The role of argument comparison in dialectical argumentation.

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1 Introduction

There are a lot of argumentation models that have been developed inside Artificial Intelligence. Among these models, differents formal systems of defeasible argumentation are defined, where arguments for and against a proposition are produced and evaluated to verify the acceptability of that proposition. In this manner, defeasible argumentation allows reasoning with incomplete and uncertain information. The development of this kind of systems has grown in the last years [SIM92, BART, KOWA96, AG97, DUNG93, DUNGLP] but no consensus has been reached yet on some issues, such as the representation of arguments, the way they interact, and the output of that interaction. Even then, the main idea in these systems is that any proposition will be accepted as true if there exist an argument that supports it, and this argument is acceptable according to an analysis between it and its counterarguments. Therefore, in the set of arguments of the system, some of them will be \acceptable" or \justified" arguments, while others not. But this bi-valued classification of arguments is not enough, due to some situations that can be found in argumentation systems.

The reasons of non-justification can be analyzed in more detail, so we can make a more specific classification of the non-justified arguments. An argument of this kind can not be justified because, for instance, it has a justified defeater, or it is involved in circular argumentation. In the former, we can think that the argument has been effectively defeated. In the latter, the justification of the argument falls in an \inconclusive" state. This is the starting point to distinguish a third kind of arguments: those which left the dispute without any conclusion. There exist various names for this arguments, like defendibles, undecided, ambiguous and undetermined. In the rest of the paper, we will call this arguments *undecided*. There is another reason to classify an argument as undecided. This reason is not so obvious as the one specified above, and is related to the comparison of arguments.

2 Causes of indecision

The first cause of indecision that we can distinguish is the presence of controversial situations in argumentation, called fallacies. The fallacies are related to the existence of cycles in the defeats scenario on the set of arguments. An arguments that belong to these cycles used to be called *fallacious argument*, even when the fallacy lies on a set of arguments. The term fallacy is a very general one [EREAS], and some kind of real world fallacies does not have useful meanings on defeasible argumentation. Among the most important ones, we distinguish circular argumentation, where the length of the cycle is even,

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and contradictory argumentation, where the length of the cycle is odd. Every argument in these cycles must be classified as undecided, except when there exists a justified argument who breaks the fallacy, defeating at least one argument in the cycle. Actually, no consensus has been reached on the treatment of this problems in Artificial Intelligence. One approach is implemented on DeLP, where argumentation lines are analyzed in order to detect cycles and to act accordingly. [GCS94, AG97, DCMAJG]

The second cause of indecision in the system is the existence of *incomparable arguments*. In argumentation systems, it is necessary to state the relative difference in strength among arguments, by means of some comparison criteria. All defeasible logics operate by means of a mechanism of defeat that computes relationships of conclusive force among arguments. Defeasible argumentation systems include a notion of conflicting arguments, but this notion does not embody any form of evaluation. Evaluating conflicting pairs of arguments is an important element of argumentation systems. It has the form of a binary relation between arguments, standing for \stronger or better than", usually denoted by $\leq$, so $A \leq B$ means \B is as strong as A" and $A < B$ means \B is stronger than A"

Most popular criterions are usually based on syntactic aspects and they just constitute a structural analysis of the involved arguments. Many researchers have proposed general criteria for adjudicating between competing lines of arguments. Most of them agree on the principle of *specificity*, introduced by Poole in 1985 [Poole85]. Other criteria to compare arguments include *directness* by Loui, *preemption* by Horty et. al., *combined defeat* by Prakken [PRAK], and *accumulation of numerical strength*, by Pollock [Pol94]. On the other hand, some authors do not commit to a specific method to compare arguments. This attitude saves them from the responsibility of telling how and why a particular argument should overrule any other argument. Therefore, these systems work with no detailed specification of defeat [DUNG93, VREE97]. Sometimes, this kind of abstract argumentation systems fails to capture the behavior of some real full-specified systems [DCMAJG, DMC99].

It is possible for two conflicting arguments to be incomparable, according to the selected comparison criteria. Two conflicting arguments A and B do not defeat each other, except one of them is stronger, according to the comparison method. If A is stronger than B, then B is defeated by A. But, if it is impossible to state which is the stronger argument, then the direction of the conflict relation can not be determined. In this case, neither A nor B are justified and they are not really defeated by a justified argument, so we can classify these arguments as \undecided". Indecision by incomparability is usually not considered in defeasible argumentation systems. On *DeLP* [AG97] there is a classification of defeaters based on comparison of arguments, and an argument A is undecided when it is not justified and at least one defeater is incomparable to A.

The chosen criterion will always have a strong influence in argument classification, because it determines the direction of the conflict relation, which leads to the defeat relation. On one side, the worst comparison criteria makes all the arguments incomparable, so the system falls in a general indecision state. However, it is not possible to construct a complete argument hierarchy. And this is not a real disadvantage, because there exists, by nature, incomparable arguments in the real world. Any criterion that always adopts a preference for any pair of arguments tends to be fictitious, because of the arbitrary conflict resolution, and it hides the possibility of indecision in the system. As stated by Vreeswijk [VREE97], incomparability is always better than overspecification.

These two causes of indecision are not independent. Actually, the presence of cycles is related to the definition of defeat used in the system. And this notion of defeat always includes some comparison method for arguments. A cycle usually arises when there are some incomparable arguments, due to the transitivity property of the partial order determined by the comparison method. This is not true when the system allows subargument attack. In this case, the arguments being compared are the subargument and its defeater, so it is possible to construct a cycle where the arguments involved are not pairwise incomparable. Gerard Vreeswijk [VREE97] proposes three conditions to be satisfied by any comparison criteria, so the defeat as a finite process is ensured. To avoid cycles and reciprocal defeaters, he assumes that arguments do not vie with each other, that arguments do not became stronger

if they are made longer, and there is no loss of conclusive force through strict rules of inference. But here, the comparison criteria is not stated explicitly.

To construct a method for comparing arguments we need a deep knowledge about the logic, the structure of rules and arguments, and even the process of justification of the system. And the comparison method should be a modular component in argumentation systems, so we can change the criteria without changing the rest of the system. This can be done because the notion of defeat is defined in terms of \stronger arguments" or \better arguments" without telling how this conclusion is reached.

An undecided argument may cause other arguments being undecided too. The reason is the justification process of an argument A requires knowledge about the status of the relevant arguments of A. If the defeaters of A are all of them non- justified arguments, except one, say D, which is undecided, then A is also an undecided argument, because it is impossible to determine the status of D as \justified" or \non-justified", and this status is needed to determine the status of A. Therefore, the indecision of A is consequence of the indecision of D. This is called \indecision propagation". The indecision propagation may be very large, causing other arguments being undecided when at least one of its relevant arguments is undecided. In DeLP, cycles detection on justification process allows the minimization of propagation due to the presence of undecided arguments in the system.

There exist, as an alternative, a credulous position about this problem. The propagation can be controlled by ignoring undecided relevant arguments during justification process, so undecided arguments are only the arguments in a cycle, or non-justified arguments with at least one incomparable defeater.

Actual works on these issues are related to the study of various argument comparison techniques, specially the one used on DeLP, the specificity criteria, and the construction of a comparison criteria which minimize the presence of fallacies in the system. This criteria could include information about the context of the discussion in which the arguments take part. In this way, the criterion could obtain different results in argument comparison, so we can avoid indecision when it is due to structural equality of the pair of arguments being compared.

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