

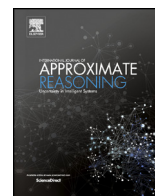


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## Argumentation update in YALLA (Yet Another Logic Language for Argumentation)



Florence Dupin de Saint-Cyr<sup>a</sup>, Pierre Bisquert<sup>b</sup>, Claudette Cayrol<sup>a</sup>,  
Marie-Christine Lagasquie-Schiex<sup>a,\*</sup>

<sup>a</sup> IRIT, Université Paul Sabatier, 31062 Toulouse Cedex 9, France

<sup>b</sup> IATE, INRA, 34060 Montpellier Cedex 2, France

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## ABSTRACT

This article proposes a complete framework for handling the dynamics of an abstract argumentation system. This frame can encompass several belief bases under the form of several argumentation systems, more precisely it is possible to express and study how an agent who has her own argumentation system can interact on a target argumentation system (that may represent a state of knowledge at a given stage of a debate). The two argumentation systems are defined inside a reference argumentation system called the universe which constitutes a kind of “common language”. This paper establishes three main results. First, we show that change in argumentation in such a framework can be seen as a particular case of belief update. Second, we have introduced a new logical language called YALLA in which the structure of an argumentation system can be encoded, enabling to express all the basic notions of argumentation theory (defense, conflict-freeness, extensions) by formulae of YALLA. Third, due to previous works about dynamics in argumentation we have been in position to provide a set of new properties that are specific for argumentation update.

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### 1. Introduction

Argumentation is commonly used in everyday life where we share and confront our opinions. We use arguments to sustain an idea, we use counter-arguments in order to attack another idea. Argumentation can be viewed as a process done in order to exchange information together with some justification with the aim to obtain well-justified knowledge, or with the aim to increase or decrease the approval of a point of view, or to confront and combine different views. When several people are sharing arguments the argumentation is pervaded by changes. Those changes may concern the public state of a debate or the agent's representation of the world. Each time an argument is uttered, the listener might change her view of the world. This is why it is important to analyze the link between argumentation and change. Let us notice that argumentation does not necessarily require an audience, since it can be done by only one agent (and in that case it is well adapted for reasoning and decision making).

In artificial intelligence, argumentation has been defined for formalizing argumentative reasoning and in order to automatize some forms of dialog (identified in [55]). As done in many other approaches we place ourselves in the framework of

\* Corresponding author.

E-mail addresses: [bannay@irit.fr](mailto:bannay@irit.fr) (F. Dupin de Saint-Cyr), [pierre.bisquert@supagro.inra.fr](mailto:pierre.bisquert@supagro.inra.fr) (P. Bisquert), [ccayrol@irit.fr](mailto:ccayrol@irit.fr) (C. Cayrol), [lagasq@irit.fr](mailto:lagasq@irit.fr) (M.-C. Lagasquie-Schiex).

abstract argumentation theory (where arguments are not precisely defined; see [31]) which handles *argumentation systems* that are graphs whose vertices are arguments and edges are attacks between those arguments. More generally, argumentation theory aims at computing the acceptability of arguments [31,11,2]. A natural development of this theory is called *enforcement* [8] and consists in finding a set of arguments to add to an argumentation system in order to make accepted a particular set of arguments.

For instance, let us consider the argumentation system containing only the two arguments “ $a_0$ : Mr. X is innocent of the murder of Mrs. X” and “ $a_1$ : Mr. X is guilty of the murder of Mrs. X”.<sup>1</sup> These arguments cannot be accepted together since they are mutually exclusive, and it is difficult to decide which argument should be accepted. To enforce  $a_0$  to be accepted it is possible to add Argument “ $a_4$ : Mr. X loves his wife, a man that loves his wife cannot murder her” which depreciates  $a_1$  and leads to accept  $\{a_0, a_4\}$ .

In this paper we want to propose a framework that generalizes this type of example (change in argumentation) and allows us to reason about this change. In such a framework, it will be possible to describe several argumentation systems (e.g. for representing an agent’s mind or the current state of a dialog), to express their properties (for instance their structure, their sets of acceptable arguments), and to reason about their evolution. Our approach uses notions of belief change theory and is justified by the following remarks.

**Dynamics of argumentation covers more than enforcement.** In the literature, enforcement is classically considered as typical of a subfield called “dynamics in argumentation” which has already been studied broadly (e.g. [50,43,14,25]). Nevertheless, the topic of “dynamics in argumentation” is more general than enforcement since it aims at *reasoning about change* in an argumentation system. For instance some underlying questions can be “In what extent the arrival of an argument modifies the accepted arguments?”, “What is the impact of a change in an argumentation system?”, “Which change is desirable and why?”.

Moreover, the notion of enforcement can also be generalized in order to consider removal of arguments [12,13] and addition/removal of attacks [25,59] and not only addition of arguments.

This is why our framework enables us to study *generalized enforcement* operators and their associated change properties.

**Links with planning.** From the point of view of an agent that aims at enforcing the acceptance of a set of arguments, Mr. X’s example is a one-step planning problem. Indeed, planning (see e.g. [33]) aims at building a strategy (sequence of actions) to perform in order to solve a task and so it can be used for handling change in artificial intelligence. In enforcement, the problem is to find only one action that leads to satisfy the goal to make accepted a given set of arguments.

**Links with persuasion.** Studying if a listener has been persuaded by a change is a natural application of dynamics in argumentation. Indeed, the persuasion process studied in the literature is a particular planning process which consists in uttering some arguments (hence producing some actions) in order to justify a fact or a decision [19,38,32,4] (i.e. to achieve some enforcements).<sup>2</sup> Usually a persuasion dialog involves several agents that have opposite views on a subject and that aim at persuading each other to change their opinion. It is possible to distinguish two kinds of persuasion settings depending on the outcome evaluation: either one agent has changed her opinion, we call it “private persuasion”, or it is publicly proven that the opinion of one agent is not acceptable, called “public persuasion”.<sup>3</sup> In this paper, we situate ourselves in a context where an agent wants to reason about the changes that occur on a target argumentation system that represents the current state of the dialog.

Clearly, our framework is related to *planning* and *persuasion*.

**Incomplete knowledge and restrictions on operations.** Public persuasion implies the existence of several agents. In this paper we consider that the agents may have (1) an incomplete knowledge and (2) that their actions are restricted with regard to their available knowledge.

For instance, suppose that the two arguments  $a_0$  and  $a_1$  have been uttered during a trial. The possibility that  $a_0$  is accepted publicly after the lawyer intervention depends on her awareness of the existence of an argument defeating  $a_1$ . If the lawyer does not know  $a_4$  or that  $a_4$  attacks  $a_1$  then she cannot utter it, hence whatever she may say,  $a_0$  will not be enforced in the public state of the dialog.

Thus the agents may have restricted possibilities according to their (*incomplete*) knowledge and according to the current state of the dialog. The private knowledge of an agent as well as the target being represented by argumentation systems, the restricted possibilities of agents are represented by constraints on the possible changes that they are authorized to perform on the target system. *Enabling constraints* is also a generalization of the enforcement framework, these constraints are restricting the possible changes that can occur to the target.

<sup>1</sup> This example is borrowed from Bisquert et al. [12] and is described in more details inside the paper.

<sup>2</sup> Moreover argumentation theory has also been used in order to analyze persuasion dialogs (see e.g. [9,48,3,20,35]).

<sup>3</sup> Formally, in private persuasion, it can be checked that the argument representing the subject of the dialog has changed its status in the argumentation system of one agent. Public persuasion uses a public argumentation system on which each agent may act by participating to the dialog; this public argumentation system is the target of every agent and represents the current state of the dialog.

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