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A characterization of types of support between structured arguments and their relationship with support in abstract argumentation

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ABSTRACT

Argumentation is an important approach in artificial intelligence and multiagent systems, providing a basis for single agents to make rational decisions, and for groups of agents to reach agreements, as well as a mechanism to underpin a wide range of agent interactions. In such work, a crucial role is played by the notion of *attack* between arguments, and the notion of attack is well-studied. There is, for example, a range of different approaches to identifying which of a set of arguments should be accepted given the attacks between them. Less well studied is the notion of *support* between arguments, yet the idea that one argument may support another is very intuitive and seems particularly relevant in the area of decision-making where decision options may have multiple arguments for and against them. In the last decade, the study of support in argumentation has regained attention among researchers, but most approaches address support in the context of abstract argumentation where the elements from which arguments are composed are ignored. In contrast, this paper studies the notion of support between arguments in the context of structured argumentation systems where the elements from which arguments are composed play a crucial role. Different forms of support are presented, each of which takes into account the structure of arguments; and the relationships between these forms of support are studied. Then, the paper investigates whether there is a correspondence between the structured and abstract forms of support, and determines whether the abstract formalisms may be instantiated using concrete forms of support in terms of structured arguments. The conclusion is that support in structured argumentation does not mesh well with support in abstract argumentation, and this suggests that more work is required to develop forms of support in abstract argumentation that model what happens in structured argumentation.

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1. Introduction

Argumentation is an important approach in artificial intelligence and multiagent systems. It provides a mechanism for single agents to make rational decisions [29], and for groups of agents to reach agreements [31], as well as a mechanism to underpin a wide range of agent interactions [35]. One of the reasons why argumentation is so useful is that it can handle conflicts due to inconsistent information — inconsistency naturally arises in multiagent systems since, for example, different agents represent different views of the world [7]. Such conflicts are captured with the notion of "attack" between arguments, and the argumentation literature includes a number of approaches to identifying which of a set of arguments should be considered to be "acceptable" given the attacks amongst them [14,25]. The differences between these approaches can be explained in terms of theoretical considerations about what constitutes a good notion of acceptability. While the representational advantages of argumentation have been discussed for many years [25,40], recent work has backed this up with strong empirical results which show that argumentation-based approaches can lead to higher quality solutions, for example: [1,27,30,52].

Our interest in argumentation in this paper is a little different. Following the tradition of systems like Capsule [64] and RAGS [24], we are using argumentation to support human decision making under uncertainty. In particular, we are using argumentation to build tools for combining information from sources that are not fully trusted and to tag conclusions with an indication of the trust that can be placed in them [41,42,53]. In work such as [24,64], we find that in assessing the available evidence, human subjects not only identify conflicts between arguments, but also they identify situations in which arguments *support* each other. To take account of such arguments, we need to understand support as well as attack between arguments.

In this paper, we are interested in studying the notion of support, starting with the idea that it is a positive interaction between arguments that does not depend on the existence of attacks between them. The notion of support has been present in the literature of argumentation since its foundation. In [55], Toulmin proposed a model for the structure of arguments that distinguishes between data, claim, warrant, backing, rebuttal and qualifier. Given Toulmin's scheme, we can identify two kinds of interactions among its elements. On the one hand, the backing provides support for the warrant. On the other hand, the presence of a rebuttal leads to the rejection of the claim through an attack on the argument. The influential work of Pollock, advanced in [45–47] and presented at full length in [44], which had a large impact on early work on computational argumentation, also deals with support at length. However, following the work by Dung [25], most studies on argumentation put aside the notion of support to focus on the notion of attack. Given an attack relation, a positive interaction between arguments was identified through the notion of *reinstatement*, corresponding to situations in which an argument defends another one. However, the notion of reinstatement is not, in our view, a form of support on its own, since it depends on the existence of attacks between arguments. In contrast, in the last decade, the study of a notion of support that does not rely on the existence of attacks has regained attention amongst researchers of the area. Recently, several interpretations of support have been proposed in the literature, the most widely used being the general support relation of [15], the deductive support of [6] and the necessary support of [8,38].

Most work on support in argumentation, much of which is surveyed in [23], has been developed at the abstract level. That is, it does not consider the internal structure of arguments. However, there is other work that addresses support in a more concrete setting. In particular, DEFLOG [58] constitutes an approach to dialectical argumentation that allows for the representation of the elements in Toulmin's scheme, as well as the support links between them [59,61]. In addition, the formalism proposed in [20] introduces a special kind of rule to represent the support relation between backings and warrants of Toulmin's scheme in the context of Defeasible Logic Programming.

It is important to note that the existing abstract argumentation formalisms addressing the notion of support do not deal with the origin of such a relation.[1] That is, they start with a given set of arguments and the corresponding attack and support relations between them and then, generally, focus on the acceptability of the given arguments by taking into account the relationships between them. As a result, they do not study the origin of the support links between the arguments. Indeed, as mentioned before, these formalisms typically just adopt an interpretation for the support relation. Then, given a particular interpretation, they characterize constraints on acceptability that are derived from it, and then take them into account by defining *complex attacks* between arguments [18,19]. These complex attacks then make it possible to obtain sets of acceptable arguments that meet the constraints.

Here, we are interested in studying how the support links between arguments originate. To do that, we need to take into account the information expressed by the arguments and/or their internal structure. As a result, we will study the notion of support in the context of a concrete argumentation formalism, and we choose to use ASPIC$^+$[36,49], which is both widely studied and, in our opinion, steers a suitable course between concreteness (which allows us to pin down what support means) and abstraction (which allows results to be imported by any instantiation). There are several kinds of support that can be identified in a concrete setting. For instance, following the general interpretation of support by [15], where the support relation is just considered as a positive interaction between arguments, one might consider different situations in which an argument supports another because they share some positive features. For instance, we can consider that an

[1] This is in contrast to the notion of attack, which has long been given an interpretation in terms of conflicts between arguments [2,5,28,49,51].