Case Law in Extended Argumentation Frameworks

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ABSTRACT

In this paper we discuss how recent developments in argumentation frameworks, most notably *Extended Argumentation Frameworks*, can inform the representation of a body of case law using abstract argumentation techniques. This builds on previous work which has first used abstract *Argumentation Frameworks*, and then *Value based Argumentation Frameworks* for this purpose.

Extended Argumentation Frameworks augment Argumentation Frameworks to not only allow arguments to be attacked, but also *attacks* to be attacked. This allows argumentation based reasoning about information normally assumed to be metalevel to the object level domain of argumentation, including argumentation over preferences, values and the audience based ranking of values promoted by arguments. The Extended Argumentation Frameworks can then be rewritten as standard Argumentation Frameworks, so that cases, and values and their rankings relevant to the cases, can be reasoned about using standard dialogue games for Argumentation Frameworks. In this way precedents can be represented as collections of arguments and dialogues using these arguments. Now, when confronted with a new case, these dialogues may be used to identify ways of deploying the arguments in the new case so as to reach a favourable position.

1. INTRODUCTION

One approach to representing a body of case law is to model the arguments presented as an abstract Argumentation Framework (AF) [15]. Then, given a new case, one removes the arguments which are not applicable and calculates whether the key argument that the case should be found for the plaintiff is admissible in the resulting framework. This approach was applied to a set of cases relating to the possession of wild animals in [4]. In that paper some conflicts could be identified but not resolved. Hence the main value of the framework was to identify these conflicts, and so to direct the user to the crucial choices that needed to be made.

Subsequently work was done in rationalising these choices. Following suggestions first made in [11], the idea was that these choices should be made so as to promote the purposes considered more desirable. This notion of rational choice is formalised by using

Value Based Argumentation Frameworks (VAFS) [6] that extend AFs with values, associating arguments with the social value that accepting them would promote. VAFs have been successfully applied to the modelling of legal reasoning, and in particular, [8] applies VAFs to model the same body of cases as [4].

This work enabled a person to choose between competing arguments on the basis of the social or legal values they promoted: given an ordering on values, a single set of admissible arguments could be discovered. This did not, however, permit argument as to which values should be preferred. Clearly it is desirable to permit such arguments. Approaches to permit argument about preferences and rule priorities can be found in e.g. [18] and [23]. However these approaches are not presented as standard argumentation frameworks, and so cannot benefit from the many results and algorithms developed for such systems. Recent work on argumentation frameworks — the Extended Argumentation Frameworks (EAF) of [20] — together with their application to VAFs [21], provide a way of incorporating reasoning about values and about preferences between values, in a standard argumentation framework. In this paper we will apply these results to the representation of case law.

Section 2 will recapitulate previous work, by describing the cases used in the representation: namely the wild animals cases previously represented in [4], and give their representation as a VAF, as described in [8]. Section 3 will introduce EAFs, and then describe how value based argumentation and reasoning about values and about preferences between values, can be encoded in EAFs. This encoding will be applied to the VAF of Section 2. Section 4 will then discuss how EAFs can then be rewritten as standard AFs, apply this rewrite to the EAF of Section 3, and discuss the benefits that this confers. Section 5 will extend the discussion, relating the approach to the representation and use of precedent cases, and make some comparisons with related work. To aid readability the formal definitions of the various frameworks, and any necessary discussion of technical points relating to them, are given as an Appendix.

2. THE CASES

Modelling a body of case law in terms of an AF was described in Bench-Capon [4], and the values necessary to turn this AF into a VAF were discussed in [7]. The body of case law used in both those papers was the wild animal cases introduced to AI and Law by Berman and Hafner [11], and much discussed since then (e.g. Bench-Capon and Sartor [10], Bench-Capon and Rissland [5] and several papers in *Artificial Intelligence and Law* Volume 10 1-3). Here, we will consider the cases discussed in [5], which presented some additional cases to those described in Berman and Hafner [11], .
The facts of the chosen cases are:

Keeble v Hickergill (1707). This was an English case in which Keeble owned a duck pond, to which he lured ducks, which he shot and sold for consumption. Hickergill, out of malice, scared the ducks away by firing guns. The court found for Keeble.

Pierson v Post (1805). In this New York case, Post was hunting a fox with hounds. Pierson intercepted the fox, killed it with a handy fence rail, and carried it off. The court found for Pierson.

Young v Hitchens (1844). In this English case, Young was a commercial fisherman who spread a net of 140 fathoms in open water. When the net was almost closed, Hitchens went through the gap, spread his net and caught the trapped fish. The case was decided for Hitchens.

Ghen v Rich (1881). In this Massachusetts case, Ghen was a whale hunter who harpooned a whale which subsequently was not reeled in, but was washed ashore. It was found by a man called Ellis, who sold it to Rich. According to local custom, Ellis should have reported his find, whereupon Ghen would have identified his lance and paid Ellis a fee. The court found for Ghen.

Conti v ASPCA (1974). In this New York case, Chester, a parrot owned by the ASPCA, escaped and was recaptured by Conti. The ASPCA found this out and reclaimed Chester from Conti. The court found that they were within their rights to do so.

New Mexico v Morton (1975) and *Kleepe vs New Mexico (1976).* These cases concerned the ownership of unbranded burros normally present on public lands, which had temporarily strayed off them. Both were won by the state.

As mentioned above, the arguments in these cases, especially the first three, and even more especially *Pierson*, have been examined and represented by many different people in various ways. In [11] cases were represented using factors, in the manner of CATO [1], but additionally linked to the purposes they advanced. For example, Keeble was pursuing his livelihood (a factor favouring the plaintiff), and finding for Keeble would advance the purpose of protecting a valuable activity from interference. Thus Keeble has an argument along the lines of *finding for the plaintiff would protect a valuable activity, because the plaintiff was pursuing his livelihood.* This is essentially the approach of [10], in which a theory of the domain is formalised as a set of cases considered as sets of factors, with each factor associated with the side it favours and the value it promotes. A somewhat different approach was taken to modelling *Pierson v Post* in [3] where one particular argumentation scheme giving a *prima facie* justification of a course of action on the basis that it would, given the facts, promote a value, was used: so the above argument would appear as *where plaintiff was pursuing his livelihood, we should find for him so as to promote valuable activity.* A very different approach was taken to modelling *Pierson* in [19], in which the Carneades system was used to model the various arguments, using a variety of argumentation schemes. Here we will use the arguments identified in [4], and the values associated with them in [8].

We may summarise the resulting model by saying that the cases were found in [4] to contain the twenty four arguments given in Table 1. Table 1 also shows the arguments they attack and their associated values. Remember that these are *abstract arguments*: they could be instantiated in a variety of ways; there is no commitment to any particular argumentation scheme, or argument structure. Thus Argument F in the Table could be instantiated in many ways, including the factor-purpose version of [11], or the practical reasoning scheme version of [3] mentioned above. Other arguments, such as Arguments I and K could be instantiated with an argument scheme such as argument from authority, and others such as G and H would require arguments designed to establish the case facts. Still others, such as the various arguments about what is to count as possession, can be seen as directed towards whether a factor is present in a case or not: this could be seen as concerning the focal slots for possession in the manner of HYPO, or cast in terms of an abstract factor hierarchy in the manner of CATO. When the arguments are instantiated in different cases, they will normally be expressed differently (if for no other reason than that the facts differ), and may even use different argument schemes. One of the reasons for using abstract argumentation is to be able to put aside the issues of how the arguments are expressed so that we can focus on the logic of their relationships.

We will briefly discuss the values which we use to turn the original AF into the VAF shown in Figure 1. Some of these values are social, concerning the desire to encourage economic or otherwise useful activity, while others, such as the desire for clear law and recognition of the proper role of the judiciary are legal values. The remaining value, protection of property rights, occupies the middle ground: respect for the property of others is a social value, but one which the law has traditionally recognised as important.

As Table 1 indicates, we use five values: CL = Clear law, UA = Useful Activity, PR = Protect property rights, EA = Economic Activity, CR = The Court Should Not Make Law. We will say something about each of these in turn.

Clear Law. This is a value that was emphasised in *Pierson vs Post* by Tomkins (argument M) in giving his majority decision.

> If the first seeing, starting, or pursuing such animals, without having so wounded, circumvented or ensnared them, so as to deprive them of their natural liberty, and subject them to the control of their pursuer, should afford the basis of actions against others for intercepting and killing them, it would prove a fertile course of quarrels and litigation.

The key idea is that any decision made by the court should have a clear justification in the facts: too much vagueness would lead to too much litigation. Similar considerations apply, for example, in the burros cases, where the animals generally are on State land but stray onto other property from time to time. This value is mostly concerned with the efficient operation of the law, and its understandability by potential litigants who will not be encouraged to bring hopeless suits by elements of ambiguity.

Useful Activity. This is a value which is argued for, for example by Livingston in the minority decision of *Pierson vs Post* (argument O). The idea here is that a person who is engaged in socially useful activities should be encouraged to continue them. Thus in *Pierson vs Post*, finding for Post would have encouraged fox hunters throughout the land to continue their (arguably) useful pursuits. The appeal here is to popular feeling: there are no specific laws or legal principles to back up this value.

Protect Property Rights. Much law is concerned with the protection of property, and there are many pieces of legislation and cases which confer specific rights relating to property. Protection of property rights can be seen as a central function of the law, in a way in which protection of the right to engage in useful activities such as hunting cannot. The value is especially important in *Keeble* and *Conti*.

ID	Argument	Attacks	Values
A	Pursuer had right to animal		claim
B	Pursuer not in possession	A, T	CL
C	Owns the land so possesses animals	C	PR
D	Animals not confined by owner	C	PR
E	Effort promising success made to secure animal made by pursuer	B, D	CL
F	Pursuer has right to pursue livelihood	B	EA
G	Interferer was trespassing	S	PR
H	Pursuer was trespassing	F	PR
I	Pursuit not enough (JUSTINIAN)	E	CL
J	Animal was taken (JUSTINIAN)	I	CL
K	Animal was mortally wounded (Puffendorf)	I	CL
L	Bodily seizure is not necessary (Barbeyrac), interpreted as animal was brought within certain control (TOMPKINS)	I	UA
M	Mere pursuit is not enough(TOMPKINS)	E, O	CL
N	Justinian is too old an authority (LIVINGSTON)	J	CL
O	Bodily seizure is not necessary (Barbeyrac), interpreted as reasonable prospect of capture is enough (LIVINGSTON)	I, M	UA
Q	The land was open	G, H, C	PR
S	Defendant in competition with the plaintiff	E, F	EA
T	Competition was unfair	S	EA
U	Not for courts to regulate competition	T	CR
V	The iron holds the whale is an established convention of whaling	B, U	CR
W	Owners of domesticated animals have a right to regain possession	B	PR
X	Unbranded animals living on land belong to owner of land	D	PR
Y	Branding establishes title	B	CR
Z	Physical presence (straying) insufficient to confer title on owner	C	CL

Economic Activity. This value is important in the *Keeble* and *Young* cases. Whereas hunting was only said to be useful, Keeble and Young were engaged in following their livelihoods, and creating tangible benefits. In finding for Keeble, for example, it was stated that for an activity

> "whereby the markets of the nation may be furnished, there is great reason to give encouragement unto"

The Court Should Not Make Law. This value was mentioned in *Young*. A question was put to the court as to whether the act of competition was unfair, but the Court felt that it was beyond their powers to make a ruling. As stated in [11], the argument (argument U) was:

> Guidelines for determining whether competition among

fishermen is fair or unfair should be left to the legislature

The same value is used in *Ghen* and both the New Mexico burros case where the Courts see their duty as to uphold well established conventions in the industries concerned. This can perhaps be best seen as a constitutional issue, which is certainly how it would be seen in US: to what extent should judges make the law? This value is typically used to ground arguments attacking arguments which try to use a teleological argument (as when U attacks T), or as the basis of arguments that an existing and accepted practice should be respected (arguments V and Y).

Figure 1: Value-Based Argumentation Framework Version[1]

Any attempt to model reasoning with cases requires some extensive analysis of the domain, whether to identify dimensions, as in HYPO, factors as in CATO, reduction operators as in [12], concrete arguments as in [19], or abstract arguments as here. Any such analysis will rely on skill and judgement, and be open to some discussion of possible alternative ways of performing the analysis. Nonetheless, an analysis is required, and we will use the analysis represented in Table 1 and Figure 1 in the remainder of this paper.

3. EXTENDED ARGUMENTATION FRAMEWORKS

The essential idea in VAFs is that, unlike AFs where attacks always succeed, some attacks may fail. Whether attacks succeed or fail depends on the value associated with the arguments and the ranking of values held by the audience evaluating the framework. One way of looking at this is that unsuccessful attacks may simply be ignored. The limitation of VAFs is that the value preferences are not themselves arguments; i.e., the preferences come from outside the framework, and cannot be reasoned about. Extended Argumentation Frameworks (EAF)s [20] provide a response to these limitations. In an EAF, preferences such as value preferences are modelled as *attacks on attacks*. Thus, if an argument X with value $V1$ attacks an argument Y with value $V2$, then a preference for $V2$ over $V1$ will attack the attack from X to Y so that X's attack on Y does not succeed. In an EAF therefore, we have a single, uniform (and hence abstract) set of arguments, but partition attacks into attacks on arguments and attacks on attacks. We can apply this to the VAF of Figure 1 to get the EAF of Figure 2 in which each pairwise ordering on values is represented as a *value preference* argument attacking

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[1] Please take note of the subgraph containing the three arguments C, B and A, where C attacks B and B attacks A. Some of the technical content in Appendix A is exemplified by reference to these three arguments, their values, and orderings on their values.
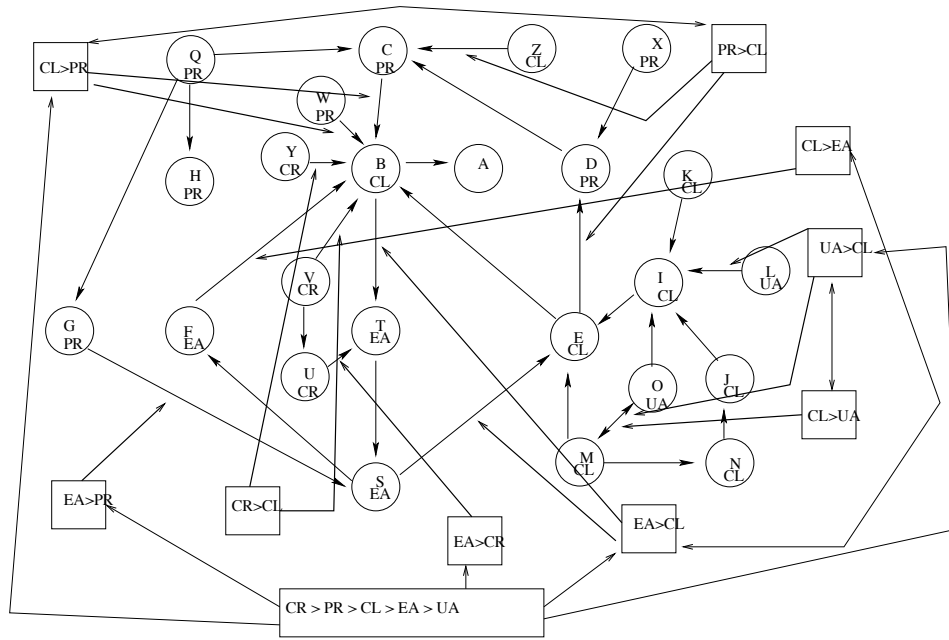
Figure 2: Extended Argumentation Framework Version

attacks. We have also included a further argument that represents a particular audience (total ordering on values[2]). The audience in turn attacks any value preference argument that the audience contradicts (we refer the reader to the Appendix for technical details and an illustrative example of EAFs).

From Figure 2 we can see that we have a number of value conflicts to resolve: between CL and EA; CL and UA; and CL and PR. These potentially give rise to eight preferred extensions, but the addition of an argument representing an audience reduces this to a single preferred extension.

Of course, the audience argument can itself be challenged by claiming membership of a different audience. For our five values there are potentially one hundred and twenty audiences. The audience arguments form a weakly complete framework (i.e., one in which every argument attacks every other argument, but no argument attacks itself), and in consequence every audience is acceptable (in the sense of belonging to a preferred extension), but no two audiences can be accepted together. The factorial relation between the number of values and the number of audiences makes any approach requiring all audiences to be represented computationally unacceptable.

Instead therefore we can consider arguments against particular preferences. Such arguments can be understood as constraints on audiences in that they exclude certain audiences that do not satisfy these constraints. For example, we might say that $EA > UA$ on the grounds that economic benefit is measurable and tangible whereas mere usefulness is not (argument M1). This argument excludes, and so attacks audiences that adopt the reverse ranking (see Figure 3). Next we might adopt Tompkin's argument that where there is no specific legal protection of a right, clarity is essen-

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[2]Here we assume audiences to be represented by total orders, termed *specific audiences* in [9]. Audiences may also be considered as partial orders: it would be possible to add arguments representing these more general audiences, although they would attack fewer preferences, and might not be sufficiently specific to resolve all conflicts. For a formal treatment of specific and more general audiences, see [9].
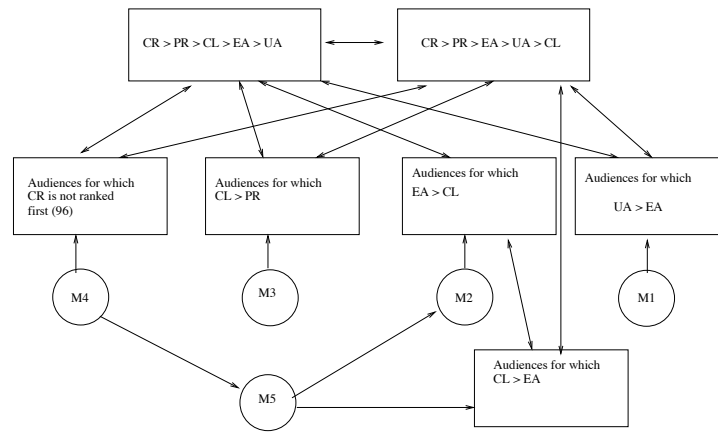
tial if there is not to be abundant and acrimonious litigation (argument M2): thus $CL > EA$, and by transitivity of the preference relation, $CL > UA$ also. We next argue that where, however, there is specific legislation, the court is obliged to apply it (argument M3). Thus $PR > CL$. Finally we argue that judges must respect the constitutional limitations on their powers, and so CR must be our most preferred value (argument M4). Each of these arguments will attack, and so exclude, groups of audiences: M4 attacks ninety six audiences, and M1-3, sixty audiences each. The only audience not attacked by any of M1-4 is the audience $CR > PR > CL > EA > UA$ (M1-4 attack all audiences that attack $CR > PR > CL > EA > UA$, and so 'reinstate' $CR > PR > CL > EA > UA$). The resulting Argumentation Framework (a standard AF) is shown in Figure 3.
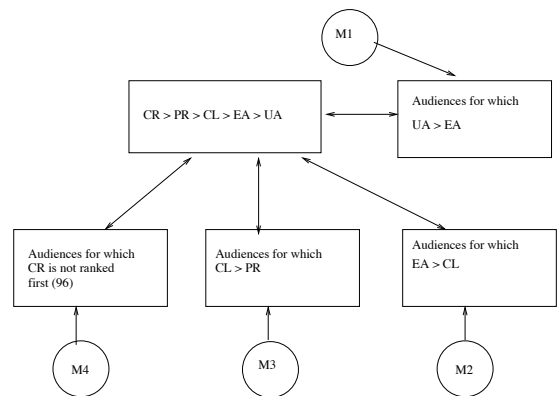
Figure 3:Argumentation Framework for Determining the Audience.

The argument framework in Figure 3 can be connected to the EAF of Figure 2 on the specific audience argument, and now a single preferred extension emerges: the preferred extension of the framework in Figure 3 establishing that the audience argument is admissible (M1-M4, and the audience argument), in union with the

Figure 4:Argumentation Framework for Determining the Audience with M5.

unique preferred extension of the remainder of the framework that is itself determined by the single admissible audience argument. Of course, the debate could continue at the audience level: someone might propose an argument M5 that a person should have the same rights to enjoy the fruits of his labour to earn his livelihood as a person has to enjoy the fruits of his property, and so $EA > CL$: if clarity can be compromised when property rights are concerned, then should it not also be comprised for the sake of labour rights? Now M5 attacks M2, and so the desired specific audience is defeated, and a different specific audience argument becomes acceptable. But, M5 can be countered. Property rights have long enjoyed specific legal protection while labour rights have not, and so extending this protection to cover labour rights would effectively involve judges effectively legislating these rights into existence. M5 is therefore attacked by M4, reinstating M2 and the original audience specific argument, as shown in Figure 4.

The debate could continue at this level. The argument M4, could, for example be attacked: the idea that judges can effectively make law has it supporters: for example this view has been imputed to the US Supreme Court under the Chief Justiceship of Earl Warren [14] and perhaps underlies a number of decisions by Lord Denning in the UK. It can in fact be found in Livingston's minority opinion in Pierson:

> Whatever Justinian may have thought of the matter, it must be recollected that his code was compiled many hundred years ago, and it would be very hard indeed, at the distance of so many centuries, not to have a right to establish a rule for ourselves.

There is an extensive treatment of such issues in [14]. In [14] Christie does not find conclusively for either point of view concluding that

> a final court of appeals with express authority to make these kinds of decisions might thus appeal to an ideal or universal audience committed to such a transcendent view of the public good [i.e not composed as the aggregation of private goods], at least if it had confidence in the political and social judgement of the judges. If it did not, it might be prepared to settle for a more constrained role for judges of final appellate courts as a second best solution.

In practice, Christie observes, thinking on this issue is like a pen-dulum which swings first one way and then another[3]. In [14] his main concern is to interpret the notion of what Perelman called the ideal or universal audience [22], in terms of particular political and legal cultures. As well as judicial discretion, he discusses a number of other topics including how interventionist the state should be, whether the public good is simply an aggregate of public goods, and whether cases should be resolved by general principles or by the particular facts. Each of these dimensions might be used as values when producing arguments for or against particular audiences which would then determine the ideal audience, as far as that legal culture is concerned.

4. REDUCTION TO ABSTRACT ARGUMENTATION FRAMEWORKS

EAFs as described in the previous section abstract away from particular types of arguments, but at the expense of introducing two different kinds of attack: attacks on arguments and attacks on attacks. However, certain classes of EAF can be rewritten as AFs, at the expense of introducing some additional arguments. This is of interest here, since the encoding of value based argumentation in EAFs fall into one such class of EAFs, and so can be rewritten in this manner. The soundness and completeness of the rewrite for VAFs was shown in [21][4].

The rewrite involves:

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[3]An example of the full swing of the pendulum may be provided by the case of *Furman v Georgia*. This case decided three years after Warren Burger had replaced Earl Warren as Chief Justice, effectively struck down capital punishment in the USA. Several of the justices in the majority relied on explicitly teleological arguments: notably Brennan and Marshall, based on the value of human dignity, and Douglas who relied on the value of equal treatment under the law. Several of the justices in the minority relied on a view of the relationship between the courts and the legislature, notably Rehnquist and Blackmun, who declared himself convinced by the arguments, and that he would vote down capital punishment if he were a legislator, but that it would be improper to do so as a judge. All four justices in the minority had been appointed after the retirement of Warren, whereas all five in the majority had served under Warren. In 1976, with Douglas retired, *Gregg v Georgia* effectively reinstated capital punishment in the US, the teleological arguments of Brennan and Marshall being found unpersuasive in the new climate.

[4]An example of a framework for which the rewrite is not sound and complete is one in which A attacks B and B attacks the attack from A to B. This situation cannot arise in VAFs

1. rewriting an attack $\langle A, B \rangle$ between two arguments where A has value $V1$ and B has $V2$, by adding two auxiliary arguments C and D such that A attacks C, C attacks D and D attacks B. Informally C may be read as "A is rejected" and D as "A defeats B".

2. adding an attack on D from an argument supporting the preference $V2 > V1$.

Thus an attack $\langle A, B \rangle$ can fail to succeed as a defeat in either of two ways: A may not be admissible (and so the argument that "A is rejected" attacks the argument that "A defeats B"), or the value of B is ranked above that of A (and so the argument that "$V2 > V1$" attacks the argument that "A defeats B"). The rewrite is shown in Figure 5.
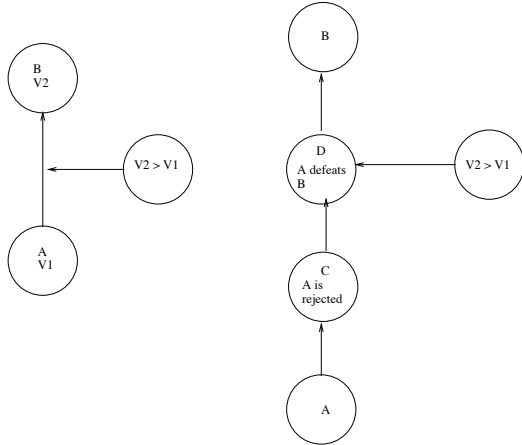
Figure 5:Rewrite of EAF representing a VAF as AF.

Note that the arguments A and B no longer have associated values, and there is now a single type of attack: attacks on arguments. We thus have a completely abstract AF in which attacks always succeed, in the manner of [15]. The reason why EAFs that encode value based argumentation can be rewritten in this way, is that they can be stratified so that domain arguments attack one another and are attacked by, but do not attack, value preference arguments; value preference arguments attack one another, and are attacked by, but do not attack, audience arguments; and audience arguments attack one another and are attacked by, but do not attack, "'M"' arguments. Note that the preference arguments and the audience arguments remain abstract arguments. The preference arguments are not, of course, a bald statement that the preference holds, but rather arguments intended to persuade someone to adopt the preference. They could be arguments citing precedents where the preference was used, or emotional appeals such as *no one should have to die because they are poor*, intended to persuade someone that life is more important than property. Similarly the audience arguments are not statements that the audience has these preferences, but rather suppositions inviting arguments that the audience cannot be like this..

Given this rewrite we can exploit the considerable body of work developed for standard AFs. In particular we can support a dialogue using the simple TPI protocol designed to be played over an AF and described in [17][5]. In this protocol a proponent puts forward an argument. Following this move, the proponent's opponent and the

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[5] As shown in [17], this protocol gives a sound and complete method for establishing credulous acceptance, so that bad play lengthens the game rather than changing the result. Moreover, since a rewritten VAF is also coherent, it follows from [16] that arguments which can be defended are also sceptically acceptable.

proponent can alternately make one of three moves: COUNTER, BACKUP and RETRACT. The opponent may counter an argument moved by proponent, by moving an attacking argument from the AF. In turn the proponent may COUNTER the opponent's argument, and so on. If an argument played has no attacker in the AF, opponent has the opportunity to BACKUP; that is play an alternative attacker to a previous argument of proponent. If opponent can neither COUNTER or BACK UP, then opponent loses. If the proponent cannot COUNTER, he must RETRACT, that is withdraw a previously played argument, and play an alternative counter. If no alternative counter is available, proponent must RETRACT the original claim, and so lose the game.

We can now use this protocol to produce dialogues based on an AF rewrite of the EAF of Figure 2, combined with Figure 4's AF relating to audiences. In producing these dialogues, we are not trying to model natural arguments as might be produced by lawyers. For one thing such dialogues are rarely encountered in legal circles: rather the case is invariably presented as a piece of continuous prose. What the dialogues can do is to make clear the logic underlying a case. The party winning the dialgoue has identified a preferred extension, a set of consistent arguments able to defend themselves against all attackers. This then shows what points need to be established and what arguments need to be deployed, and identifies the counter arguments these arguments are required to rebut. The lawyer making the case must choose how to express the arguments, how to present them, and whether or not to point to the attacking arguments they defeat. The dialogue thus identifies the materials which are needed for the case, and the logic of the case, but does not express the case itself. Now let us first consider *Keeble*. One way to argue this would be as follows. Note that odd numbered arguments are issued by the proponent and even numbered arguments by the opponent.

1. A

2. COUNTER B

3. COUNTER E

4. COUNTER M

5. COUNTER O defeats M

6. COUNTER CL > UA: *for M to survive the attack, its value must be preferred to that of O*

7. RETRACT E: COUNTER F defeats B: *rather than argue against the value preference, another defence is used*

8. COUNTER CL > EA: *since S is unavailable in Keeble, the attack must be resisted with a value preference.*

9. RETRACT F: COUNTER C defeats B: *again the proponent chooses not to argue for the value preference, but tries a third possible defence.*

10. COUNTER CL > PR: *neither Z nor Q are available in Keeble and D looks unpromising*

11. COUNTER Audience is $CR > PR > CL > EA > UA$ *this time proponent does contest the preference*

12. COUNTER CL > PR in audience: *moving to the meta framework of Figure 4*

13. COUNTER M3

14. BACKUP: COUNTER D: *opponent must now try D*

15. COUNTER X: *X cannot be answered: it has the same value as D and no attackers.*

At this point opponent is defeated: X has no attackers and the opponent cannot respond that $EA > CL$ because this argument is not available to the opponent since it was attacked by opponent at move 8. Note also that although arguments based on the usefulness and economic benefits of Keeble's activity were explored, the winning line was based on his ownership of the pond, and the rights of a land owner to unbranded animals habitually frequenting his land. Given a knowledge of the value ordering that was likely to be upheld, unsuccessful preference assertions can be avoided.

Pierson initially follows Keeble, but since F is unavailable (Pierson was hunting for pleasure not profit), the proposer cannot RETRACT at move 7, and so must contest the value preference. The dialogue then proceeds:

7. COUNTER audience is $CR > PR > EA > UA > CL$

8. COUNTER audience contains $CL > UA$

9. COUNTER M5

10. COUNTER M4

As mentioned above, M5 is an abstraction from the part of Livinston's opinion which argues for the ability of judges to effectively make the law. This clearly was not enough to sway the verdict, and so it seems that the majority accepted an argument instantiating M4.

Next consider *Young*. Since Young is engaged in following his livelihood, proponent can follow *Keeble* until 7, where opponent can deviate at move 8 by pointing to the fact that Hitchens was also engaged in an economic pursuit, so avoiding the need to assert a value preference at this stage:

8. COUNTER S

9. COUNTER T

10. COUNTER U defeats T

11. COUNTER $EA > CR$

12. COUNTER audience is $CR > PR > CL > EA > UA$

13. COUNTER audience does not rank CR highest

14. COUNTER M4

Ghen follows *Young* until move 11, the argument claiming that $EA > CR$. Since V is available in this case the following can be played, arguing that U is defeated, rather than simply insufficiently strong to defeat T:

11. COUNTER U is defeated

12. COUNTER U

13. COUNTER V: *V is decisive as it has no attackers and the same value as U.*

The remaining cases are much clearer: in *Conti*, B is immediately defeated by W, and in both the Burros case we can jump straight to move 14 of the *Keeble* dialogue.

5. DISCUSSION

We can now apply this work to the topic of reasoning with cases in AI and Law. The current best known approach is represented by the representation of cases as collections of factors favouring plaintiff and defendant, e.g. CATO [1], although there are variants using dimensions instead of factors as in HYPO [2], and incorporating values [10]. The above suggests a novel way of representing cases, by representing them instead as sets of arguments and the attack relations between them. This does, of course, relate very strongly to factors, dimensions and values, since it is these elements that form the basis of the arguments. Case precedents are, however, more than just the sets of arguments; they also provide the dialogues as given above, suggesting how the arguments can be deployed in arguing the case. Now these dialogues can be seen and used in the same way as, for example, collections of past games in Chess. In Chess, opening variations and whole games have been extensively analysed over the years and have produced an understanding of which lines are good for white, which are good for black, and which remain unclear. Good Chess players will be well aware of this analysis, and will have a repertoire of variations and games which they will exploit in an effort to steer games into positions where they have an advantage. In the middle game there are also well known tactical sequences that reappear in many games, and many end games have been extensively analysed so that there are completely standard ways of, for example, mating with rook and king against king. The above suggests that precedents could be used in a similar way: given a representation of a body of case law as an EAF, and a knowledge of the various previous dialogues, advocates in a new case can deploy the available arguments so as to follow, or avoid, previous lines, and thus try to ensure that the dialogue has a favourable outcome. In some cases there will be a winning line, otherwise it will be necessary to try to reach a position which is at any rate unclear, or to find some improvement to the existing line by deploying an argument not available in the previous case. For example, in the *Young* dialogue above, the plaintiff must avoid the line in *Pierson and Post*, depending on UA since this is known to be bad for the plaintiff. Instead there is an attempt to follow the line in *Keeble*, relying on EA even though the winning line of *Keeble* relying on PR is not available since Young was not working on his own property. At least, however, the situation $CL > EA$ can be seen as unclear, since it was not tested in *Keeble*, as a superior line was available. Unfortunately for the plaintiff, however, the defendant can also improve on the line used in *Keeble*, since he can use an argument based on CR, and the case that $CR > EA$ is more clearly favourable to the defendant than $CL > EA$.

This is clearly related to the earlier approaches. The notion of on-pointness found in CATO and HYPO relates to which precedents are most likely to offer lines of play that can be reproduced in the current case. Distinctions relate to points at which deviation from the desired variation is possible. Similarly the move in [10] from preferences between factors to preferences between values, is related to the shift from conflicts between domain arguments to conflicts between audiences.

In general it seems that stronger lines of play are those that can be enforced without moving away from domain arguments. The more dubious lines come when it is necessary to rely on the arguments about audiences: successful introduction of new arguments at the audience level, or a successful attempt to overturn an established resolution at that level are likely indicators of landmark cases in which a House of Lords or Supreme Court decision changes the way the law relating to the subject is viewed.

This novel way of viewing cases also sheds some light on some

other issues relating to Case Based Reasoning in AI and Law. In [13] Branting argued that the task of matching in case based reasoning could often be improved by matching with portions of precedents rather than with the whole case. On our account this is readily explained because the various dialogue sequences taken from the precedents are typically followed for some of their length before deviating into a line taken from some other precedent. Some particularly well established precedents can be seen as rather like standard tactical sequences in Chess, which can reappear in a number of variations, like the advance of the Queens Bishop's Pawn coupled with a King side fianccceto of the King's Bishop. Just as in a game of Chess it is rare that a previous game will be followed to completion, and even rarer for a game to have no familiar sequences, so rarely are two cases identical, but almost always relate to various precedents in some respects.

The second issue is that precedents which often appear to bear little relation to the case in hand can be seen as very relevant. There is little surface similarity between a case involving the possession of a home run ball in a baseball stadium (*Popov v Hayashi* [24]), and the wild animals cases we have been discussing, and even less similarity with disputes about salvaging ships lost at sea. But precedents discussed in this paper, and precedents relating to salvage, were cited and discussed in *Popov*. How do they relate? We would argue that the point lies not in the analogies that can be drawn between the baseball and a hunted animal, or between the waiting fans and hunters: rather the important similarities lie at the level of values. The wild animal cases were used in *Popov* to argue about the need or otherwise for a clear criterion as to when someone had possession of something of potential worth. In terms of their role in the dialogue, arguments, on the view we have offered, have importance in terms of the values on which they are based, rather than in terms of of the facts which led to the ascription of those values. If I have an argument about whether a convention established in a particular community should be followed, the wild animals precedents can be relevant, no matter what the nature of the activity: indeed *Swift v Gifford* (an earlier whaling dispute cited in *Ghen v Rich*) is used to endorse recognition of the baseball convention that a fan who catches a home run ball is entitled to keep it.

6. CONCLUDING REMARKS

In this paper we have applied a recent advance in work on abstract argumentation, Extended Argumentation Frameworks, to the representation of a body of case law. The advantage of this is that these frameworks enable important meta level elements relating to values and preferences to be represented as if they were entirely abstract frameworks, allowing the simple dialogues developed for use with abstract frameworks to handle these metalevel issues. This in turns mean that we can supplement cases represented as static collections of arguments with their dynamic aspects showing how these arguments conflict and how resolution of these conflicts was reached. This illuminates the use of precedents, the importance of portions of precedents, and the relevance of superficially unrelated precedents

7. APPENDIX: FORMAL DEFINITIONS

7.1 Argumentation Frameworks

Originally proposed in [15].

DEFINITION 1. *An Argumentation Framework (AF) is a pair =* $\langle \mathcal{A}, \mathcal{R} \rangle$, *where* $\mathcal{A}$ *is a set of arguments and* $\mathcal{R} \subseteq \mathcal{A} \times A$ *is a binary conflict based attack relation on the arguments.*

If $(X, Y) \in \mathcal{R}$ *we say that* "X *attacks* Y" *(also denoted* $X \rightarrow Y$*).*

1. $X \in \mathcal{A}$ *is* acceptable w.r.t. $S \subseteq \mathcal{A}$ *iff for every* Y *that attacks* X, *there is a* $Z \in S$ *that attacks* Y *(i.e.,* Z *'defends'* X *against* Y *'s attack).*

2. $S \subseteq \mathcal{A}$ *is* conflict free *iff no two arguments in* S *attack each other.*

3. *A conflict free set* S *is* admissible *iff every argument in* S *is acceptable w.r.t.* S.

4. S *is a* preferred extension *iff it is a maximal (with respect to set inclusion) admissible subset of* $\mathcal{A}$.

The key notions are the admissible set, which represents a group of arguments free from internal conflict and able to defend themselves against external attacks, and the *preferred extension* which represents a position which is admissible, but also cannot be further extended without becoming inconsistent, or indefensible in the sense of not being able to defend all its contained arguments.

EXAMPLE 1. *Consider the* AF: $C \rightarrow B \rightarrow A$.[6] *Both* $\{C\}$ *and* $\{C, A\}$ *are conflict free and admissible, and only* $\{C, A\}$ *is a preferred extension.*

7.2 Value Based Argumentation Frameworks

Originally proposed in [6].

DEFINITION 2. *A value-based argumentation framework (VAF) is a 5-tuple* $\langle \mathcal{A}, \mathcal{R}, V, val, P \rangle$, *where:*

$\mathcal{A}$ *is a finite set of arguments,* $\mathcal{R}$ *is an irreflexive binary attack relation on* $\mathcal{A}$ *(i.e.* $(\mathcal{A}, \mathcal{R})$ *is a standard AF),* V *is a non-empty set of values,* val *is a function which maps from elements of* $\mathcal{A}$ *to elements of* V, *and* P *is the set of possible audiences (i.e total orders on* V*).*

We say that an argument $X \in \mathcal{A}$ relates to value $v \in V$ if accepting X promotes or defends v: the value in question is given by $val(X)$.

Our purpose in introducing VAFs is to allow us to distinguish between one argument *attacking* another, and that attack *succeeding*. Whether an attack by X on Y succeeds, that is whether X *defeats* Y, depends on the value order of the audience considering the VAF. We therefore define the notion of *defeat for an audience*:

DEFINITION 3. *Let* $>_a \in P$ *be a total ordering on values. Then* X defeats$_a$ Y *for audience* a, *if and only if* X *attacks* Y *and not* $Y >_a X$.

The idea then, is that the admissible and preferred extensions of a VAF are individuated with respect to a given audience. For each $a \in P$ a defeat$_a$ relation can be defined, and then the admissible and preferred extensions of the VAF, for audience a, are the admissible and preferred extensions of the standard argumentation framework $\langle \mathcal{A}, \text{defeat}_a \rangle$. Thus a VAF represents a family of AFs, each member of which corresponds to an audience. When rewritten as an EAF, the various audiences are explicitly included, and additional arguments provide the mechanism whereby arguments which are unsuccessfully (for an audience) attacked are defended by the preferences of that audience. Now, whereas each audience in the VAF has a single preferred extension, the rewritten framework has a preferred extension for each audience, and every preferred extension contains one and only one audience argument.

DEFINITION 4. *Let* $\Gamma = \langle \mathcal{A}, \mathcal{R}, V, val, P \rangle$ *be a VAF. For each* $a \in P$, *the admissible (preferred) extensions for audience* a *are the admissible (preferred) extensions of* $\langle \mathcal{A}, \text{defeat}_a \rangle$ *as defined in Definition 1 with the binary relation defeat$_a$ substituting for* $\mathcal{R}$.

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[6]This and the subsequent examples are subgraphs of Figure 1.

EXAMPLE 2. *Consider a VAF $C \rightarrow B \rightarrow A$ where $V = \{Claim, PR, CL\}$ (PR = protect property rights, CL = clear law), and $val(A) = Claim$, $val(B) = CL$, $val(C) = PR$.*

- *Suppose the audience $PR >_{a1} CL >_{a1} Claim$. Then C defeats$_{a1}$ B and B defeats$_{a1}$ A, and so $\{C, A\}$ is the single preferred extension for audience $a1$.*

- *Suppose the audience $CL >_{a2} PR >_{a2} Claim$. Then only B defeats$_{a2}$ A and $\{C, B\}$ is the single preferred extension for audience $a2$.*

Provided there are no cycles in a single value, a VAF will have a unique non-empty preferred extension for any given audience. Given the audience this extension can be computed in polynomial time. Both results are proven in [6]. The original definition of VAFs represented audiences by total orderings on values. In [9] audiences represented as partial orders were considered and formalised. In the terminology of [9], the original totally ordered audiences are known as *specific audiences*.

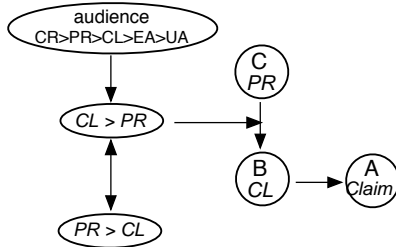## 7.3 Extended Argumentation Frameworks

Originally proposed in [20].

Figure 6: Value Based Argumentation in an Extended Argumentation Framework

DEFINITION 5. *An* Extended Argumentation Framework *(EAF) is a tuple $(\mathcal{A}, \mathcal{R}, \mathcal{D})$, where $\mathcal{A}$ is a set of arguments, $\mathcal{R} \subseteq \mathcal{A} \times \mathcal{A}$ (i.e. $(\mathcal{A}, \mathcal{R})$ is a standard AF), and:*

- $\mathcal{D} \subseteq (\mathcal{A} \times \mathcal{R})$

- *If $(Z, (X, Y)), (Z', (Y, X)) \in \mathcal{D}$ then $(Z, Z'), (Z', Z) \in \mathcal{R}$*

In an EAF, if $(Z, (X, Y)) \in \mathcal{D}$ then Z is an argument for preferring Y to X, and if any two such *preference arguments* express contradictory preferences, then they attack each other. The notion of a successful attack — *defeat* — is then parameterised w.r.t. preferences specified by some given set S of arguments:

DEFINITION 6. *X defeats$_S$ Y, denoted by $X \rightarrow^S Y$, iff $(X, Y) \in \mathcal{R}$ and $\neg \exists Z \in S$ s.t. $(Z, (X, Y)) \in \mathcal{D}$.*

A conflict free set of arguments is then defined so as to allow for the case where Y *asymmetrically* attacks X, but given a preference for X over Y, both may appear in a conflict free set and hence an extension (as in value based argumentation). Notice that a conflict free set does not admit arguments that symmetrically attack, irrespective of the preference arguments contained.

DEFINITION 7. *S is conflict free iff $\forall X, Y \in S$: if $(Y, X) \in \mathcal{R}$ then $(X, Y) \notin \mathcal{R}$ and $\exists Z \in S$ s.t. $(Z, (Y, X)) \in \mathcal{D}$.*

The acceptability of an argument X w.r.t. a set S is now defined for an *EAF*. The basic idea is that for any attacker Y of X, there is a Z in S that attacks Y ($Z \rightharpoonup Y$), where this attack is itself reinstated against preference argument attacks. The definition is motivated in more detail in [20] and relates to an intuitive requirement (captured by Dung's fundamental lemma in [15]) on what it means for an argument to be acceptable w.r.t. an admissible set S of arguments: *if X is acceptable with respect to S, then $S \cup \{X\}$ is admissible*. To ensure satisfaction of this requirement, acceptability for *EAF*s requires the notion of a *reinstatement set* for a defeat.

DEFINITION 8. *Let $S \subseteq \mathcal{A}$ in $(\mathcal{A}, \mathcal{R}, \mathcal{D})$. Let $R_S = \{X_1 \rightarrow^S Y_1, \ldots, X_n \rightarrow^S Y_n\}$ where for $i = 1 \ldots n$, $X_i \in S$. Then R_S is a reinstatement set for $C \rightarrow^S B$, iff:*
- $C \rightarrow^S B \in R_S$, and
- $\forall X \rightarrow^S Y \in R_S$, $\forall Y'$ s.t. $(Y', (X, Y)) \in \mathcal{D}$, $\exists X' \rightarrow^S Y' \in R_S$

DEFINITION 9. *X is acceptable w.r.t. $S \subseteq \mathcal{A}$ iff $\forall Y$ s.t. $Y \rightarrow^S X$, $\exists Z \in S$ s.t. $Z \rightarrow^S Y$ and there is a reinstatement set for $Z \rightarrow^S Y$.*

Admissible and preferred semantics for *EAF*s are now defined on the basis of acceptability of arguments, in the same way as for standard argumentation frameworks, except that conflict free is defined as in Definition 7.

EXAMPLE 3. *Consider the EAF in Figure 6. The single preferred extension contains the arguments A, C, the value preference argument $PR > CL$, and the audience argument advocating this value preference.*

8. REFERENCES

[1] V. Aleven. *Teaching Case Based Argumentation Through an Example and Models*. Phd thesis, University of Pittsburgh, Pittsburgh, PA, USA, 1997.

[2] K. D. Ashley. *Modeling Legal Argument*. MIT Press, Cambridge, MA, USA, 1990.

[3] K. Atkinson, T. Bench-Capon, and P. McBurney. Arguing about cases as practical reasoning. In *Proceedings of the 10th International Conference on AI and Law (ICAIL 2005)*, pages 35–44. ACM Press, 2005.

[4] T. Bench-Capon. Representation of case law as an argumentation framework. In A. Daskalopoulu T. Bench-Capon and R. Winkels, editors, *Proceedings of JURIX 2002*, pages 103–112, Amsterdman, The Netherlands, 2002. IOS Press.

[5] T. Bench-Capon and E. L. Rissland. Back to the future: dimensions revisited. In B. Verheij, A. Lodder, R. Loui, and A. Muntjewerff, editors, *Proceedings of JURIX 2001*, pages 41–52, Amsterdman, The Netherlands, 2001. IOS Press.

[6] T. J. M. Bench-Capon. Persuasion in practical argument using value based argumentation frameworks. *Journal of Logic and Computation*, 13 3:429–48, 2003.

[7] T. J. M. Bench-Capon. Try to see it my way: Modelling persuasion in legal discourse. *Artificial Intelligence and Law*, 11 (4):271–87, 2003.

[8] Trevor J. M. Bench-Capon, Katie Atkinson, and Alison Chorley. Persuasion and value in legal argument. *J. Log. Comput.*, 15(6):1075–1097, 2005.

[9] Trevor J. M. Bench-Capon, Sylvie Doutre, and Paul E. Dunne. Audiences in argumentation frameworks. *Artif. Intell.*, 171(1):42–71, 2007.

[10] Trevor J. M. Bench-Capon and Giovanni Sartor. A model of legal reasoning with cases incorporating theories and values. *Artif. Intell.*, 150(1-2):97–143, 2003.

[11] D. H. Berman and C. D. Hafner. Representing teleological structure in case-based legal reasoning: the missing link. In *Proc. of the 4th ICAIL*, pages 50–59. ACM Press, 1993.

[12] Karl Branting. A reduction-graph model of ratio decidendi. In *Proceedings of the Fourth International Conference on AI and Law*, pages 40–49, 1993.

[13] L. Karl Branting. Reasoning with portions of prcedents. In *Proceedings of the 3rd International Conference on AI and Law (ICAIL 1991)*, pages 145–154. ACM Press, 1991.

[14] C. G. Christie. *The Notion of an Ideal Audience in Legal Argument*. Kluwer Academic Press, 2000.

[15] P. M. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77:321–357, 1995.

[16] Paul E. Dunne and Trevor J. M. Bench-Capon. Coherence in finite argument systems. *Artif. Intell.*, 141(1/2):187–203, 2002.

[17] Paul E. Dunne and Trevor J. M. Bench-Capon. Two party immediate response disputes: Properties and efficiency. *Artif. Intell.*, 149(2):221–250, 2003.

[18] T. F. Gordon and N. I. Karacapilidis. The Zeno argumentation framework. In *Proc. of 6th International Conference on AI and Law*, pages 10–18. ACM Press, 1997.

[19] Thomas F. Gordon and Douglas Walton. Pierson vs. post revisited - a reconstruction using the carneades argumentation framework. In Paul E. Dunne and Trevor J. M. Bench-Capon, editors, *COMMA*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 208–219. IOS Press, 2006.

[20] S. Modgil. Reasoning about preferences in argumentation frameworks. *Artificial Intelligence (doi:10.1016/j.artint.2009.02.001)*, 2009. *In press*.

[21] Sanjay Modgil and Trevor J. M. Bench-Capon. Integrating object and meta-level value based argumentation. In Philippe Besnard, Sylvie Doutre, and Anthony Hunter, editors, *COMMA*, volume 172 of *Frontiers in Artificial Intelligence and Applications*, pages 240–251. IOS Press, 2008.

[22] C. Perelman and L. Olbrechts-Tyteca. *The New Rhetoric: A Treatise on Argumentation*. University of Notre Dame Press, Notre Dame, IN, USA, 1969.

[23] Henry Prakken. Formal systems for persuasion dialogue. *Knowledge Eng. Review*, 21(2):163–188, 2006.

[24] A. Wyner, T. Bench-Capon, and K. Atkinson. Arguments, values and baseballs: Representation of popov v. hayashi. In *Proceedings of Jurix 2007*, pages 151–160, Amsterdam, 2007. IOS Press.