Three Senses of "Argument"

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Abstract. In AI approaches to argumentation, different *senses* of argument are often conflated. We propose a *three-level* distinction between arguments, cases, and debates. This allows for modularising issues within levels and identifying systematic relations between levels. Arguments, comprised of rules, facts, and a claim, are the basic units; they instantiate argument schemes; they have no sub-arguments. Cases are sets of arguments supporting a claim. Debates are a set of arguments in an attack relation; they include cases for and against a particular claim. Critical questions, which depend on the argument schemes, are used to determine the attack relation between arguments. In a debate, rankings on arguments or argument relations are given as components based on features of argument schemes. Our analysis clarifies the role and contribution of distinct approaches in the construction of rational debate. It identifies the source of properties used for evaluating the status of arguments in Argumentation Frameworks.

Keywords. Argumentation, argument, case, debate.

1 Introduction

In AI we find a number of approaches to argumentation and argument. Some approaches represent arguments as trees or graphs (e.g. Reed and Rowe 2005), some are highly concerned with the structure of arguments (e.g. Caminada and Amgoud 2005) and the way arguments support one another (e.g. Cayrol and Lagasquie-Schiex 2005). From informal logic we have the notion of argument schemes (e.g. Walton 1996), while much of the more formal work has taken place in the context of abstract argumentation frameworks (e.g. Dung 1995). With this variety of approaches it is important to determine the relations between them, and in particular to avoid conflation of distinct ideas. To this end we will, in this paper, explore three different senses of the word "argument", all of which are represented in the previous work mentioned above, in order to give a clear characterisation of what may be intended by argument, and to identify the appropriate role of various senses in argumentation as a whole.

The Oxford English Dictionary lists seven senses of the word “argument”, of which three will concern us in this paper. We begin by giving the definitions below: although these are senses 3a, 4 and 5 in the OED, we will introduce our own numbering for clarity. In Sense 1 an argument is a self-contained entity, a reason for a conclusion.

> **Sense 1: “3. a.** A statement or fact advanced for the purpose of influencing the mind; a reason urged in support of a proposition.”

Thus we can see an argument in Sense 1 as a pair <reason, conclusion>, which makes no reference to any other arguments. This is quite a common use in AI and elsewhere: Toulmin’s scheme (Toulmin 1958), as originally presented, was “stand alone” in the sense that it made no reference to the grounds on which the reasons were believed, nor the uses to which the claim might be put. The arguments based on the many schemes found in (Walton 1996) share this feature. Most common of all in AI are arguments of the form “Q because P” representing the application of a single (defeasible) rule. In law this is akin to a single point made within a case.

In the second sense, reference is made to where the reasons come from:

> **Sense 2: “4.** A connected series of statements or reasons intended to establish a position (and, *hence*, to refute the opposite); a process of reasoning; argumentation.”

In Sense 2 we move beyond a single step of reasoning, giving grounds for the reasons advanced for the conclusion. An argument in Sense 2 may be seen as a chain of reasons, reasons for reasons. In AI this can appear as a proof tree, as with the typical “how” explanation of a rule based expert system, and is a commonly used notion of argument in work such as (Pollock 2001) when an “argument” has sub-arguments: e.g. “$P \rightarrow Q$” and “$Q \rightarrow R$” are sub-arguments of the argument “P, $P \rightarrow Q$, $Q \rightarrow R$, so R” where “$\rightarrow$” is some kind of, possibly defeasible, implication. In law this may be seen as the whole case to be presented for a particular party.

The third sense relates arguments in the previous senses:

> **Sense 3: “5. a.** Statement of the reasons for and against a proposition; discussion of a question; debate.”

In Sense 3 we have the possibility of conflict: we have reasons *against* as well as *for*, the proposition, and we may have multiple arguments in the preceding two senses on both sides. In AI this corresponds more to an argumentation framework in the sense introduced by Dung (1995). In law it corresponds to the whole of a case with all the arguments for both parties and perhaps also the adjudication of a judge.[1]

In this paper we shall distinguish between these three senses of argument. In the following we will refer to Sense 1, as an *argument*: we shall always here mean an argument which cannot be divided into sub-arguments. For Sense 2, a collection of arguments advocating a particular point of view, we shall use the term *case*. This

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[1] In AI sometimes “argumentation” is used rather than “argument”: in fact no distinction between these terms is reflected in the definitions given in the OED. There are senses of “argumentation” corresponding to each of the senses of “argument” discussed above. Differences seem to be in connotation: “argumentation” is typically used pejoratively, and sometimes carries a sense of process, the putting forward of arguments.

picks up on phrases such as "the case for the prosecution", but should not be confused with the whole of a case as mentioned above. Rather, for a collection of arguments for and against a point of view, we shall use the term *debate*.

In distinguishing the three senses, we also relate them. Arguments are *parts* of cases, and a case is *part* of a debate. Furthermore, changes in one of the parts may induce a change in another, as we shall see.

Before proceeding further, we should mention, for purposes of comparison, Prakken's well known four layer model of argumentation (Prakken 1997). He distinguishes a *logic* layer, which is concerned with arguments and is where questions such as whether the argument is sound can be posed. Prakken, however, does not distinguish between Senses 1 and 2, and so both arguments and cases may emerge from the logic layer. Next there is a *dialectical* layer, which examines conflicts between the arguments/cases identified in the logic layer. This layer corresponds to what we are terming debate, and it is intended to resolve conflicts between the arguments/cases identified. Next there is a *procedural* layer, which controls the conduct of the dispute, how arguments can be introduced and challenged. Finally, there is a *strategic* layer: while the procedural layer controls what it is possible or legal to do, the strategic layer determines what it is advisable to do. In what follows we will be concerned only with the logical and dialectical layers.

In Section 2, we present arguments as the basic unit. However, arguments have parts, which are specified by the argument schemes which they instantiate; for instance, arguments have claims, which is the proposition that holds if the argument succeeds. A key notion is that arguments do not have other arguments as parts. In Section 3, critical questions are presented as a means to establish attack relations between arguments; given an argument and a critical question associated with it, an affirmative answer to the question implies that another argument attacks the argument and in what way. Given arguments and attack relations, we move to the level of debates in Section 4, where sets of arguments are provided for and against a particular claim. Different sets of arguments are derived from different attack relations; in turn, the attack relations depend on the critical questions and the argument schemes that have been instantiated. In Section 5, we discuss abduction in Argumentation Frameworks. We present cases in Section 6 in terms of admissible sets in an Argumentation Framework, for a case is a set of arguments that support a particular claim. We discuss the role of evaluation metrics such as preference or value rankings in Section 7; the rankings use properties that come from particular argument schemes, and have consequences for properties of sets of arguments at the level of the Argumentation Framework.

2 Arguments

In order to generate some arguments, we will need some facts and some means of inferring conclusions from those facts. We will use as a starting point a very simple knowledge base, KB1, comprising four defeasible rules and three facts, from which we can generate a standard form of argument: *P and if P then Q, so Q* . The facts and rules of KB1 are:

R1 P $\rightarrow$ Q
R2 Q $\rightarrow$ R
R3 S $\rightarrow$ $\neg$Q
R4 T $\rightarrow$ $\neg$R
F1 P
F2 S
F3 T

We begin by forming arguments by applying the available rules to the available facts. Each of the facts is the antecedent of a rule, and so we get three arguments:

A1 F1, R1 so Q
A2 F2, R3 so $\neg$Q
A3 F3, R4 so $\neg$R

Note that A1 and A2 have conflicting claims. This is not unusual: it simply means that we have a reason to believe Q, and a reason to disbelieve Q: we are not saying that the claims of all the arguments are true, only that we have a reason to think they may be. We expect such conflicts to appear in the logic level of argumentation: it is the role of the dialectical layer to resolve them. In our terms, such conflicts open up the possibility of debate. Of course, it needs to be ensured at that level that arguments with conflicting claims are not co-tenable.

But now we have obtained Q using A1 and Q is itself the antecedent of a rule, so we can perhaps add:

A4 Q, R2, so R

Alternatively we might want to reflect that Q was derived as the conclusion of A1 and so include A1 as a sub-argument.

C1 A1, R2, so R.

Note that C1 is, in our terms a case and not an argument: it contains A1 as a sub-argument. It is a chain of arguments for R, and so what we call a case. A difference between these approaches emerges if we add another rule and fact to KB1 to get KB2:

R5 U $\rightarrow$ Q
F4 U

Now we have a second argument for Q:

A5 F4, R5, so Q

Now A4 still applies, so we get no extra argument for Q, but using the approach with sub-arguments we would get a second *case* for R:

C2 A5, R2, so R

Although the production of such cases is very natural in AI, in which the chaining of rules is standard practice, and although these cases (i.e. arguments with sub-arguments) have been termed arguments in a number of common approaches (Caminda and Amgoud 2005, and Pollock 2001), we will restrict ourselves for the time being to strict arguments in Sense 1.

We see arguments in Sense 1 as *the instantiation of an argument scheme*. In relation to KB1 we will use two argument schemes:

AS1 Defeasible Modus Ponens
Data: Type: Fact | Conjunction of Facts
Warrant: Type: Rule with Data as antecedent
Claim: Type Fact: the consequent of Warrant.

AS2 Argument by Assertion
Data: Type: Fact
Claim: Type: Fact, namely Data

Now A1-5 are all instantiations of AS1: instantiating AS2 gives us four more arguments:

A6: P, so P
A7: S, so S
A8: T, so T
A9: U, so U

While in this sense, arguments do not have sub-arguments, arguments nonetheless have *parts*, as indicated by the argument schemes. Among the parts of an argument we have Data, Warrant, and Claim, and other argument schemes may have other parts.

We have now identified all the arguments that can be generated from KB2. All these arguments are sound in that they are instantiations of our permitted argument schemes. Our argument schemes do not allow the production of cases such as C1 and C2: that would require a scheme which allowed an argument to act as Data like a Fact. We do not want to allow this, since our conception of argument (Sense 1) does not permit arguments to be related to one other. As we consider later, there are relations between arguments, where the term is used in its other senses.

3 Critical Questions

Having identified the arguments, we will now wish to identify relations between them. In particular we need to identify which arguments attack one another. As noted above, A1 and A2 are in mutual conflict because the claim of one negates the claim of the other. In order to make our identification of attacks systematic, we will draw on the notion of *critical questions*, taken from informal logic. In Walton (1996) each argument scheme is associated with a characteristic set of critical questions. Argument schemes are instantiated. Let us suppose an argument A which instantiates a scheme and with respect to which we ask a critical question. An affirmative answer to the question implies an argument which is the instantiation of some scheme and which is in some conflict with our initial argument A. As we remark below, there are several ways the conflict can arise.

So what are the critical questions in our example?

For AS2, the only possibility is that we deny the premise and conclusion, which are of course, the same for this scheme. Thus:

AS2CQ1 Have we reason to believe the premise/claim is false?

If there is an argument A which instantiates AS2 and the answer to this question is *yes*, then there will be another argument B which instantiates AS2 and which is in conflict with A. Thus, we have two arguments A and B which we say *attack* one another, for they make claims which are in conflict.

For AS1 we would expect to have three critical questions corresponding to the standard kinds of attack found in the literature, namely premise defeat, undercut and rebuttal. AS1, however, cannot be undercut, since the claim of AS1 is always a fact, not a rule, and so we cannot infer that a rule is inapplicable. Accordingly we modify AS1 to AS3:

AS3 Defeasible Modus Ponens with undercut
Data: Type: Fact | Conjunction of Facts
Warrant: Type: Rule with Data as antecedent
Claim: Type Fact | Rule: the consequent of Warrant

This gives the following three critical questions.

AS3CQ1: Have we reason to believe the data is false?
AS3CQ2: Have we reason to believe the warrant does not apply?
AS3CQ3: Have we reason to believe the claim is false?

Thus an argument whose claim is the negation of the data, or the warrant, or the claim of an instantiation of AS3 will, in their corresponding ways, attack that instantiation. Note that AS3CQ3 gives rise to a symmetric attack, the others to asymmetric attacks.

The use of these critical questions thus allows us to determine which of our arguments are in conflict.

We might also consider whether we have additional critical questions. For example, if we have used as data the claim of a defeasible argument, we will need to be wary of conclusions we draw on the basis of it, since we cannot rely on such rules to be transitive. So we might add a critical question to AS3:

AS3CQ4: Are we sure the data is true?

Such a critical question instantiates the following argument scheme:

AS4 Argument from Defeasibility:
Data: Type: Fact: where Fact is the claim of an instantiation of AS3
Claim: Type: Fact: negation of Data.

This raises doubt, but does not substantiate the doubt.

The associated critical question is:

AS5CQ1: Do we have an independent reason to believe Data?

Having discussed arguments and their relationships, we can move the discussion to the level of debates, for which we will use argumentation frameworks. There we consider the arguments only in terms of the relationships we have determined hold between them, namely *attack*. After having discussed debates, we return to discuss the cases, which we define as part of a debate.

4 Argumentation Frameworks and Debates

For our dialectical layer we will use Dung’s Argumentation Framework (AF), introduced in Dung (1995). In an AF, we have arguments in attack relations. We recall some key notions of that framework.

Definition 1 *An* argument system *is a pair AF = <X,A> in which X is a set of* arguments *and A is the* attack relationship *for AF. Unless otherwise stated, X is assumed to be* finite*, and A comprises a set of ordered pairs of* distinct *arguments. A pair <x, y> is referred to as ‘x* attacks *(or* is an attacker of *) y’ or ‘y* is attacked by *x’.*

For R, S subsets of arguments in the system AF we say that:

a) s ∈ S is attacked by *R if there is some* r∈ R such that <r, s> ∈ A.

b) x ∈ X s acceptable with respect to S *if for every y ∈ X that attacks x there is some z ∈ S that attacks y.*

c) S is conflict-free if *no argument in S is attacked by any other argument in S.*

d) *A conflict-free set S is* admissible *if every argument in S is acceptable with respect to S.*

e) *S is a* preferred extension *if it is a maximal (with respect to set inclusion) admissible set.*

f) *S is a* stable extension *if S is conflict free and every argument y, ¬ (y ∈ S), is attacked by S.*

g) *S is a* complete extension *if S is a subset of A, S is admissible, and each argument which is defended by S is in S.*

h) *S* is a grounded extension *if it is the least (wrt set inclusion) complete extension*.
i) *An argument x is* credulously accepted *if there is* some *preferred extension containing it; x is* skeptically accepted *if it is a member of* every *preferred extension.*

Dung specifically states that arguments are abstract, and that attack is the only relation between them. This in part motivates our desire to exclude cases, arguments related to other arguments which form their parts, from the dialectical layer. As discussed above, we can use our argument schemes and critical questions to identify the sets X and A. So, what is the argumentation framework, AF2, corresponding to KB2?

X is the set of all arguments generated in the previous section: {A1, A2, A3, A4, A5, A6, A7, A8, A9}.

Using AS3CQ3, we can see A1 and A2 are in conflict, since the claim of one is the negation of the claim of the other. Next AS3CQ1 shows that A2 must attack A4, since the claim of A2 negates a premise of A4. Applying these two principles gives us the attack relation: {<A1,A2>, <A2,A1>, <A2,A4>, <A3,A4>, <A4,A3>, <A2,A5>, <A5,A2>}. A graphical representation of AF2 is given in Figure 1: here, to help understanding of the diagram, we label arguments with their claim as well as their name, even though strictly these claims are abstracted away with the rest of the structure when we form an AF.

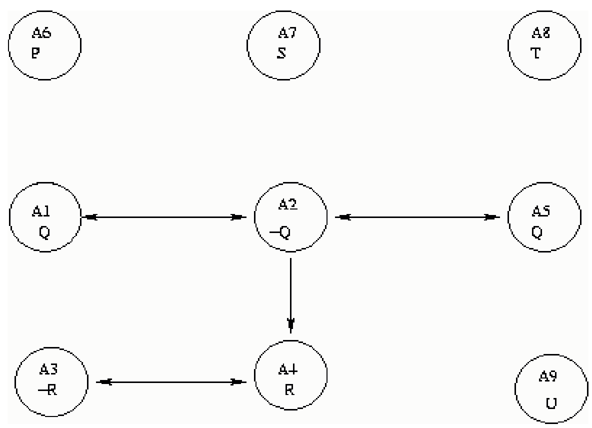

Figure 1: AF2

The grounded extension is the rather disappointing {A6,A7,A8,A9}. We have a number of preferred extensions:

{ A1, A3 A5,A6,A7,A8,A9}
{ A1, A4 A5,A6,A7,A8,A9}
{ A2,A3,A6,A7,A8,A9}

These extensions allow us, therefore, to accept any of the arguments credulously, but only the arguments from assertion sceptically. This is, of course, not very useful, and so we often find some notion of priority between arguments. This is often based on a notion of priority between the rules on which they are based. For example we might say R5 > R3 > R1. The effect of this is to break the symmetry of the attack relation between arguments with the same conclusion: thus from KB1, A2 would now defeat A1, but the additional rule, R5, in KB2 means that in AF2 the attacks <A1, A2> and <A2, A5> are both removed, so that A2 is defeated. We would still then need to decide the priority between A3 and A4. Note again that we have to resort back to the logical level to identify the rules and their priorities.

To illustrate undercutting, suppose we extend KB2 to KB3 by adding :

R6: $U \rightarrow \neg R2$ (i.e. $U \rightarrow \neg (Q \rightarrow R)$)

Now we can extend AF2 to AF3 by adding an extra argument which instantiates AS3:

A10 F4, R6, so ¬R2

A10 attacks A4 (by undercut), but not vice versa, so <A10,A4> is added to the attack relation of AF3.

5 Another Argument Scheme

The above discussion used two argument schemes. There is, however, no reason to limit ourselves to the sorts of arguments we can generate. For example, let us consider KB4, which is KB2 but with F1 and F4 replaced by F5, namely R. Using the argument schemes AS1-3, we can show arguments A2, A3, A7, A8 and A9 and, using argument by assertion,

A11: R, so R.

Suppose, we now introduce an additional argument scheme:

AS5 Argument from Abduction
Data: Type: Fact
Warrant: Type: Rule with Data as consequent
Claim: Type Fact: the antecedent of Warrant

This enables us to produce the following arguments[2]:

A12 F5, R2, so Q
A13 Q, R1, so P
A14 Q, R5, so U

[2] Here we do not consider arguments based on the contraposition of defeasible rules.

Like any argument scheme, AS5 will need its characteristic critical questions. For this scheme we need to consider not only the usual notions of premise defeat, undercut and explanation, but also the possibility of their being a competing, perhaps better, explanation of the claim. It is part of the notion of arguing by abduction that the justification for abducing the antecedent is that it represents the *best* explanation of the consequent. Here P and U are competing explanations for Q. We assume that two abductive arguments conflict when they have the *same* data, since we cannot reuse the explanation. This is an important point: determining whether arguments attack one another depends crucially on the argument scheme which they instantiate.

We therefore have four critical questions:

AS4CQ1: Have we reason to believe the data is false?
AS4CQ2: Have we reason to believe the warrant does not apply?
AS4CQ3: Have we reason to believe the claim is false?
AS4CQ4: Is there another explanation of the data?

Thus, instantiations of AS4 are attacked by arguments with the same data as well as the attacks applicable to AS3.

Now we can organize this into an argument framework AF4.

The set of arguments is now {A2, A3, A7, A8, A11, A12, A13, A14}.

What of the attacks? A3 and A11 are in mutual conflict, as are A2 and A12. But now using AS4CQ4 we can see that A13 and A14 are in conflict. Additionally if A3 is accepted, by AS4CQ1 A12 must fail, since the abductive premise fails. Similarly A2 attacks A13 and A14, using AS4CQ1.

Thus attacks = {<A2, A12>, <A12, A2>, <A3, A11>, <A11, A3>, <A13, A14>, <A14, A13>, <A3, A12>, <A2, A13>, <A2, A14>}

We can show the resulting AF4 in Figure 2.

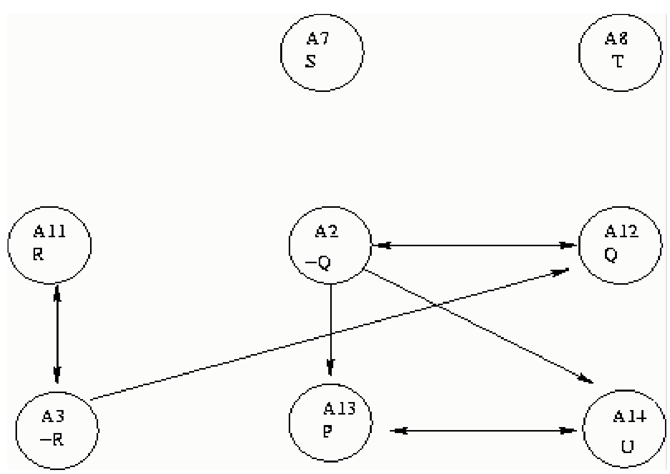

Figure 2: AF4

Preferred extensions of AF4 are:

{A7, A8, A11, A12, A13}
{A7, A8, A11, A12, A14}
{A7, A8, A11, A2}
{A7, A8, A3, A2}

We will leave for later consideration how we might choose between these preferred extensions.

A further possibility is that we might think that there may be another explanation of the claim of an instantiation of AS4, even if we don't know what it is:

AS4CQ5: Might there be another explanation?

A positive answer to this critical question instantiates AS6:

AS6: Argument from Unknown Explanation
Data: Type: Fact: where Fact is the claim of an instantiation of AS4
Claim: Type: Fact: Claim.

Note that AS6 is not legitimate if we believe that our knowledge of possible explanations is complete. This gives two critical questions:

AS6CQ1 Do we have an independent reason to believe Claim?
AS6CQ2 Is our knowledge of the explanations for Claim complete?

Applying AS5 to KB2 gives A15 and applying AS6 to KB4 gives A16-18.

A15 ¬R since Q defeasibly inferred.
A16 ¬Q since there may be an unknown explanation for R
A17 ¬P since there may be an unknown explanation for Q
A18 ¬U since there may be an unknown explanation for Q

We can usefully label the arcs in the framework with the critical questions. If we add A16-A18 to AF4 we get AF4a as shown in Figure 3.

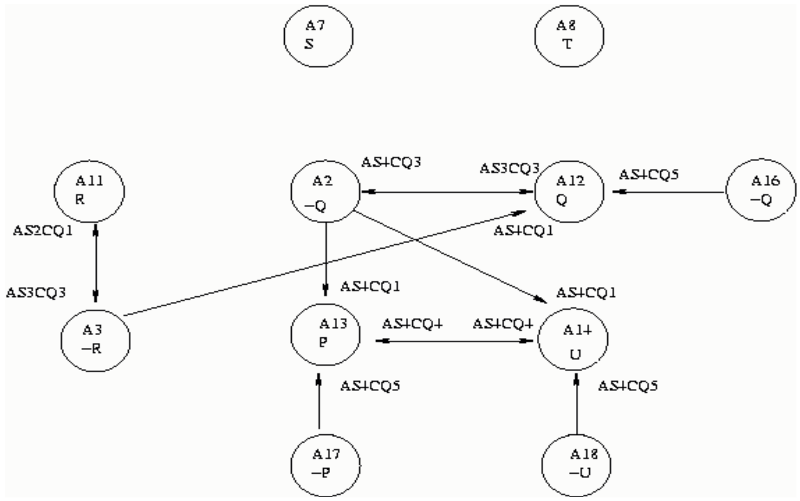

Figure 3: AF4a

6 Cases

We now need to return to the notion of a case. Recall that we decided to admit only arguments without sub-arguments into our framework, thus precluding the possibility of representing support for an argument as sub-argument. Also we want to stay within Dung's original intentions, and so do not wish to include an additional relation to show support, as is done, for example, in Cayrol and Lagasquie-Schiex (2005). We can, nevertheless, obtain a clear notion of support, and hence of arguments in Sense 2, by considering admissible sets.

An admissible set is conflict free and able to defend itself against attackers. This means that a given argument in the admissible set which is attacked will have defenders in the admissible set. Moreover if these defenders have attackers, they too will have defenders in the admissible set. Thus the minimal admissible set containing a given argument will contain all the arguments needed to make that given argument part of an admissible set. It is in this way that we can express the notion of support while staying within Dung's framework, as originally specified.

Consider, as an example, A13 in AF4 above. This argument appears in only one preferred extension: {A7, A8, A11, A12, A13}. A12 is needed to defend A13 against A2, and A11 is needed to defend A12 against A3. A7 and A8 are included only to make the extension maximal. Thus the minimal admissible set containing A13 is {A11, A12, A13}. Thus we can say that A13 is supported by A11 and A12, and that these three arguments form the case for the claim of A13, P. This would make the case something like "P is the best explanation of Q, which is the best explanation of R, which is known to hold." Had we adopted the sub-argument approach we would have had

C3: A11, A12, R1, so P,

showing the connection between chains of arguments and admissible sets.

Note, however, that on this notion of case, A2 is *not* supported by A7, which would, as being the datum required to infer ¬Q using A2, often be thought to be a sub-argument of A2. We argue that we should not see A7 as supporting A2, because this aspect of A2 is not in question, the only attack on A2 coming from A12, which is a rebuttal, not a premise defeat. In other words, A7 is accepted without question, and so its claim can be presumed in any argument that requires it, meaning that the argument stands in no need of support in this respect. Of course, if the logic level had in fact generated an argument with claim ¬S, we would have an argument attacking the datum of A2, but that argument would itself be attacked by A7. In that case A7 would be required to admit A2 into an admissible set, and so would be regarded as supporting it. We feel that this notion of support, which only calls in potential supporters if they are required, is clearer than notions which attempt to identify all potential supporters at the logical level and without regard to their supporting role in a debate.

7 Evaluation

When discussing AF2 and AF4, we used the standard notion of evaluating the argumentation framework in which all arguments have equal weight, and all attackers succeed, and where we calculate the grounded, preferred or stable extensions, according to our semantic preferences. Yet, as noted earlier, we may have multiple preferred extensions which we want to differentiate; we want to have some principled *reason* to choose between them.

The usual method of distinguishing between multiple preferred extensions, and so provide a reason to choose between them, is to ascribe some property to the arguments representing their strength, and to require an attacker to be at least as strong as the attacked argument if the attack is to succeed. In virtue of these more fine-grained attacks, we can distinguish among previously undistinguished preferred extensions. For example Amgoud and Cayrol (2002) use preferences in this way, and Bench-Capon (2003) uses the notion of value (the social interest promoted by the acceptance of an argument) to determine the relative strength of pairs of arguments. But where do these properties come from?

The answer must be that they come from the argument schemes instantiated to produce the arguments in the framework. At the very least therefore the arguments can be ascribed the property of being instantiations of a particular argument scheme. This in turn means that we could apply a preference order to schemes: for example we might rate Argument from Assertion most highly, since this requires a known fact in the database, then Defeasible Modus Ponens, then Abduction. Or we could choose a different order if we desired. The general idea is that the arguments can be ascribed properties, these properties can be ranked, and this ranking is used in determining the status of arguments in the framework. Note that although the schemes determine which properties can be ascribed to the arguments, the ranking is produced independently, and that different rankings may be applied to the framework for different purposes or by different audiences.

If we use different argument schemes, we may be able to ascribe a wider range of properties. Three examples are:

- One well known argument scheme is Argument from Authority (e.g. Walton 1996). In order to instantiate this scheme an authority must be identified. All arguments instantiating this scheme therefore will have the property of being endorsed by some particular authority. If we have several competing authorities, we can use a ranking of confidence in these authorities to determine the strength of arguments.
- In Atkinson (2005) an argument scheme for practical reasoning is proposed. In this scheme the social value promoted by acceptance of the argument has to be identified in order to instantiate the scheme. This allows arguments from this scheme to be labeled with these values, which in turn means that the resulting framework can be regarded as a Value Based Framework (Bench-Capon 2003)), and evaluated according to a particular audience's ranking of the values.
- Work on case-based reasoning in law such as Ashley (1990), effectively identifies a set of argument schemes and critical questions tailored to reasoning with legal precedents. Each of these argument schemes is related to the citation of a legal decision, and so comes with information such as the date of the case, the jurisdiction in which it was decided, and the level of court which made the decision. All of these things represent useful properties of argument which can feed into the evaluation of the status of arguments when they are formed into a framework.

Properties of arguments will not, however, suffice for AF4a. The use of Argument Scheme AS6 means that any abductive argument will have an attacker. If attacks always succeeded, this means that we simply could not use abductive arguments. The implication is that we need to provide some way for attacks to fail. One obvious strategy is to use the labels on the attacks. For example it might be that one considered that AS4CQ5 should not defeat the argument it attacks, unless that argument is attacked by some other argument. Thus in AF4a, none of the abductive arguments will succeed, because they have independent attackers. But suppose we did not have the fact that S, so that A2 no longer can be made. Now if we accept A11 to defeat the other attacker of A12, we will accept A12. A13 and A14 are, however, still defeated since they mutually attack, as well as being attacked using AS4CQ5. This seems reasonable, since we do not have another explanation of R, but P and U are competing explanations for Q, and we have no reasons given for preferring one to another.

There are two important points to note here. First, the properties of arguments can play an important role in deciding the status of arguments in an argumentation framework, since they can form the basis for rational choice between competing preferred extensions. Second, the properties ascribed to arguments in the AF need to have their origin in the argument schemes which ground the arguments in the framework. The schemes used will thus determine the properties which are available at the framework level.

8 Summary

In this paper we have attempted to make clear distinctions between three senses in which “argument” may be used, and which can sometimes appear to be conflated in work on argumentation.

First we have the level of the atomic argument. For us this is an instantiation of an argument scheme, and cannot be divided into any constituent parts which are themselves arguments. There is a wide variety of argument schemes found in the literature: the choice of which schemes to use will depend on the nature of the application – different schemes are appropriate for legal, practical, scientific, mathematical and evidential reasoning. These schemes have associated with them critical questions, and various arguments will form the basis of these questions posed against other arguments. This provides a principled basis for deciding which arguments are in conflict, and whether the conflict is symmetric or not. Also the different critical questions permit attacks to be labeled according to the question being posed. Finally particular schemes will permit the ascription of properties to these arguments.

The above allows us to form the arguments into an argumentation framework, which represents the notion of argument as debate, sets of reasons for and against particular propositions. At this level it is possible to evaluate arguments to form a view as to which should be accepted and which should be rejected. Where suitable argument schemes have been used, properties of arguments and attacks can be used to inform the evaluation, according to rankings of these properties.

Finally we can define the notion of a case, a set of supporting arguments for a particular point of view, in terms of a minimal admissible set taken from the framework.

We believe that it is important to maintain a distinction between these three senses. Moreover we can see that our separation shows clearly the links between them. An argumentation framework is independent of the argument schemes used to form it. The properties of arguments do depend on the schemes used, and so some evaluations will be possible only if the arguments instantiate particular argument schemes. The notion of support is derived from the status of arguments in the framework level, rather than being identified at the logic level and thus is dependent on the method of evaluation for the framework.

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