Planning with Argumentation Schemes in Online Dispute Resolution

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Planning with Argumentation Schemes in Online Dispute Resolution

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Abstract

Online dispute resolution is becoming the main method when dealing with a conflict in e-commerce. Our interest regards automating the dispute resolution process in order to face the increasing number of disputes. Quite aware of the difficulty that lies ahead of such task, we drive our attention to argumentation schemes to cover the gap between arguments based on propositional logic and plain linguistic arguments used by the human mediators. The contribution here consists in proposing a classification of the argumentation schemes suitable for B2B disputes. Finding the argumentation line supporting a claim is considered as an AI planning problem and it is meant to be agent-driven. By using argumentation schemes we intend to maintain a high level of abstraction to easily accomodate human intervention. The schemes are formalising in PDDL in a framework compatible with the emerging semantic web. The main advantages relie on the facts that communication is guided by the critical questions, whilst PDDL offers metrics to compare argument chains under time constraints.

1 Introduction

Online Dispute Resolution (ODR) promises to become the predominant approach to settle e-commerce disputes after ten years of fast and sustained development[1]. ODR is cheaper, faster, and more important from the business viewpoint, is private. In order to face the increasing number of disputes in e-commerce, there is an acute need for flexible ODR support systems, both to enhance the expertise level of the mediator, and to structure argumentation.

Our interest regards automating the dispute resolution process, but taking in consideration how a human mediator thinks [11]. We drive our attention to argumentation schemes to cover the gap between arguments based on propositional logic used in theoretical research and plain linguistic arguments used by the human mediators. The research is an attempt to formalise the schemes that practising lawyers use in their cases in the domain of B2B disputes[2]. We approach the problem of deriving argumentation chains for a claim as a planning problem, with two strong advantages: the possibility to encapsulate the communication protocol as schemes' preconditions, and the opportunity to use different metrics for deciding on the validity, reasonability, or certainty of arguments under time constraints.

2 Argumentation Schemes for B2B

Argumentation schemes (ASs) capture stereotypical patterns of human reasoning, especially defeasible ones [15]. ASs can be viewed as heuristic search procedures in supporting a claim. Formally, an AS is composed of a set of premises P_i, a conclusion C, and a set of critical questions CQ_i, aimed to defeat the derivation of the consequent. If the other party asks one of the critical questions, the burden of proof may be shifted to the proponent of the argument. Our research is an attempt to formalise the schemes that practising lawyers use in their cases in the domain of B2B.

The proposed functional taxonomy is intended to cover practical scenarios and it runs along five dimensions: practice in law, economical efficiency, the need for trust, semantic inference, and strategic reasoning.

[1] For an economical perspective, ODR is a booming business. A 2004 survey accounted 115 ODR providers [12], the most encountered services offered by these providers are mediation and arbitration, but some sites also provides automated negotiation, negotiation support, case appraisal, or complaint handling schemes.

[2] Other domains in which ODR had already been proved useful include: division of the joint property in divorces, e-commerce disputes between businesses and consumers, or financial services.

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Argument from precedent case $\doteqdot$ *AS_PC*

A_1 : *Generally, case* C_1 *is similar to case* C_2

A_2 : *A is true (false) in case* C_1

C : *A is true (false) in case* C_2

CQ_1 : *Are* C_1 *and* C_2 *similar in the respect cited?*

CQ_2 : *Is A true (false) in* C_1*?*

CQ_3 : *Are there differences between* C_1 *and* C_2 *that would tend to undermine the force of the similarity cited?*

CQ_4 : *Is there some other case* C_3 *that is also similar to* C_1 *but in which A is false (true)?*

Figure 1. AS is formed by the premises A_i, the conclusion C, and the critical questions CQ_i.

Argument from commitment $\doteqdot$ *AS_C*

A_1 : *Agent A is committed to clause P.*

C : *In this case A should support P.*

CQ_1 : *Is the commitment indirect?*

CQ_2 : *Is the commitment defeasible?*

CQ_3 : *Is the contract to which the clause belongs valid?*

Figure 2. Contracts constitute the baseline in B2B dispute resolution.

2.1 Legal argumentation schemes

Because ODR systems deal preponderantly with interjurisdictional issues, the available legal ASs must cover both case based reasoning, applied in common law countries, and also legal syllogism, used in civil law regulations. *Argument from legal rule* and *Argument from precedent case* meet these requirements and they must be placed on top of the ontology. If needed, these ASs *legal rule AS* can be extended with *commanding*, *derogative*, or *empowering* normative rules, as in [13].

Actually, the e-commerce disputes follow some well-known patterns. Therefore, *Argument from precedent case* seem to be a useful scheme when computing the outcome (figure 1). From our viewpoint two practical constraints limit its applicability to ODR systems. Firstly, the processes are private, therefore they rarely can be cited, and secondly, business entities are merely concerned about themselves, and they do not easily accept the outcome computed for a past case, regardless of the degree of similarity. Consequently, the parties will make use of the available critical questions. This can be proved particularly useful, considering it is not important to blindly apply the law or an argumentation chain, which proved to be successful in other cases, but rather to give satisfaction to the parties. Therefore, the similarity of the cases regards both the facts and the requirements or the situation of the parties involved.

Contracts signed between business entities constitute the main legal baseline when arbitrating a dispute. They imply commitments which are active during their running window, with effects on both normal runs as well as in the case of exceptions. *Argument from commitment* scheme may be used to invoke contractual commitments (figure 2). Its associated critical questions regard the strength of the commitment and the validity of the contract. When $AS\_C\_CQ_3$ is invoked, the burden of proof is shifted to the proponent in order to demonstrate the validity of the contract. If the certainty factor does not meet the level of proof required by the current stage of the dispute, the burden of proof may be shifted back to the opponent, who has to demonstrate the contract invalidity. To do this, *Argument from legal rules* may be invoked by instantiating the legal rule which supports the contract invalidity.

2.2 Economical argumentation schemes

These types of schemes are not encountered in the existing theoretical argumentation frameworks [14, 5], even if they are warranted by the current practice in law, but they could prove to be very strong arguments in practical applications. They are domain dependent and therefore are highly probable to be extended in order to cover the most encountered arguments conveyed by the disputants in a specific domain. For instance, the following arguments are particularly relevant in B2B domains such as supply chains [6]:

- *Expectation damages argument*: it supports a reward that places the victim of breach in the position he or she would have been in if the other party had performed the contract [2];
- *Reliance damages argument*: it puts the victim in the same position after the breach as if he had not signed a contract with the promisor or anyone else [2];
- *Opportunity costs argument*: it supports an outcome that places victims of breach in the position that they would have been if they had signed the contract that would have been the best alternative to the one that was breached [2].

The critical questions of the economical schemes are formalised according to the queries asked by the prac-

Argument from expectation damages $\doteqdot$ *AS_ED*

A_1 : *A contract C was signed between a debtor D and a creditor C regarding a subject G for the price* P_c.

A_2 : *The victim's own valuation of the item is V.*

C : *The breacher must compensate* $P_c - V$ *damages.*

CQ_1 : *Is the contract C valid?*

CQ_2 : *Can the valuation V be proved by the victim?*

CQ_3 : *Did the breacher try to mitigate damages?*

CQ_4 : *Does the breacher offer any substitute item?*

Figure 3. Critical questions may defeat the derivation of the conclusion.

tising lawyers when they construct their case. The first step consists in assuring the validity of the contract ($AS\_ED\_CQ_1$ in figure 3). For the *Expectation damages argument* the most encountered issue is to prove the profit that the victim would have obtained in case the contract had been performed. Failing to bring such proves blocks the applicability of this argument ($AS\_ED\_CQ_2$). Normative rules are designed to assure economical efficiency. Thus, the breacher will have to pay less penalties in case he can demonstrate that he tried to mitigate damages ($AS\_ED\_CQ_3$). In the same spirit of economical efficiency, legal rules protect long running business relationships. In this case, a substitute item is preffered to a money penalty ($AS\_ED\_CQ_4$).

2.3 Ontological argumentation schemes.

Some questions may arise during the argumentation process: Is there a nonlegal term subsumed by a legal term? Is there an object an instance of some term? Are these terms synonyms? To answer these questions one needs semantic knowledge about the domain. The information is obtained by querying legal and linguistic ontologies and it is defeasibly accepted. The following ASs [5] can be used to capture such aspects: *Argument from the sameness of meaning*, *Class membership argument*, or *Argument from species to genes.*

A typical scenario for *Class membership argument* (figure 4) would be the next one. A is a TV set. All TV devices are members of the electrical devices. Rule R, which says that "all electrical appliances are sold only with at leat one year guarantee", is applied to electrical devices. In consequence, the A device must have one year gurantee. In case there exists a more specific rule, which applies directly to A, stipulating another clause, the conclusion can be defeated ($AS\_CM\_CQ_1$). .

Class membership argument $\doteqdot$ *AS_CM*

A_1 : *A is an F.*

A_2 : *All Fs are members of the class of Gs.*

A_3 : *Rule R applies to G.*

C : *Rule R applies to A.*

CQ_1 : *Is there a rule* R_1 *which applies to A, not applies to G, and it is in conflict with R?*

Figure 4. The premises A_1 and A_2 can be obtained by querying domain ontologies.

Argument from expert opinion $\doteqdot$ *AS_EO*

A_1 : *E is an expert in domain D.*

A_2 : *E asserts that A is known to be true.*

A_1 : *A is within D.*

C : *A may (plausibly) be taken to be true.*

CQ_1 : *Is E a genuine expert in D?*

CQ_2 : *Is A relevant to domain D?*

CQ_3 : *Is A consistent with what other experts in D say?*

CQ_4 : *Has the expert E a good reputation?*

Figure 5. The lack of trust in expert opinion may block the derivation of the consequent.

2.4 Trust argumentation schemes

Argumentation systems should be endowed with the ability to provide argumentation schemes that are not necessarily based on the rationality or evidence, such as *Argument from reputation* and *Argument from expert opinion* (figure 5). Here, ($AS\_EO\_CQ_1$) also implies semantic reasoning, by the need to compute if a specific domain belongs or not to the expertise area of an expert. Contradictory opinions ($AS\_EO\_CQ_3$), or a bad reputation ($AS\_EO\_CQ_4$) may defeat the consequent.

2.5 Strategic Argumentation Schemes

Modelling legal reasoning is not only about finding the relevant argumentation schemes, but also about deciding how each scheme contributes to the final outcome. A system needs strategies (or meta-argumentation schemes) that can use schemes as premises. *Persuasion Argument* [7] (figure 6), can be applied when independent ASs, supporting the same claim, provide stronger arguments in favor of that conclusion. For instance, by applying two *Argument*

Persuasion Argument $\doteqdot$ *AS_P*
A_1 : AS_1 *sustains conclusion C.*
A_2 : AS_2 *sustains the same conclusion C.*
C : Increase confidence in conclusion C.
CQ_1 : *Are* AS_1 *and* AS_2 *independent?*
CQ_2 : *Does the accrual of arguments hold in case of C?*
CQ_3 : *Are the conclusions supported similar?*

Figure 6. ASs may have ASs as premises.

from witness testimony schemes, the conclusion is more strongly supported. One issue regards the difficulty to identify independent schemes: if the two witnesses are relatives or they conferred with each other, only one testimony is accepted in the trial.

In order to set priorities among conflicting rules, *Argument from legal principles* scheme can be extended by introducing legal strategies such as:

- *Legis posterior argument*: under the legis posterior doctrine, the most recent law or precedent case takes precedence when computing the outcome;
- *Legis superior argument*: according to the legis superior principle, the resolution imposed by the stronger court takes precedence;
- *Legis specialis argument*: for instance, the European e-commerce laws would take precedence over the member's states law.

3 ASs as a Protocol

Dispute resolution process does not begin having all the relevant knowledge available. Before conveying a claim, the disputants must be aware of possible threats. Usually, the parties do not have time or knowledge to check the invalidity of the potential counter-arguments. Thus they have to defeasibly adjust their initial argumentation chain when a valid counter-argument arises. It was argued that, using defeasible planning, the updating plans can be done more efficiently than by replanning [8]. Defeasible reasoning is a rule-based approach for efficiently handling incomplete and inconsistent information, situations that usually arise during dispute resolution.

An argumentation line p for a claim q is a chain of argument schemes $\langle AS_i^a \rangle$, where the last AS has as a consequent q and where a represents the agent who instantiated the scheme. Each argumentation line sustaining a claim provides the correspondent critical questions that the opponent may use when he wants to challenge the pleading. When a CQ is conveyed, the conclusion of the AS to which the respective CQ belongs is suspended, until the subject of the dispute is clarified. Whoever is responsible for this clarification, in other words who has the burden of proof, depends on the type of the CQ.

Definition. *An undercutting CQ attacks the link between the premises and the conclusion. The burden of proof is shifted to the proponent of the argument.*

Definition. *A rebuttal CQ challenges an argument by instantiating an AS sustaining the opposite conclusion. The burden of proof remains to the opponent.*

An undercutting CQ cannot be used to draw any conclusion, their only use is to prevent the derivation of some conclusions. Having the burden of proof, the proponent of the claim has to provide more justifications in favour of that conclusion. A rebuttal CQ is used to derive the opposite claim. Having the burden of proof, the opponent must instantiate a scheme sustaining the opposite conclusion. In current practice of law the burden of proof can be itself the subject of the dispute.

4 Planning with ASs

4.1 Motivating Scenario

Mike Jones was a small manufacturer of quality sports products. Fun Equipments Ltd operates on the same market selling online a wide range of products and accessories. Fun Equipments wanted to complete its products range and it initiated an online auction to select the most adequate partner who can meet the quality specifications of the item. Among two other existing candidates who bid 110$, and respectively 120$ for manufacturing the item, Mike Jones won the auction by bidding 100$ per item. Fun Equipments anticipates to sell the product with 115$ per unit. An order of 10,000 units was confirmed as the initial purchase. The development took 2 months, period in which Fun Equipments spent 5,000$ on publicity for that product. On delivery the company observes that the items do not meet the specified standards of quality. Consequently, it returns the products and claims for 40,000$ as compensation damages. Both firms are members of the Business Enterprise Centre where they signed a compromisory clause[3]. Thus, an ODR process begins.

[3]When signing a contract, the parties are encouraged to include a clause of compromise. Such a clause is needed because the experience indicates at the time a dispute arises, people can not agree on anything, for instance 95 percent of the USA arbitrations result from pre-dispute arbitration clauses.

When analysing the facts, Fun Equipments observes that, under the expectation damages doctrine, the expected profit is E_p=15$*10,000-5,000$=145,000$, under the reliance damage doctrine E_p=5,000$, while under opportunity costs doctrine E_p=5$*10,000-5,000$=45,000$. Using these facts, a planner will compute the following initial argumentation lines that might support its claim:

$p_1 = \langle A_1^p, A_2^p \rangle$
$p_2 = \langle A_3^p, A_4^p, A_5^p, A_7^p \rangle$
$p_3 = \langle A_3^p, A_4^p, A_6^p, A_7^p \rangle$
$p_4 = \langle A_3^p, A_4^p, A_{56}^p [A_5^p, A_6^p], A_7^p \rangle$

where A_i^a is the i^{th} AS within the argumentation chain and a represents the agent who instantiates the scheme (p stands for proponent, o for opponent, and m for mediator). Considering the most simple strategy, the agent p choses the p_1 argumentation line (figure 7) to support its claim. It consists of two ASs: knowing a precedent similar case, where the outcome favoured the victim (A_1^p = *Argument from precedent case*), and by applying opportunity costs doctrine on the current facts (A_2^p = *Argument from opportunity costs*), the claimed damage is warranted. The opponent makes use of $AS\_PC\_CQ_4$ rebuttal critical question (figure 7) to attack the argument. Having the burden of proof, he instantiates argument A_8^o=*Argument from exception* demonstrating that the respective case was actually an exception. Then the mediator utters A_{89}^m = *Legis Specialis*, which is a strategic AS used to compare two conflicting argumentation schemes. The plan p_1 proving to be defeated, the proponent chooses next to convey the argumentation chain p_4.

The new plan (figure 8) is constructed based on the expectation damages doctrine (A_7^p = *Argument from expectation damages*), which is warranted by a persuasion meta-argument A_{56}^p. A_{56}^p uses two schemes A_5^p and A_6^p to stronger support the claim. The A_6^p argument stresses that a contract was signed and that Mike company breached it, whilst A_5^p represents the opinion of an expert who proves that the quality of the products is not a high one.

The expert bases its conclusion on two arguments: the products show some signs (A_4^p), which combined with domain knowledge taken from an ontology (A_3^p), prove the poor quality of the items. Firstly, the opponent chose to attack the plan by requesting profs, showing that the expected profit reached the claimed amount. For doing this, it uses $AS\_ED\_CQ_2$ (figure 3). Being an undercutting CQ, the burden of proof is shifted back to the proponent who instantiates argument A_9^p to provide evidence for its evaluation. Next,

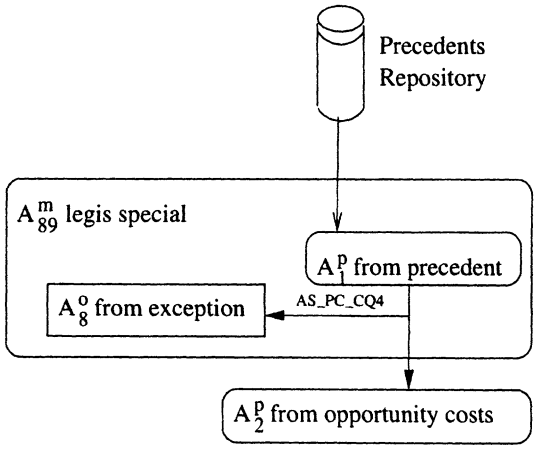

Figure 7. The argumentation line $\langle A_1, A_2 \rangle$ is attacked by the rebuttal critical question $AS\_PC\_CQ_4$.

the opponent wants to verify that the expert opinion is reliable by using the undercutting critical question $AS\_EO\_CQ_4$ (figure 5). The answer is relied on the A_{10}^p argument scheme based on reputation.

To summarise, the next facts follow the above scenario: i) each conveyed argumentation line provides a set of critical questions that can be used to defeat it; ii) the burden of proof is shifted to the parts depending on the type of the current critical question; iii) strategic ASs may be used to strengthen a plan or to compare conflicting conclusions.

4.2 Implementation issues

We identify the following technical requirements for modelling ASs: richness of knowledge representation system, semantic web compatibility, and metrics to compare argument chains. The classical solution for proving a sentence is to use an inference engine. We approach the problem from a different perspective: each AS is implemented as an action within a planning domain, whilst the sentence we want to prove represents the goal of that planning problem. We drive our attention to PDDL with the following advantages arising by applying it to dispute resolution systems:

- It is formal enough to support computational implementation.
- It is very expressive having different levels of richness of domain descriptions: types, probabilities, time constraints.

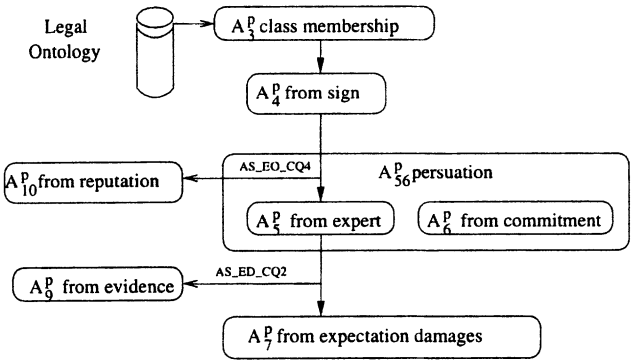

Figure 8. The argumentation line $\langle A^p_3, A^p_4, A^p_{56}[A^p_5, A^p_6], A^p_7\rangle$ is attacked by two undercutting critical questions: $AS\_ED\_CQ_2$ and $AS\_EO\_CQ_4$.

- It is supported by a wide range of planning engines. Having the schemes in PDDL, they may be delegated to the most suitable planner for the current issue. For instance, if the demand requires explanations of the outcome, the schemes' chain will be computed by an abductive planner. In case of anticipating a strong argumentation debate, a defeasible planner may be adequate. In case the level of legal complexity is high, a hierarchical task decomposition planner would be more appropriate.

- The protocol of applying schemes can be encapsulated in preconditions and effects, while the consequents are modelled with domain axioms and conditional effects[4].

- Several metrics can be attached to each argument in order to decide upon the most suitable one for a specific context. For instance, in a formal dispute one prefers arguments chains comprising preponderantly from *legal argumentation schemes*, or in a long run business relationship one seeks argumentation plans composed by *economical argumentation schemes*. Soft constraints, available in PDDL 3.0 [4], might be used to capture this by applying them, both to the claim and the preconditions.

- The core ontology can be easily extended by using PDDL domains. ODR mediators are not necessarily lawyers or judges, or they can manifest different levels of experience. As they get experience, the mediators might extend and refine[5] the basic argumentation schemes.

- Through WEB-PDDL[6], the framework is compatible with semantic web. Therefore, ODR systems can benefit from the existing translation tools or legal ontologies.

In our approach, the most suitable argumentation line for pleading is computing as a planning problem (figure 9). The domain starts by defining types for ASs, CQs, or the agents implied: the mediator, the debtor and the creditor of the signed contractual clauses, and eventually the experts involved. Then, the needed predicates are defined. For instance, the predicate commitment denotes that if a fact *?condition* is brought about the creditor *?creditor*, the debtor *?debtor* has the obligation to fulfill the proposition *?promise*.

The actions that an agent can do are to convey a specific AS. In case of claiming the argumentation scheme from expert opinion, the required parameters are: the agent $?a$ who utters the scheme, the expert $?e$ cited by the agent $?a$, the fact $?x$ on which the expert has given his or her expertise, and the domain $?d$ to which the fact $?x$ belongs. The preconditions assure that the scheme can be conveyed, in our case: i) it is legal to be uttered in the current context and ii) the agent $?a$ has the burden of proof. Then, the conditional preconditions implement the premises of the argumentation schemes, as they have been depicted in figure 5. The effect consists of asserting the conclusion $?x$ sustained by the expert, but it also introduces the legality to utter the associated critical questions CQ_1 and CQ_2 of the current scheme.

5 Discussion and Related Work

Flexibility in configuring ODR systems is both an opportunity and a challenge. The opportunity is that any business can, quite quickly, have its own "court" specialized in disputes that might occur in its specific business domain. The challenge is that the technical instrumentation must simultaneously satisfy the business viewpoint asking for trust [10] and the legal viewpoint, which requires accordance with the current practice in law. The flexibility in our framework is provided by the argumentation schemes from which a business can choose or extend when configuring its own dispute resolution system. The accordance with practice in law is assured by encapsulated legal schemes and defeasible

[4]The derivation of a conclusion may depend on the proof standard required by the stage of the dispute.

[5]The extension can be applied to critical questions inside an existing scheme.

[6]http://aimlab.cs.uoregon.edu/

```
(define (domain OnlineDisputeResolution)
(:requirements :typing :adl)

(:types as cq category fact agent - object
        mediator debtor creditor expert - agent)

(:constants AS_EXPERT AS_COMMITMENT - as
            AS_EXPERT_CQ1, AS_EXPERT_CQ2 - cq)

(:predicates (expert ?e - expert ?d - category)
        (claim ?e - expert ?x - fact)
        (belongs ?x - fact ?d - category)
        (plausibly ?x - fact)
        (evidence ?x - fact)
        (sign ?s - fact)
        (legal ?as - as)
        (commitment ?debtor - agent ?creditor - agent
                    ?condition - fact ?promise - fact))

(:action claim_AS_EXPERT
    :parameters (?a agent ?e - expert
          ?d - category ?x - fact)
    :precondition (and (legal AS_EXPERT)
           (burdenofprof ?a))
    :effect  (when (and (expert ?e ?d)
                        (claim ?e ?x)
                        (belongs ?x ?d))
             (and (plausibly ?x)
                  (legal AS_EXPERT_CQ1)
                  (legal AS_EXPERT_CQ2))))
```

Figure 9. ASs for ODR domain implemented as PDDL operators.

patterns which proved to be adequate to legal reasoning.

The framework introduces a novel classification scheme adequate for practical purposes and it uses PDDL both to model ASs and to encapsulate the communication protocol. The novelty in the functional taxonomy of ASs is represented by the economical and strategic argumentation schemes. The first group of ASs covers an important issue during a dispute, by providing legal support when computing the amount of remedy. The other cluster of ASs tries to increase flexibility when modeling the layer's strategic reasoning.

We advocate three main advantages of the approach for ODR domain. Firstly, by introducing argumentation schemes, we fill the gap between human linguistic argumentation and theorem provers based on propositional logic. Secondly, the implemented defeasible reasoning mechanism can handle gradual revealing of information that usually occurs in any legal dispute, and also the plan can efficiently accommodate successful attacks from the disputants. Thirdly, the framework can entail protocols for governing the dispute resolution process.

A method for formalizing schemes [9] for agent communication is based on Argument Markup Language. The formal tool[7] allows analysing arguments from natural language discourse and it provides an online database of analysed examples. Differently, in our approach the arguments can be automatically chained in order to support complex claims. Gipo[8] can be used to obtain similar graphical representation of the arguments as Arucaria does. After the PDDL domain and task are loaded into Gipo, the user can choose from available argumentation schemes and he, both manually and automatically, generates plans for the current task. Through WEB-PDDL, the framework is also compatible with the emerging Semantic Web, as in the case of Dr-Brokering [1] tool.

Argument-based planning in defeasible logic appears in [3], but the argument remains at the propositional level. The argument schemes are closer to the mediator's patterns of reasoning, while their critical questions offer the same argumentative semantics as in defeasible logic. The agent can handle the relevant information by using the available critical questions and, at the same time, narrowing down the argumentation dialectic chain based on the available argumentation schemes.

6 Conclusions

The intention of the research that has been carried out was to provide an agent-driven formalism for computing arguments, but with enough level of abstraction to easily accomodate human intervention in ODR scenarios. The novelty in the functional taxonomy of ASs is represented by the economical and strategic argumentation schemes, which are highly useful when modelling real-life scenarios. Our future work regards how the classification of the schemes guides the planning process.

The composition of the argumentation schemes can be governed by further protocols rules which dictate when a specific argumentation scheme can be applied. Argumentation schemes can be easily integrated with the complaints schemes[9] implemented by the current ODR providers, but also with models of scheme-based communication.

[7] Araucaria at www.computing.dundee.ac.uk/staff/creed

[8] Graphical Interface for Planning with Objects.

[9] The complaints schemes intend to accurate and focus the communication between disputants. On the one hand, they help people complain more effectively by clarifying what they want to achieve: compensation, specific action, or an explanation. On the other hand, they help companies to obtain relevant structured information describing the current complaint.

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