

For the future, we would like to extend our framework to be able to cope with more than two parties. In real cases a dispute can involve multiple parties.The main challenge in this will be to determine who can or should offer counter-arguments to a given claim.

For the implementation we consider an architecture similar to the Governor approach presented in [1]. Balke et al, use an institution to collect the norms and the normative results of the agent's actions. To make this information accessible via queries the authors introduce the Governor, an agent that acts as a relay between the norms and their (possible) consequences and the agent's query.

In our case, the arbitrator would have take the role of the Governor. Apart from simply relaying queries to the institution/norms, it will actively retrieve information to pass on to the agents, e.g. the exception to the claim. [1] uses the Jason BDI architecture [4] for setting up the multi-agent system and InstAL based on answer set programming [2, 11] for the institution/norms. We would be able to do the same. The use of a BDI architecture [18] has the added advantage of being able to model agent reasoning in more detail. Currently, our agents' mental model contains only beliefs or a knowledge base. In a BDI architecture we could express the goals and intentions of the agents more efficiently and take them into account when they put forward their claim.

For the dialectical proof procedure, we are considering also an implementation using answer set programming. Dung's argumentation framework and conflict-free semantic have already been implemented by answer set programming [10], giving us a good indication that this approach is worth considering.

This paper only investigates the use of argumentation for conflict resolution in a legal domain. For the future, we wish to extend it to other domains. With an institution rather than a set of norms, we would be able to keep track of normative states and allow agents to reason about conflicts that appear after a period of time. Having more expressive agents, give us the chance to investigate different strategies for agents to deal with the norm compliance, as they could decide whether the gain of breaking a norm is worth the sanction.

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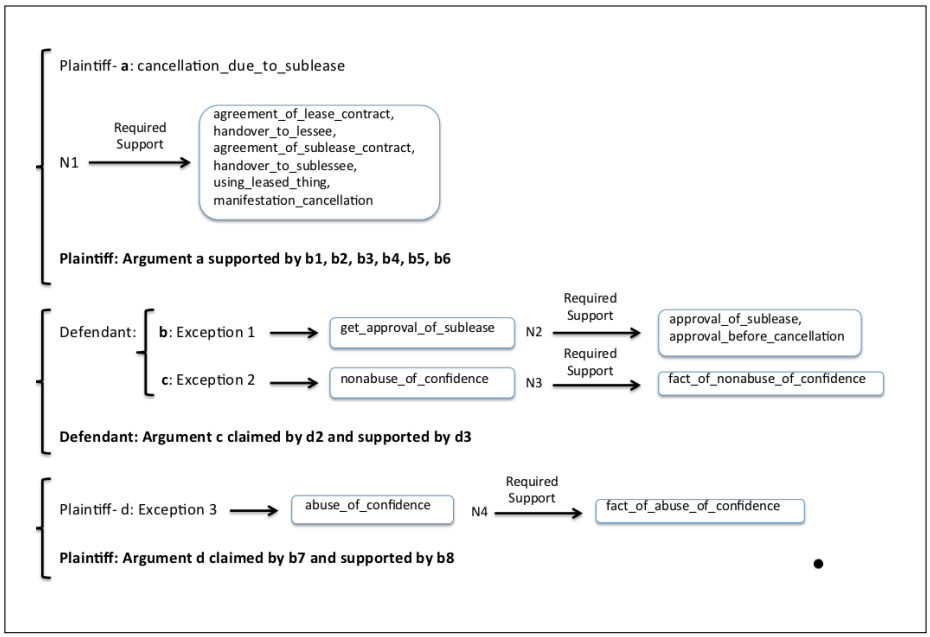

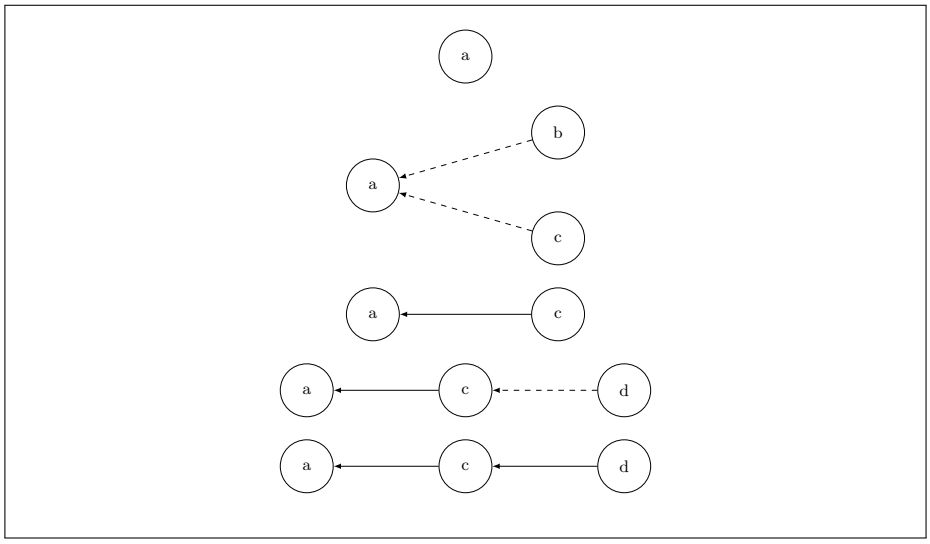

Fig. 6. Contract Scenario Argumentation Framework