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ConArg: A Tool for Classical and Weighted Argumentation

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Abstract. ConArg is a tool for solving different problems related to extension-based semantics: e.g., enumeration of extensions, sceptical and credulous acceptance of arguments. We have extended it in order to deal with *Weighted Abstract Argumentation Frameworks*, where each attack is associated with a strength score. Classical notions of defence and conflict-freeness have been redefined with the purpose to have different (weighted) degrees of their relaxation. The ultimate aim is to let an agent choose between a higher internal consistency or a stronger defence.

Keywords. Abstract Argumentation Frameworks, Extension-based semantics, Weighted attacks, Weighted defence, Inconsistency tolerance.

ConArg[1] [5,2] is an Argumentation-related reasoner based on *Gecode*[2], which is an open, free, and efficient C++ library where to develop constraint-based applications. ConArg is able to find all the classical extensions on a given *Abstract Argumentation Framework* (*AAF*) [7]: conflict-free, admissible, complete, stable, grounded, preferred, semi-stable, and ideal extensions. In addition, it can check the credulous or sceptical acceptance of a given argument. The tool is offered to users as a stand-alone command-line executable, or through a Web-interface that can be found at the official site of ConArg.

Besides classical unweighted problems [7], ConArg has been extended to also deal with *Weighted Abstract Argumentation Frameworks* (*WAAF*s) [4]. This is accomplished *i)* by allowing an internal conflict *inside* the extensions satisfying a given semantics, and *ii)* by relaxing defence taking into account the difference between the two weights of attacks (aggregated per attacker) and defence. Hence, two parameters influence new semantics: α is the amount of internal conflict that can be tolerated, while γ represents how much defence can be relaxed. The result is the definition of α^γ-semantics (e.g., α^γ-admissible). The strictest (not relaxed) level of defence corresponds to w-defence [3]: an extension $\mathscr{B} \subseteq \mathscr{A}_{rgs}$ defends an argument $b \in \mathscr{A}_{rgs}$ from $a \in \mathscr{A}_{rgs}$, if the sum of all the attack weights from $\mathscr{B}$ to a is stronger than the sum of all the attacks from a to $\mathscr{B} \cup \{b\}$.

For instance, looking at Fig. 1, $\mathscr{B}$ is w-defended (or 0-defended) from the attacks of a ($2+6=8 \geq 7$), while $\mathscr{B}$ is not w-defended from f ($5+2=7<8=5+3$): $\mathscr{B}$ is only 1-defended (i.e., the difference between attack and defence, $8-7=1$). $\mathscr{B}$ is 2-conflict-free, since it encompasses two attacks with weight 1 each (between b and e, and e and c). To summarise, $\mathscr{B}$ is 2^1-admissible ($\alpha=2$ and $\gamma=1$): we tolerate an internal conflict of 2, and that the defence is weaker (by 1) than the aggregated weight of attacks (from f).

[1] `http://www.dmi.unipg.it/conarg/`.
[2] `http://www.gecode.org`.

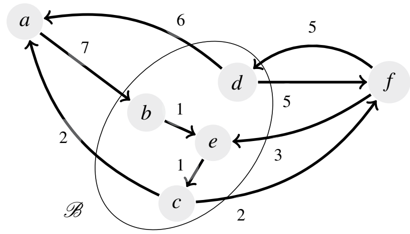

Figure 1. $\mathscr{B}$ is w-defended from a, but only 1-defended from f. $\mathscr{B}$ is also 2-conflict-free.

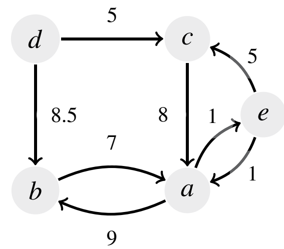

Figure 2. $\{a,d\}$ is 0^3-admissible, $\{a,d,e\}$ is 2^0-admissible.

ConArg can import (W)AAFs with a format as, *e.g.*, *arg(a), arg(b), att(a,b)*. If *att(a,b):-6*, then it means that the attack from a to b is associated with a weight of 6.

Parameters α and γ mutually influence each other: allowing a small conflict may lead to have one more argument inside an extension, which consequently may be more strongly defended by exploiting the attacks of this additional argument, or more weakly, in case such additional argument receives attacks from external arguments. Figure 2 is presented to show how internal and defence relaxations are strictly linked together: the set $\{a,d\}$ is 0^3-admissible, since a is attacked by c with weight of 8, but only a counter-attack with weight 5 is present from d to c (hence, the difference to be tolerated is $8-5=3$). However, if an internal inconsistency of 2 can be tolerated (inconsistency is ubiquitous in every-day life [1]), the set $\{a,d,e\}$ is 2^0-admissible: by allowing a small internal conflict, the defence against b and c becomes stronger (no defence-relaxation is needed to defend them). Therefore, we provide a means to an agent to decide between $\{a,d\}$ or $\{a,d,e\}$, satisfying either the first (with a higher internal consistency) or the second semantics (with a stronger defence).

In the future we will study two-criteria (α and γ) decision-making procedures to help an agent choose between internal or defence relaxations (as in the example in Fig. 2). We will also extend weighted relaxations to coalitions of arguments [6].

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