# Evidential Reasoning in Bipolar Argumentation Frameworks ⋆

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**Abstract.** Bipolar argumentation frameworks have been instrumental in capturing the notion of support between arguments. However, some of their semantics are counterintuitive in situations regarding evidential reasoning, and we extend them to account for this. To account for our long term research goals, we also update Bipolar argumentation frameworks to be able to handle support and attack by multiple argument in the same style as Nielsen's work.

## 1 Introduction

The importance of the notion of support has been recognised by members of the argumentation community, and Bipolar Argument Frameworks [1], hereafter referred to as BAFs, have emerged as a popular way of representing this concept. Like Dung's original model [2], BAFs provide an abstract representation of argument, and allow for the computation of different extensions, that is, sets of compatible arguments, from an initial set of supporting and attacking arguments.

To see the need for the idea of support, consider the following set of arguments:

- $a$ A new survey states that fast flowing water exists at coordinates x,y. Fast flowing water would mean that mud cannot build up.
- $b$ Our historic survey says that slow water exists at coordinates x,y.
- $c$ We have been told that mud exists at x,y.
- $x$ The bridge should be built where slow water exists without mud (i.e.at x,y).

These arguments may be represented by a BAF of the form

$$\{(a, b, c, x), \{(a, b), (a, c), (c, x)\}, \{(b, x)\}\}$$

Where the first part of the tuple lists the arguments in the system, and the second and third elements enumerate attack and support between pairs of arguments respectively.

Then the extensions defined for BAFs all contain the argument $a$, with no extensions containing $x$ as it is both set-defeated (through $b$), and set supported (through $c$) by $a$.

If however, instead of $x$, we had the alternate argument $x'$:

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$x'$ We would prefer that the bridge be built where slow water exists without mud. If we believe that this could be the case, the bridge should definitely be built at x,y.

Intuitively, arguments $\{a, x\}$ should be accepted. However, BAF extensions do not do this. Note that the only difference between these two systems is the presence (or absence) of evidence, and in the next section, we suggest how BAFs may be extended so as to allow us to deduce the correct set of arguments in both situations. Since we ultimately want to be able to represent the accrual of evidence, our extension also incorporates Nielsen's work [3], so as to allow for attack and support by multiple arguments.

## 2 Approach

By extending the notion of an argument to include the empty set (which is immune to attack), we may interpret support from it to another argument as having evidence from the environment to support the other argument.

We can then define a supported attack by a set of arguments $S$ against an argument $a$ as those arguments which attack $a$, and the arguments needed to create a chain of support from the empty set to the attacking arguments.

From these notions, auxiliary notions such as conflict free and self supporting may be derived, as well as the notion of acceptability and admissibility. Thus, for example, an acceptable argument $a$ with respect to a set $S$ is an argument whose chain of support can be found in $S$, and for any supported attack against $a$, there is an attack in $S$ such that the attack is no longer supported. Admissibility, as usual, can then be defined as a conflict free set of acceptable self-acceptable arguments. It is then possible to define (evidential) preferred, stable and grounded extensions[1]. Thus, in our framework, support edges from $\{\}$ to $a, b, c$ and $x$ would exist in the first case, but no edge would lead from $\{\}$ to $x'$.

## 3 Discussion and Conclusions

We have introduced a refinement of BAFs that allows us to reason about evidential reasoning. The extensions computed by this refinement agree with one's intuition. We are currently investigating the framework's formal properties. So far, we have been able to find analogies to many of Dung's results. We intend to enhance the framework so as to support important evidential reasoning concepts such as accrual of arguments.

## References


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[1] A Prolog implementation can be found at `http://www.csd.abdn.ac.uk:~/noren`