Group-Based Extension and Computation of Argumentation Framework

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ABSTRACT

Abstract argumentation framework may lead to counter intuitive results according to the attack relation between single arguments. In this paper, we first present the group-based argumentation framework to deal with the attack relation among sets of arguments. We define annotate arguments that contain the labels of groups to extend the argumentation framework. We prove that the new framework is a general case of abstract argumentation framework without self-attacks. We then present an approach to compute the preferred extension and winner of the group-based argumentation.

CCS Concepts

• Computing methodologies → Philosophical/theoretical foundations of artificial intelligence

Keywords

argumentation; preferred extension; computation.

1. INTRODUCTION

The abstract argumentation framework introduced by Dung [1] is useful in knowledge representation in artificial intelligence. There are a number of researches followed in the framework, among others, computation and complexity[2,3,4,5], various extended frameworks[6,7,8,9,10,11,12,13,14,15].

The abstract argumentation framework AF (for short) can be represented as a directed graph with a set of arguments and a set of binary attack relation (directed arcs) on the set of arguments. The conclusions of argumentation is defined by extension that is the final conclusions of argumentation. There are some limitations of AF by the attack relations that are defined between single arguments.

Intuitively, there may exist that α indirectly attacks β in AF, while they have the same standpoint in a group and would not attack each other by themselves. Thus we have to consider the attack relations among the sets of arguments, in which a set of arguments stands for the same point in argumentation.

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ICMLSC '17, January 13-16, 2017, Ho Chi Minh City, Viet Nam

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DOI: <http://dx.doi.org/10.1145/3036290.3036315>

In literature, there are some works mentioned the sets of arguments [1,16,17,18,19,20,21]. Dung [1] mentioned that a set of arguments attacks an argument but didn't give the formalization. Nielsen and Parsons [16] proposed the set of arguments attacks an argument and provides an approach to compute the preferred

extension in [17], but they didn't notice that the arguments in a set would have the same standpoint. In other words, they only used the sets of arguments but didn't consider the inherent relations of sets of arguments. In [18,19,20,21], the relations of the sets of arguments are not mentioned.

There are some literature on the computation of the extensions for abstract argumentation frameworks. Doutre and Mengin [2] provides the approach to enumerate preferred extensions of abstract argumentation by constructing a binary tree with the node as a partition of arguments. Cerutti and Dunne et al [3] presented a SAT-based approach to compute preferred extensions of abstract argumentation.

In this paper, we will introduce the group-based argumentation framework that aims to study the attack relations among sets of arguments. We present an approach to enumerate the preferred extensions which is similar to the work in [2] and an algorithm to the winners of group-based argumentation framework.

The rest of this paper is organized as follows. In Section 2, we briefly review the abstract argumentation framework. In Section 3, we present the group-based argumentation framework. In Section 4, we provide the method for enumerating preferred extension and the algorithms to the winners of group-based argumentation framework. In Section 5, we discuss the related works. Finally, we make conclusion in the concluding section.

2. PRELIMINARIES

In this section, we present the abstract argumentation framework introduced in [1,22].

Definition 1. An argumentation framework is a pair $AF = \langle A, R \rangle$, where A is a set of arguments and R is a binary relation on A , i.e. $R \subseteq A \times A$.

$(\alpha, \beta) \in R$ denotes argument α attacks argument β .

Definition 2. Let $AF = \langle A, R \rangle$ be an argumentation framework, S be a set of arguments ($S \subseteq A$), $\alpha, \beta, \gamma, \dots \in A$.

- S is conflict-free set iff $\forall \alpha, \beta \in S$, there is no α attacks argument β .
- An argument α is acceptable w.r.t S iff $\forall \beta \in A$, if $(\beta, \alpha) \in R$, there exists $\gamma \in S$ and $(\gamma, \beta) \in R$.
- A conflict-free set S is admissible iff $\alpha \in S$, α is acceptable w.r.t S .

- The characteristic function of AF, denoted by F_{AF} , is defined as follows:

$$F_{AF}: 2^R \rightarrow 2^R,$$

$$F_{AF}(S) = \{A | A \text{ is acceptable w.r.t } S\}.$$

Definition 3. Let $AF = \langle A, R \rangle$ be an argumentation framework, S be an admissible set of AF , and F be the characteristic function of AF . Then

- S is a preferred extension of AF iff S is a maximal admissible set (w.r.t set inclusion) of AF .
- S is a complete extension of AF iff each argument which is acceptable w.r.t S is in S .
- S is a stable extension of AF iff $\forall \beta \notin S$, there exists $\alpha \in S$ and $(\alpha, \beta) \in R$.
- S is a grounded extension of AF iff S is the least fixed point of F .
- S is ideal iff it is a subset of each preferred extension. The ideal extension of AF is a maximal (w.r.t. set inclusion) ideal set.

For semantics

$y \in \{\text{preferred, complete, stable, grounded, ideal}\}$, argument α is said to be skeptically acceptable under semantics y iff α belong to the intersection of all the extension under semantics y .

Argument α is said to be credulous acceptable under semantics y iff α belong to the union of all the extension under semantics y .

3. GROUP-BASED ARGUMENTATION FRAMEWORK

Definition 4. Let A be a set of arguments, and $\mathcal{G} = \{\Phi_1, \Phi_2, \dots, \Phi_n\}$ a partition of A . An annotate argument is $w = \alpha: \Phi_i$, where $\alpha \in \Phi_i, i \in \{1, 2, \dots, n\}$.

The set of arguments A is partitioned into groups $\Phi_i (i \in \{1, 2, \dots, n\})$ such that every group has only one standpoint. We denote the argument and the annotation involved in w by $D(w)$ and $G(w)$, that is, $\alpha = D(w), \Phi_i = G(w)$.

Definition 5. Let A be a set of arguments, and $\mathcal{G} = \{\Phi_1, \Phi_2, \dots, \Phi_n\}$ a partition of A . A group-based argumentation framework is a pair $GAF = \langle W, \mathcal{R} \rangle$, where W is the set of annotate arguments, and $\mathcal{R}$ is a binary relation on W , i.e. $\mathcal{R} \subseteq W \times W$.

The annotate argument $w_\alpha = \alpha: \Phi_i \in W$ attacks $w_\beta = \beta: \Phi_j \in W$ if and only if $\Phi_i \neq \Phi_j$ and α attacks β . If for all $\Phi_i \neq \Phi_j, \alpha: \Phi_i, \beta: \Phi_j \in \mathcal{S} (\mathcal{S} \subseteq W)$, and α does not attacks β , we say that $\mathcal{S}$ is conflict-free.

Let $\mathcal{S} \subseteq W$ be a set of annotate arguments, an annotate argument $w_\alpha \in W$ is acceptable w.r.t $\mathcal{S}$ if and only if for all $w_\beta \in W$, it holds that if w_β attacks w_α then there is an annotate argument $w_\gamma \in \mathcal{S}$, such that w_γ attacks w_β . A conflict-free set $\mathcal{S}$ of annotate arguments is admissible if and only if for each annotate argument $w_\alpha \in \mathcal{S}$, w_α is acceptable with respect to $\mathcal{S}$.

Definition 6. Let $GAF = \langle W, \mathcal{R} \rangle$ be a group-based argumentation framework, $\mathcal{S} \subseteq W$ an admissible set. Then $\mathcal{S}$ is a preferred extension of GAF if and only if $\mathcal{S}$ is a maximal admissible set of GAF .

We write $E_{pr} = \{\mathcal{E}_1, \dots, \mathcal{E}_n\}$ as the extensions under preferred semantics.

Definition 7. Let $GAF = \langle W, \mathcal{R} \rangle$ be a group-based argumentation framework. The winner of GAF under preferred semantics is defined by $Win_{pr}(GAF) = \{\Phi_k | k = \max_{i \in N} count(\Phi_i)\}$, Win_{pr} for short, where $\mathcal{A}_{pr} = \{w_\alpha | w_\alpha \text{ is skeptically acceptable under preferred semantics}\}$ and $count(\Phi_i)$ is a function to count the number of Φ_i in $\mathcal{A}_{pr}$ which satisfies $G(w_\alpha) = \Phi_i$.

An annotate argument w_α is said to be skeptically acceptable under preferred semantics if and only if w_α belong to the intersection of all the extension under preferred semantics. An annotate Argument w_α is said to be credulous acceptable under preferred semantics if and only if w_α belong to the union of all the extension under preferred semantics.

Notice that $\mathcal{A}_{pr}$ is the more reliable evidence in all of the sets of arguments. The winner is considered the group that is more confident to be accepted as a whole, even though it may exist some arguments which are not acceptable.

Example 1. Let $GAF = \langle W, \mathcal{R} \rangle$ with $W = \{\alpha_1: \Phi_1, \beta_1: \Phi_2, \beta_2: \Phi_2, \gamma_1: \Phi_3, \gamma_2: \Phi_3, \xi_1: \Phi_4, \xi_2: \Phi_4, \psi_1: \Phi_5, \psi_2: \Phi_5\}$, and $\mathcal{R}$ as indicated on the figure.1 below.

Figure.1

The preferred extension $E_{pr} = \{\{\alpha_1: \Phi_1, \gamma_1: \Phi_3, \psi_1: \Phi_5, \psi_2: \Phi_5\}, \{\alpha_1: \Phi_1, \xi_1: \Phi_4, \psi_1: \Phi_5, \psi_2: \Phi_5\}\}$, $Win_{pr} = \{\Phi_5\}$, which we will prove later in the paper.

GAF has nice properties. In fact, GAF is a general case of abstract argumentation framework without self-attacks.

Proposition 1. The abstract argumentation framework without self-attacks is a special case of the group-based argumentation framework.

Proof. Suppose that arguments $\alpha_1, \dots, \alpha_n$ in AF are represented as the form of annotate arguments $\alpha_1: \{\alpha_1\}, \alpha_2: \{\alpha_2\}, \dots, \alpha_n: \{\alpha_n\}$, since the arguments in AF without self-attacks can be regarded as they belong to the groups themselves. The attack relations $(\alpha_i, \alpha_j) \in R (i, j \in \{1, 2, \dots, n\})$ in AF can be converted to the attack relations $\alpha_i: \{\alpha_i\}$ attacks $\alpha_j: \{\alpha_j\}$ in GAF correspondingly. $\square$

Proposition 2. Let $GAF = \langle W, \mathcal{R} \rangle$ be a group-based argumentation framework, $\mathcal{S}$ an admissible set, and $\alpha: \Phi_i$ and $\alpha': \Phi_j$ annotate arguments which are acceptable with respect to $\mathcal{S} (i, j \in \{1, \dots, n\})$. Then

- $\mathcal{S}' = \mathcal{S} \cup \{\alpha: \Phi_i\}$ is admissible.
- $\alpha': \Phi_j$ is acceptable with respect to $\mathcal{S}'$.

Proof.

- Need to proof $\mathcal{S}'$ is a conflict-free set. Suppose not, there exists an annotate argument $\beta: \Phi_k \in \mathcal{S} (k \neq i)$ and $\beta: \Phi_k$ attacks $\alpha: \Phi_i$ or $\alpha: \Phi_i$ attacks $\beta: \Phi_k$. There is an annotate argument $\gamma: \Phi_m \in \mathcal{S}$ and $\gamma: \Phi_m$ attacks $\beta: \Phi_k (m \neq k)$ or $\gamma: \Phi_m$ attacks $\alpha: \Phi_i (m \neq i)$ since the admissibility of $\mathcal{S}$ and the acceptability of $\alpha: \Phi_i$. Because $\mathcal{S}$ is conflict free set, $\gamma: \Phi_m$ attacks $\alpha: \Phi_i$. There is an annotate argument $\eta: \Phi_p \in \mathcal{S}$ and $\eta: \Phi_p$ attacks $\gamma: \Phi_m (p \neq m)$ since $\alpha: \Phi_i$ is acceptable with respect to $\mathcal{S}$. Contradiction. $(i, k, m, p \in \{1, \dots, n\})$
- Obvious. $\square$

Corollary 1. Let $\text{GAF} = \langle W, \mathcal{R} \rangle$ be a group-based argumentation framework. Then for each admissible set $\mathcal{S}$ of GAF, there is a preferred extension $\mathcal{E}_i$ of GAF and $\mathcal{S} \subseteq \mathcal{E}_i$.

Corollary 2. Every GAF at least has one preferred extension.

Corollary 3. If GAF has the unique preferred extension E_{pr} , then $\mathcal{A}_{pr}$ is equivalent to E_{pr} .

Proposition 3. Let $\text{GAF} = \langle W, \mathcal{R} \rangle$ be a group-based argumentation framework, $\langle \Phi_j \rangle = \{w_\alpha | G(w_\alpha) = \Phi_j\}$. For each $w_{\alpha_i} \in \langle \Phi_j \rangle$, for all $w_\beta (G(w_\beta) \neq \Phi_j)$, if w_β attacks w_{α_i} , there exists $w_{\alpha_k} \in \langle \Phi_j \rangle$ and w_{α_k} attacks w_β , then $\langle \Phi_j \rangle \subseteq \mathcal{E}_i$. ($\mathcal{E}_i \in E_{pr}$)

Proof. First, it is obvious that $\langle \Phi_j \rangle$ is an admissible set. $\langle \Phi_j \rangle$ is conflict free because all of its annotate arguments are in the same group. And from the condition of the proposition, we can see that every annotate argument in $\langle \Phi_j \rangle$ is acceptable with respect to $\langle \Phi_j \rangle$.

On the second step, let $\mathcal{S}$ be the maximal admissible set of GAF. Suppose that $\langle \Phi_j \rangle \not\subseteq \mathcal{S}$, then there exists at least one annotate argument $\alpha_m: \Phi_j \notin \mathcal{S}$. While $\alpha_m: \Phi_j$ is acceptable with $\langle \Phi_j \rangle$, it must belong to $\mathcal{S}$. It's contradict to that $\mathcal{S}$ is the maximal admissible set of GAF. $\square$

4. COMPUTATION

4.1 Computing Preferred Extensions

We now present a method for computing the preferred extensions and the Win_{pr} of the group-based argumentation framework. The method is similar to the approach which is presented in [2]. The basic strategy is to enumerate all possible divisions of annotate arguments W into two sets, I and O , where I is the annotate arguments that are in preferred extension and O is the annotate arguments that are not. And then check that if I is a preferred extension.

The enumerate of the division for the given annotate arguments W is constructed as a binary tree, which the node is a partition of W into three sets (I, O, U) , where the set U is the annotate arguments still not partition to I or O . The root of the tree is a node that both I and O are all empty set and U is equal to the given annotate arguments W . Each child (I', O', U') is refinement of the node (I, O, U) , i.e. $I \subseteq I'$ or $O \subseteq O'$. If $U = \emptyset$ then the node is a leaf of the tree. The enumerate of the division is exponential in the number of the annotate arguments, while we often get away with only some branch of the tree.

First, we define the node in the tree. We denote them as W -candidates. For a given set $A \subseteq W$, we define

$$A^+ = \{\beta: \Phi_j \in W | \forall (\alpha: \Phi_i) \in A, (\alpha: \Phi_i, \beta: \Phi_j) \in \mathcal{R}\}$$

$$A^- = \{\beta: \Phi_j \in W | \forall (\alpha: \Phi_i) \in A, (\beta: \Phi_j, \alpha: \Phi_i) \in \mathcal{R}\}$$

A^+ is the set of annotate arguments that attacked by the annotate arguments in A , and A^- is the set of annotate arguments that attack the annotate arguments in A . If $A^- \subseteq A^+$, then A defends itself. A W -candidates is the triple (I, O, U) satisfies $I^+ \subseteq O$, $I^- \subseteq O$.

It follows that for any candidates $\mathcal{C} = (I, O, U)$, I is conflict-free. And we have to check that I can defends itself, i.e. I is admissible. We denote by $pref(\mathcal{C})$ the set of all preferred extensions E_{pr} , where $I \subseteq E_{pr} \subseteq I \cup U$. Because the annotate arguments in the same group of GAF would not attack each other, we need to consider the attack from other groups. Now we give the following property, it's the maximal condition: If I is a maximal admissible set if and only if every subset X of U , $I \cup X$ is not admissible.

$$Max(I, O, U, \mathcal{R}) = \forall X \subseteq O, X = \emptyset \vee X^- \not\subseteq (I \cup U \cup X)^+$$

Proposition 4. Let GAF be a group-based argumentation framework and $\mathcal{C} = (I, O, U)$ be a W -candidates with $U = \emptyset$. If $I^- \subseteq I^+$, and $Max(I, O - (I^+ \cup I^-), \emptyset, \mathcal{R})$ holds, then $pref(\mathcal{C}) = \{I\}$, otherwise $\emptyset$.

Proof. According to $\mathcal{C} = (I, O, \emptyset)$ be a W -candidates, there have not any annotate arguments to add to I . And I defends itself, far more, I is the maximal admissible set. So I is the preferred extension of GAF. $\square$

Example 2. (Continuation of Example 1) The GAF in the example 1, we have several candidates are $(\emptyset, W, \emptyset)$, $(\{\alpha_1: \Phi_1\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2\}, \{\gamma_1: \Phi_3, \gamma_2: \Phi_3, \xi_1: \Phi_4, \xi_2: \Phi_4, \psi_1: \Phi_5, \psi_2: \Phi_5\})$, $(\{\alpha_1: \Phi_1, \gamma_1: \Phi_3, \psi_1: \Phi_5\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2, \xi_1: \Phi_4, \xi_2: \Phi_4\}, \{\gamma_2: \Phi_3, \psi_2: \Phi_5\})$.

Given a candidate $\mathcal{C} = (I, O, U)$ and an annotate arguments $\alpha: \Phi_i \in U$, define triples

$$\mathcal{C} - \{\alpha: \Phi_i\} = (I, O \cup \{\alpha: \Phi_i\}, U - \{\alpha: \Phi_i\})$$

and

$$\mathcal{C} + \{\alpha: \Phi_i\} = (I \cup \{\alpha: \Phi_i\}, O \cup \{\alpha: \Phi_i\}^+ \cup \{\alpha: \Phi_i\}^-, U - (\{\alpha: \Phi_i\} \cup \{\alpha: \Phi_i\}^+ \cup \{\alpha: \Phi_i\}^-))$$

where

$$\{\alpha: \Phi_i\}^- = \{\beta: \Phi_j \in U | (\beta: \Phi_j, \alpha: \Phi_i) \in \mathcal{R}\}, \text{ and}$$

$$\{\alpha: \Phi_i\}^+ = \{\beta: \Phi_j \in U | (\alpha: \Phi_i, \beta: \Phi_j) \in \mathcal{R}\}$$

Example 3. (Continuation of Example 2) The GAF in the example 2, we add an annotate arguments $\gamma_2: \Phi_3$ to the candidate $\mathcal{C}_1 = (\{\alpha_1: \Phi_1\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2\}, \{\gamma_1: \Phi_3, \gamma_2: \Phi_3, \xi_1: \Phi_4, \xi_2: \Phi_4, \psi_1: \Phi_5, \psi_2: \Phi_5\})$, then we have

$$\{\gamma_2: \Phi_3\}^- = \{\beta_2: \Phi_2, \xi_1: \Phi_4, \psi_2: \Phi_5\}$$

$$\{\gamma_2: \Phi_3\}^+ = \{\xi_2: \Phi_4\}$$

so

$$\begin{aligned} \mathcal{C}_1 + \{\gamma_2: \Phi_3\} \\ = (\{\alpha_1: \Phi_1, \gamma_2: \Phi_3\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2, \xi_1: \Phi_4, \psi_2: \Phi_5, \xi_2: \Phi_4\}, \{\gamma_1: \Phi_3, \psi_1: \Phi_5\}) \end{aligned}$$

It is obvious to see that not all triples $\mathcal{C} + \{\alpha: \Phi_i\}$ or $\mathcal{C} - \{\alpha: \Phi_i\}$ is a candidate.

Proposition 5. Let GAF be a group-based argumentation framework, $\mathcal{C} = (I, O, U)$ be a W -candidates, and $\alpha: \Phi_i \in U$, then $\text{pref}(\mathcal{C}) = \text{pref}(\mathcal{C} - \{\alpha: \Phi_i\}) \cup \text{pref}(\mathcal{C} + \{\alpha: \Phi_i\})$.

Proof. It is obvious that $\text{pref}(\mathcal{C} - \{\alpha: \Phi_i\}) \cup \text{pref}(\mathcal{C} + \{\alpha: \Phi_i\}) \subseteq \text{pref}(\mathcal{C})$, we need to proof that $\text{pref}(\mathcal{C}) \subseteq \text{pref}(\mathcal{C} - \{\alpha: \Phi_i\}) \cup \text{pref}(\mathcal{C} + \{\alpha: \Phi_i\})$.

Let $S \in \text{pref}(\mathcal{C})$, then $I \subseteq S \subseteq (I \cup U)$. On the one hand, if $\alpha: \Phi_i \notin S$, it follows that $S \subseteq I \cup (U - \{\alpha: \Phi_i\})$, then hence that $S \in \text{pref}(\mathcal{C} - \{\alpha: \Phi_i\})$. On the other hand, if $\alpha: \Phi_i \in S$, then $I \cup \{\alpha: \Phi_i\} \subseteq S$. We need to show that $S \subseteq I \cup \{\alpha: \Phi_i\}$, let $\mathcal{C}' = (\mathcal{C} + \{\alpha: \Phi_i\}) = (I', O', U')$, we have $S \subseteq I' \cup U'$, so $S \subseteq (I \cup \{\alpha: \Phi_i\}) \cup U'$, the results followed. $\square$

Now we will show how to compute the $\mathcal{A}_{pr}$ and Win_{pr} . Let $\text{pref}(\mathcal{C}) = \{\mathcal{E}_1, \dots, \mathcal{E}_n\}$, where $\mathcal{E}_i = \{w_{\alpha_{i1}}, \dots, w_{\alpha_{ik_i}}\}$. Then $\mathcal{A}_{pr} = \bigcap_{i=1}^n \mathcal{E}_i$. The function to select $\mathcal{A}_{pr}$ is the following:

Algorithm 1. Select- $\mathcal{A}_{pr}(\text{pref}(\mathcal{C}))$

Input: $\text{pref}(\mathcal{C}) = \{\mathcal{E}_1, \dots, \mathcal{E}_n\}$, $\mathcal{E}_i = \{w_{\alpha_{i1}}, \dots, w_{\alpha_{ik_i}}\}$

Output: $\mathcal{A}_{pr}$

$v(w_{\alpha_i}) \leftarrow 0$, for every annotate arguments in W

for $i = 1$ to n

for $j = 1$ to k_i

if $\mathcal{E}_i$ contains $w_{\alpha_{ij}}$, then $v(w_{\alpha_{ij}}) \leftarrow v(w_{\alpha_{ij}}) + 1$

end for

end for

return $\{w_{\alpha_{ik_i}} | w_{\alpha_{ik_i}} = n\}$

The idea of the above algorithm is through labelled the annotate arguments which exist in the preferred extension to achieve $\mathcal{A}_{pr}$. Based on this work, we will search the set $\mathcal{A}_{pr}$ to count Φ_i which appears most in $\mathcal{A}_{pr}$, that is the Win_{pr} .

4.2 Pruning of the Tree

In this section, we study properties that can be applied to prune the binary tree.

Proposition 6. Let GAF be a group-based argumentation framework and $\mathcal{C} = (I, O, U)$ be a W -candidates. If $I \cup U \subseteq S$, for some admissible set S , then $\text{pref}(\mathcal{C}) = \emptyset$.

Proof. Obvious. $\square$

One condition of preferred extension is that the set I has to defend itself, i.e. if I is admissible of GAF, then I has to satisfies $I^{\leftarrow} \subseteq I^{\rightarrow}$.

Proposition 7. Let GAF be a group-based argumentation framework and $\mathcal{C} = (I, O, U)$ be a W -candidates.

- If there exists an annotate argument $w_{\alpha} \in I^{\leftarrow} - I^{\rightarrow}$, then $\text{pref}(\mathcal{C}) = \emptyset$.
- If $I^{\leftarrow} \subseteq I^{\rightarrow}$ then $\text{pref}(\mathcal{C}) \neq \emptyset$ and I is admissible.

Proof.

- Assume otherwise, and $\mathcal{E} \in \text{pref}(\mathcal{C})$. As $w_{\alpha} \in I^{\leftarrow} - I^{\rightarrow}$, it follows that there has an annotate argument $w_{\beta} \in I \subseteq \mathcal{E}$ and w_{α} attacks w_{β} . Furthermore, as $\mathcal{E}$ is a preferred extension, it

is an admissible set, and thus there has an annotate argument $w_{\gamma} \in I$ attacks w_{α} , which is contradict to $w_{\alpha} \notin I^{\rightarrow}$.

- Obvious. $\square$

The attack relations in GAF would not exist between the annotate argument which on the same group, so if I consists of the annotate argument which all in group Φ_i and an annotate argument $\alpha: \Phi_i \in W - I$ is acceptable w.r.t I , then $I \cup \{\alpha: \Phi_i\}$ is also admissible.

Proposition 8. Let GAF be a group-based argumentation framework and $\mathcal{C} = (I, O, U)$ a W -candidates, and I concludes several annotate arguments from group Φ_i . If annotate argument $\alpha: \Phi_i \in W - I$ satisfies $I \cup \{\alpha: \Phi_i\}^{\leftarrow} \subseteq I \cup \{\alpha: \Phi_i\}^{\rightarrow}$, then $\mathcal{C}' = (\mathcal{C} + \{\alpha: \Phi_i\})$ is a W -candidates.

Proof. As $\alpha: \Phi_i$ satisfies $I \cup \{\alpha: \Phi_i\}^{\leftarrow} \subseteq I \cup \{\alpha: \Phi_i\}^{\rightarrow}$, it follows that for all $\beta: \Phi_j \in W - (I \cup \{\alpha: \Phi_i\})$, if $\beta: \Phi_j$ attacks $\alpha: \Phi_i$, then there exists an annotate argument $\gamma: \Phi_k \in I \cup \{\alpha: \Phi_i\}$ and $\gamma: \Phi_k$ attacks $\beta: \Phi_j$, in other words, $\alpha: \Phi_i$ is acceptable w.r.t $I \cup \{\alpha: \Phi_i\}$. Far more, $\mathcal{C} + \{\alpha: \Phi_i\} = (I \cup \{\alpha: \Phi_i\}, O \cup \{\alpha: \Phi_i\}^{\leftarrow} \cup \{\alpha: \Phi_i\}^{\rightarrow}, U - (\{\alpha: \Phi_i\} \cup \{\alpha: \Phi_i\}^{\leftarrow} \cup \{\alpha: \Phi_i\}^{\rightarrow}))$, so $\mathcal{C}' = (\mathcal{C} + \{\alpha: \Phi_i\})$ is a W -candidates. $\square$

Example 4. (Continuation of Example 1) We consider the GAF in the example 1. There are no annotate arguments attacks $\alpha_1: \Phi_1$ and $\psi_1: \Phi_5$, it is clear that they belong to the preferred extension. We therefore consider the W -candidates $\mathcal{C}$ - tree with the root $\mathcal{C}$ where $I = \{\alpha_1: \Phi_1, \psi_1: \Phi_5\}$, $O = \{\beta_1: \Phi_2, \beta_2: \Phi_2, \xi_2: \Phi_4\}$, $U = \{\gamma_1: \Phi_3, \gamma_2: \Phi_3, \xi_1: \Phi_4, \psi_2: \Phi_5\}$. We consider the annotate arguments in U with the order $\gamma_2: \Phi_3, \psi_2: \Phi_5, \gamma_1: \Phi_3, \xi_1: \Phi_4$, and construct the tree in figure 2 in the following:

Figure 2.

Firstly, we consider $\mathcal{C}'_1 = \mathcal{C} + \{\gamma_2: \Phi_3\}$, then $\mathcal{C}'_1 = (\{\alpha_1: \Phi_1, \psi_1: \Phi_5, \gamma_2: \Phi_3\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2, \xi_2: \Phi_4, \xi_1: \Phi_4, \psi_2: \Phi_5\}, \{\gamma_1: \Phi_3\})$, then $I_{\mathcal{C}'_1}$ satisfies the first case of proposition 7, so the sub-tree rooted at $\mathcal{C}'_1$ has no preferred extension. We next consider $\mathcal{C}'_2 = \mathcal{C} - \{\gamma_2: \Phi_3\}$, then $\mathcal{C}'_2 = (\{\alpha_1: \Phi_1, \psi_1: \Phi_5\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2, \xi_2: \Phi_4, \gamma_2: \Phi_3\}, \{\gamma_1: \Phi_3, \xi_1: \Phi_4, \psi_2: \Phi_5\})$, it is easy to see that $\mathcal{C}'_2$ contains an admissible set $\{\alpha_1: \Phi_1, \psi_1: \Phi_5\}$.

Secondly, we consider $\mathcal{C}''_1 = \mathcal{C}'_2 + \{\psi_2: \Phi_5\}$, then $\mathcal{C}''_1 = (\{\alpha_1: \Phi_1, \psi_1: \Phi_5, \psi_2: \Phi_5\}, \{\beta_1: \Phi_2, \beta_2: \Phi_2, \xi_2: \Phi_4, \gamma_2: \Phi_3\}, \{\gamma_1: \Phi_3, \xi_1: \Phi_4\})$, it is easy to see that $\mathcal{C}''_1$ contains an admissible set $\{\alpha_1: \Phi_1,$

$\psi_1:\Phi_5, \psi_2:\Phi_5\}$. Now we consider $\mathcal{C}_2'' = \mathcal{C}_2' - \{\psi_2:\Phi_5\}$, then $\mathcal{C}_2'' = \{\alpha_1:\Phi_1, \psi_1:\Phi_5, \{\beta_1:\Phi_2, \beta_2:\Phi_2, \xi_2:\Phi_4, \gamma_2:\Phi_3, \psi_2:\Phi_5\}, \{\gamma_1:\Phi_3, \xi_1:\Phi_4\}\}$, this contradict to the condition of $Max(I, O, U, \mathcal{R})$, so it will not to be the maximal admissible set.

Thirdly, we consider $\mathcal{C}_1''' = \mathcal{C}_1'' + \{\xi_1:\Phi_4\}$, then

$\mathcal{C}_1''' = \{\alpha_1:\Phi_1, \psi_1:\Phi_5, \psi_2:\Phi_5, \xi_1:\Phi_4, \{\beta_1:\Phi_2, \beta_2:\Phi_2, \xi_2:\Phi_4, \gamma_2:\Phi_3, \gamma_1:\Phi_3\}, \emptyset\}$, now I is an admissible and $U = \emptyset$, so $\{\alpha_1:\Phi_1, \psi_1:\Phi_5, \psi_2:\Phi_5, \xi_1:\Phi_4\}$ is a preferred extension. Next, we consider $\mathcal{C}_2''' = \mathcal{C}_1''' - \{\xi_1:\Phi_4\}$, then $\mathcal{C}_2''' = \{\alpha_1:\Phi_1, \psi_1:\Phi_5, \psi_2:\Phi_5, \{\beta_1:\Phi_2, \beta_2:\Phi_2, \xi_2:\Phi_4, \gamma_2:\Phi_3, \xi_1:\Phi_4\}, \{\gamma_1:\Phi_3\}\}$, then we next get that $\mathcal{C}_2''' + \{\gamma_1:\Phi_3\}$ contains a preferred extension.

Lastly, we can get that $\mathcal{A}_{pr} = \{\alpha_1:\Phi_1, \psi_1:\Phi_5, \psi_2:\Phi_5\}$, so the $Win_{pr} = \{\Phi_5\}$.

5. RELATED WORKS

In recent years, many works are proposed to develop and enhance the abstract argumentation framework, including various extend frameworks and the computation of extensions. However, there has not clear work to study the attack relation among sets of arguments. In this paper, we propose a group-based argumentation framework to cope with attack relation among the sets of arguments, and a method to describe the computation questions for group-based argumentation frameworks.

In [16,17], Nielsen and Parsons proposed the concept of the set of arguments attacks an argument and gave an approach to computing the preferred extension. A set of arguments B attacks an argument A if there is a set $B' \subseteq B$ and B' attacks A . However, they had not noticed that the arguments in the set may have the same standpoint, so they just used the sets of arguments but not considered the inherent relations of sets of arguments. Far more, the attack relation can not be represented by a graph. As a comparison, our framework describe the standpoints of groups and formalize the attack relations.

The literature [18], A.Bochman used the abstract argumentation theory to build the semantics of disjunctive arguments attack through a four-valued logic and allowed finite sets of arguments(contains empty set) attacks or attacked by argument. He was concentrated on the study of semantics but not the abstract argumentation theory with the attack relation among the sets of arguments. Even though the literature [16] and [18] had different motivations, they had the same idea in coping with the attack relation among the sets of arguments and had not noticed and solved the counter intuition results in abstract argumentation frameworks.

In [19], P.Baroni et al provided a solution satisfied the same rationality postulates as $ASPIC^+$ and based on the closure of the contrariness relation at the abstract representation of conflicts between sets of arguments to preserving the same level of generality. In [20], N.Oren et al presented a semantics for evidence-based argumentation to describe the attack relations between the sets of arguments and a peculiar argument. In [21], Gabbay analyzed the attack relations among sets of arguments and a single argument through nested the network and three labelled (in, out, undecided). However, they all had not noticed the relations of the arguments in attack or attacked set. In

our work, we consider the the attack relations between the sets of arguments which concentrate on the arguments have the same viewpoint.

In [3], F.Cerutti and P.E.Dunne et al presented a SAT-based approach to computing preferred extensions in abstract argumentation, they were proposed a SAT encoding which is based on the label-based argumentation to reduce the problem of computing question and used a depth-first search method to derive preferred extensions.

6. CONCLUSIONS

We propose a new argumentation framework to deals with the attack relations among sets of arguments, give the semantics and properties, present an approach for enumerating the preferred extension for the framework, and give an algorithm to achieve the winner under preferred semantics. In our framework, the arguments from one agent or different agents in the same group does not exist attack relations, and different agents with the same standpoint can belong to one group and attack other groups with different standpoints. We proof that the framework has good properties similar to abstract framework. The approach of computation is through construct a binary tree to exhibit the preferred extension, the node of the tree is a partition of the set of annotate arguments. This method has presented lots of optimization rules which help to reduce the running time of implementations.

7. ACKNOWLEDGMENTS

This work is supported by the National Natural Science Foundation of China under number 61672049 and the Ph.D Programs of the Ministry of Education of China.

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