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An approach to abstract argumentation with recursive attack and support ☆

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ABSTRACT

This work introduces the *Attack–Support Argumentation Framework (ASAF)*, an approach to abstract argumentation that allows for the representation and combination of attack and support relations. This framework extends the Argumentation Framework with Recursive Attacks (AFRA) in two ways. Firstly, it adds a *support relation* enabling to express support for arguments; this support can also be given to attacks, and to the support relation itself. Secondly, it extends AFRA's attack relation by allowing attacks to the aforementioned support relation. Moreover, since the support relation of the ASAF has a necessity interpretation, the ASAF also extends the Argumentation Framework with Necessities (AFN). Thus, the ASAF provides a unified framework for representing attack and support for arguments, as well as attack and support for the attack and support relations at any level.

1. Introduction

Argumentation is an attractive and effective paradigm for conceptualizing common-sense reasoning [6,8,29]. Briefly, argumentation is a form of reasoning where a piece of information (*claim*) is accepted or rejected after considering the reasons (*arguments*) for and against that acceptance providing a reasoning mechanism capable of handling contradictory, incomplete and/or uncertain information. Several approaches were proposed to model argumentation: on an abstract basis [20], using classical logics [7], or using logic programming [22]. Additionally, the argumentation process has been employed in various applications and domains such as decision making and negotiation [3,9], and multi-agent systems [28,2].

☆ This article is an extended version of [18].

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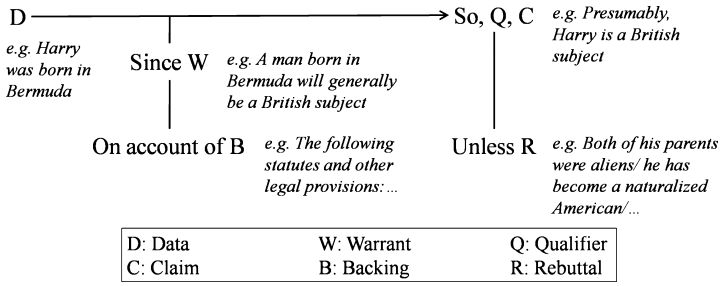

Fig. 1. Toulmin's scheme for the layout of arguments, including the famous "*Harry is a British subject*" example [30].

One of the reasons that argumentation is so useful is that it can handle conflicts due to inconsistent information, and inconsistency naturally arises in multi-agent systems since, among other reasons, different agents represent different views of the world [11]. Such conflicts are captured with the notion of *attack* between arguments. On the other hand, we can also identify situations where there exists a positive interaction between arguments, that is, situations in which arguments *support* each other.

The notion of support has been present in the literature of argumentation since its foundation. In [30] Toulmin proposed a model for the layout of arguments, shown in Fig. 1, that distinguishes between data, claim, warrant, backing, rebuttal and qualifier. Given Toulmin's scheme, we can identify two kinds of interactions among its elements. First, in addition to the data supporting the claim, the backing provides support for the warrant. Second, the presence of a rebuttal leads to the rejection of the claim through an attack on the argument.

Following the seminal work by Dung [20] later studies on argumentation put aside the notion of support to focus on the notion of attack. Several extensions of Dung's frameworks were proposed over the years, including the consideration of attacks to the attack relation [24,4,5]. Notwithstanding this, in the last decade, the study of the notion of support regained attention among the researchers. Several approaches were proposed, where different interpretations for the notion of support are considered [19]. The Bipolar Argumentation Frameworks [1,16] were the first to extend Dung's work by incorporating a general support relation between arguments. Then, other interpretations of support such as evidential support [27], deductive support [10,32] necessary support [25,26,12] and a backing relation [17] were addressed by different argumentation formalisms.

This substantial body of research shows that having attack and support relations between arguments is relevant; furthermore, adding attacks to attacks has also been proved useful, for instance, to express preferences over conflicting arguments [24,4,5]. On the other hand, as shown in [10,32], allowing attacks to the support relation gives the possibility of overriding the acceptability constraints imposed by the support relation.

In this work we will introduce the Attack–Support Argumentation Framework (ASAF), an abstract argumentation framework considering recursive attack and support between arguments, as well as the combination of the attack and support relations. Thus, we propose a novel unified framework for representing attack and support for arguments, as well as attack and support for the attack and support relations at any level. We will use a necessity interpretation of support [25,26,12] which, as will become clearer in the following sections, allows to capture the intuitions behind the combination of the attack and support relations.

Briefly, according to [25,26,12], the necessity interpretation of support establishes that if $\mathcal{A}$ is *necessary* for $\mathcal{B}$ then: if $\mathcal{B}$ is accepted, then $\mathcal{A}$ is also accepted; and if $\mathcal{A}$ is not accepted, then $\mathcal{B}$ is not accepted either. Taking this into account, by having an argument supporting an attack (respectively, a support), the supporting argument will provide conditions under which the attack (respectively, the support) makes sense. Similarly, by having an argument that attacks an attack (respectively, a support), the attacking argument