Towards Realisability of Rankings-based Semantics*

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In recent years, *abstract argumentation frameworks* (AF) [4] have gathered research interest as a model for argumentative reasoning. They are a model for rational decision-making in presence of conflicting information. *Arguments* and *attacks* are represented as nodes and edges, respectively, of a directed graph, i.e. an argument a *attacking* argument b is represented as a directed edge from a to b. In a scenario of strategic argumentation, an agent wants to persuade an opponent. One way to find a persuasion strategy is by considering the strength of each argument, since stronger arguments have a higher chance to persuade the opponent. Hence, *ranked-based semantics* were introduced (see [3, 1] for an overview). These functions define a preorder based on the acceptability degree of each argument s.t. we can state that an argument a is "stronger" than an argument b.

Consider a scenario where an agent observes other agents discussing. Based on this observation she prepares arguments and a strength assessment of each argument. However, the agent has no knowledge about the underlying AF. So, the underlying AF has to be established first.

In this work, we discuss the question whether there exists an AF with the observed strength assessment. So, for a given ranking-based semantics ρ and a preorder r can we find an AF, which exactly has r as its ranking when applying ρ? This problem is known as *realisability* and was already investigated for *extension semantics*, which specify when a set of arguments is considered jointly acceptable. Dunne et.al. [5] have shown that there are sets of arguments for which we cannot find an AF s.t. these sets are considered jointly acceptable.

Example 1. Assume the ranking $a \succ b \succ c \succ d$ and the ranking-based semantics *Categoriser* defined by [2]. So, a is preferred over b, b over c, and d is the weakest argument. The Categoriser semantics is defined via a ranking $\succeq^{Cat}$ on A s.t. for $a, b \in A$, $a \succeq^{Cat} b$ holds iff $Cat(a) \geq Cat(b)$, and $Cat : A \to]0, 1]$ is defined with $Cat(a) = \frac{1}{1+\sum_{b \in a^-} Cat(b)}$. Where A is the set of arguments, R the set of attacks between two arguments, and a^- the set of arguments attacking a. We want to find an AF s.t. the Categoriser semantics returns $a \succ b \succ c \succ d$ as the corresponding ranking. One such an AF would be $AF_r = \{\{a, b, c, d\}, \{(a, b), (a, c), (a, d), (d, b), (d, c), (b, c)\}\}$ as depicted in Figure 1.

* The research reported here was supported by the Deutsche Forschungsgemeinschaft under grant 423456621.

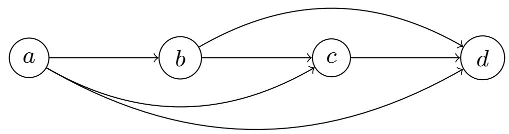

Fig. 1. AF_r constructed in Example 1.

In Example 1, we have seen that, we can find an AF for a given ranking based on the Categoriser semantics. Now, we can ask whether it is always possible to find such an AF. Formally, for a given ranking r, can we find an AF s.t. this AF has r as its corresponding ranking, when applying the Categoriser semantics? Indeed, it is possible, consider the following construction: Given a ranking r based on the Categoriser semantics, we construct an $AF_r = (A, R)$ in the following way: Every argument a appearing in r is part of A; If $a \succ^{Cat} b$, then $(a, b) \in R$. So, if an argument a is ranked better than argument b, then a attacks b. An example use of the construction can be found in Example 1. We can show that the Categoriser semantics applied to AF_r will always return r. Therefore, for every ranking based on the Categoriser semantics we can find an AF.

What does these results mean for our agent? If she uses the Categoriser semantics as her reasoning formalism, then she can always find an AF with her strength assessment. We can construct other AFs with the same ranking based on the Categoriser semantics. Based on this observation we can define an *equivalence* notion. Two AFs are *ρ-equivalent* iff applying ρ returns the same ranking for both AFs.

References

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