

Acceptable Argumentation Lines: A Revised Definition

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Abstract

The appropriate definition of argumentative reasoning systems requires a careful study of the dialectical analyses that are carried out in these formalisms. In this work we present a research line that points to the correct definition of such dialectical analyses. These dialectical analyses must be accomplished correctly, guided by proper criteria in order to prevent the construction of fallacious or ill formed argumentation lines. In this context, we analyze the definition of acceptable argumentation line in DELP and propose a revised version.

1 Defeasible Logic Programming

Defeasible Logic Programming (DELP) is a formalism that combines Logic Programming and Defeasible Argumentation. DELP allows the representation of defeasible information in the form of two kinds of rules: defeasible rules and strict rules. The first ones, also called weak rules, are used in the representation of tentative information, and the second ones for representing strict knowledge. The language used allows strong negation, and DELP uses an argumentation formalism to deal with contradictory knowledge. In DELP a query q will succeed if q is a warranted literal, that is, if there is a supporting argument for q which is not defeated. An argument \mathcal{A} can be defeated by another argument \mathcal{B} only if \mathcal{B} is a counter-argument for \mathcal{A} and, by some criterion, it is preferred over \mathcal{A} . However, in order to establish whether an argument \mathcal{A} is defeated or not, DELP follows a dialectical analysis. This analysis considers all the defeaters for \mathcal{A} , and then the defeaters for each of them, and so on. In this manner, for each defeater for \mathcal{A} a sequence of arguments can be created, where each argument in the sequence defeats its predecessor. This sequence is called an argumentation line. DELP requires all argumentation lines to be *acceptable* in order to avoid problematic situations in the dialectical process such as circular argumentation, infinite argumentation lines, and contradictory argumentation lines. The definition given in [3] avoids all those situations, but it also avoids other situations which, although not problematic, are interesting modeled as a dialectical process.

In this work we analyze the definition of acceptable argumentation line showing examples of these non problematic situations. Then, we suggest a revised definition considering the implications of such revision.

2 Acceptable Argumentation Lines

There are some restrictions imposed over the argumentation lines in order to avoid problematic situations [3]. These restrictions are stated in the following definition.

Definition 1

Let $\Lambda = [\langle \mathcal{A}_0, h_0 \rangle, \langle \mathcal{A}_1, h_1 \rangle, \langle \mathcal{A}_2, h_2 \rangle, \dots, \langle \mathcal{A}_n, h_n \rangle]$ be an argumentation line. Λ is an acceptable argumentation line iff:

1. Λ is a finite sequence.
2. The set Λ_S , of supporting arguments is concordant, and the set Λ_I of interfering arguments is concordant.
3. No argument $\langle \mathcal{A}_k, h_k \rangle$ in Λ is a sub-argument of an argument $\langle \mathcal{A}_i, h_i \rangle$ appearing earlier in Λ ($i < k$).
4. For all i , such that the argument $\langle \mathcal{A}_i, h_i \rangle$ is a blocking defeater for $\langle \mathcal{A}_{i-1}, h_{i-1} \rangle$, if $\langle \mathcal{A}_{i+1}, h_{i+1} \rangle$ exists, then $\langle \mathcal{A}_{i+1}, h_{i+1} \rangle$ is a proper defeater for $\langle \mathcal{A}_i, h_i \rangle$.

These restrictions avoid the problematic situations mentioned above. However, other non problematic situations are also prohibited. For instance, when a sub-argument of a defeated argument is not attacked, there is no reason for avoiding its re-introduction in the line.

Example 1

Consider the following de.l.p. $\mathcal{P}_1 = (\Pi_1, \Delta_1)$

$$\Pi_1 = \left\{ \begin{array}{l} \text{birthday_party} \\ \text{rain} \\ \text{noon} \\ \neg \text{sun} \leftarrow \text{overcast} \\ \text{august_day} \leftarrow \text{birthday_party} \end{array} \right\} \quad \Delta_1 = \left\{ \begin{array}{l} \text{sun} \rightarrow \text{noon.} \\ \text{overcast} \rightarrow \text{august_day.} \\ \text{cold} \rightarrow \neg \text{sun.} \\ \neg \text{sun} \rightarrow \text{rain.} \\ \text{take_a_taxi} \rightarrow \text{overcast, cold.} \end{array} \right\}$$

and the following argument structures:

$$\langle \mathcal{D}, \text{cold} \rangle = \langle \{ \text{cold} \rightarrow \neg \text{sun.}, \neg \text{sun} \rightarrow \text{rain.} \}, \text{cold} \rangle$$

$$\langle \mathcal{B}, \text{sun} \rangle = \langle \{ \text{sun} \rightarrow \text{noon.} \}, \text{sun} \rangle$$

$$\langle \mathcal{C}, \text{overcast} \rangle = \langle \{ \text{overcast} \rightarrow \text{august_day.} \}, \text{overcast} \rangle$$

Suppose we have a preference relation (\succ) between arguments that states:

$$\langle \mathcal{C}, \text{overcast} \rangle \succ \langle \mathcal{B}, \text{sun} \rangle \succ \langle \mathcal{D}, \text{cold} \rangle$$

Argument $\langle \mathcal{C}, \text{overcast} \rangle$ attacks argument $\langle \mathcal{B}, \text{sun} \rangle$ at literal sun since $\Pi_2 \cup \{ \text{sun}, \text{overcast} \}$ is contradictory. Argument $\langle \mathcal{B}, \text{sun} \rangle$ attacks argument $\langle \mathcal{D}, \text{cold} \rangle$ at literal $\neg \text{sun}$.

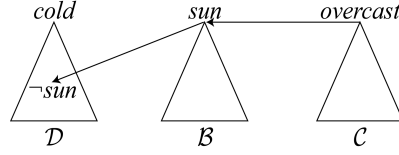


Figure 1: Argumentation line for literal *cold*

In the example, sequence $\Lambda = [\langle \mathcal{D}, cold \rangle, \langle \mathcal{B}, sun \rangle, \langle \mathcal{C}, overcast \rangle]$ is an acceptable argumentation line in which each argument structure is a proper defeater of its predecessor. Argument \mathcal{D} is defeated by \mathcal{B} and this one by \mathcal{C} . In this way, there is a warrant for literal *cold* since its supporting argument $\langle \mathcal{D}, cold \rangle$ is finally undefeated.

Suppose you are asked about literal *take_a_taxi*. The following argument structure is a supporting argument for *take_a_taxi*:

$$\langle \mathcal{A}, take_a_taxi \rangle$$

where $\mathcal{A} = \{take_a_taxi \rightarrow overcast, cold., overcast \rightarrow august_day., cold \rightarrow \neg sun.\}$

Set \mathcal{A} is a superset of \mathcal{D} and for this reason argument $\langle \mathcal{A}, take_a_taxi \rangle$ can be defeated by $\langle \mathcal{B}, sun \rangle$. Argument $\langle \mathcal{B}, sun \rangle$ could be defeated by $\langle \mathcal{C}, overcast \rangle$ but the argumentation line

$$[\langle \mathcal{A}, take_a_taxi \rangle, \langle \mathcal{B}, sun \rangle, \langle \mathcal{C}, overcast \rangle]$$

is not acceptable because $\langle \mathcal{C}, overcast \rangle$ is a sub-argument of $\langle \mathcal{A}, take_a_taxi \rangle$ (see condition 3 in *Definition 1*). However, there is no reason to avoid the introduction of $\langle \mathcal{C}, overcast \rangle$ in the argumentation line since it is a non defeated argument. Since the attack of $\langle \mathcal{B}, sun \rangle$ over $\langle \mathcal{A}, take_a_taxi \rangle$ does not involve argument $\langle \mathcal{C}, overcast \rangle$, this argument could be used to attack $\langle \mathcal{B}, sun \rangle$. Then, the acceptable argumentation line definition can be revised to allow the situation illustrated in the example. Condition 3 of *Definition 1* can be modified allowing the re-introduction of arguments such as $\langle \mathcal{C}, overcast \rangle$.

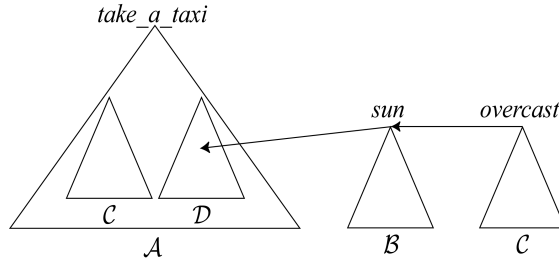


Figure 2: Non acceptable argumentation line according to *Definition 1*

3 Revised Definition

The proposed modification must be carried out carefully since we are interested in avoiding the problematic situations mentioned above. Then, we propose a modification which is based on the concept of *disagreement sub-argument*. In DELP, an argument $\langle \mathcal{A}_j, h_j \rangle$ *counter-argues*, *rebutts*, or *attacks* $\langle \mathcal{A}_i, h_i \rangle$ at literal g_i , if and only if there exists a sub-argument $\langle \mathcal{S}_i, g_i \rangle$ of $\langle \mathcal{A}_i, h_i \rangle$ such that g_i and

h_j disagree. If $\langle \mathcal{A}_j, h_j \rangle$ counter-argues $\langle \mathcal{A}_i, h_i \rangle$ at literal g_i then sub-argument $\langle \mathcal{S}_i, g_i \rangle$ is called the *disagreement sub-argument*.

Definition 2 (Acceptable Argumentation Line - Revised)

Let $\Lambda = [\langle \mathcal{A}_0, h_0 \rangle, \langle \mathcal{A}_1, h_1 \rangle, \langle \mathcal{A}_2, h_2 \rangle, \dots, \langle \mathcal{A}_n, h_n \rangle]$ be an argumentation line. Λ is an acceptable argumentation line iff:

1. Λ is a finite sequence.
2. The set Λ_S , of supporting arguments is concordant, and the set Λ_I of interfering arguments is concordant.
3. No argument $\langle \mathcal{A}_k, h_k \rangle$ in Λ is a super-argument of $\langle \mathcal{S}_i, g_i \rangle$, where $\langle \mathcal{S}_i, g_i \rangle$ is the disagreement sub-argument determined in the attack of $\langle \mathcal{A}_{i+1}, h_{i+1} \rangle$ over $\langle \mathcal{A}_i, h_i \rangle$, ($i < k$).
4. For all i , such that the argument $\langle \mathcal{A}_i, h_i \rangle$ is a blocking defeater for $\langle \mathcal{A}_{i-1}, h_{i-1} \rangle$, if $\langle \mathcal{A}_{i+1}, h_{i+1} \rangle$ exists, then $\langle \mathcal{A}_{i+1}, h_{i+1} \rangle$ is a proper defeater for $\langle \mathcal{A}_i, h_i \rangle$.

Now we have to analyze the effects of this modification. The modification allows the re-introduction of certain sub-arguments appearing earlier in the line, but this decision does not interfere in the formation of the desired argumentation lines. *Definition 1* establishes conditions to avoid (1) infinite lines, (2) contradictory lines, (3) circular argumentation, and (4) blocking-blocking situations. The proposed revision modifies only the third condition which prevents circular argumentation lines; that is, lines in which attacked arguments are introduced again in the line in order to defend itself. These lines are still avoided by the revised definition since we are only allowing the re-introduction of (sub)arguments that are not super-arguments of an attacked sub-argument in the line. This restriction is kept since a super-argument of an attacked (sub)argument is also an attacked argument. In this way circular argumentation lines are avoided by *Definition 2*. Finally, note that the modification does not cause problems with the other conditions of the definition.

We say that a sub-argument in a line Λ is a *non attacked sub-argument* in Λ if it is not a disagreement sub-argument. However, it is important to note that these non attacked sub-arguments could be re-introduced as either supporting arguments or interfering arguments. If the re-introduced sub-argument belongs to a supporting argument, then there is no problem using it as a new supporting argument since it does not cause circular argumentation. A different situation could arise if the re-introduced sub-argument belongs to a supporting argument, and then it is re-introduced as an interfering argument. We show that this situation does not cause any problem because the concordance condition (2) of the definition prevents this kind of lines from being acceptable. Then,

If a non attacked sub-argument of a supporting argument is re-introduced as an interfering argument in a given argumentation line Λ , then set of supporting arguments Λ_S , is not concordant.

Suppose there is an argumentation line $\Lambda = [\langle \mathcal{A}_1, h_1 \rangle, \langle \mathcal{A}_2, h_2 \rangle, \dots, \langle \mathcal{A}_n, h_n \rangle]$ in which a *non attacked* sub-argument in the line, $\langle \mathcal{S}_j, g_j \rangle$, is re-introduced as an interfering argument in position i , where $i = j + 1 + 2p$, $p \geq 0$.

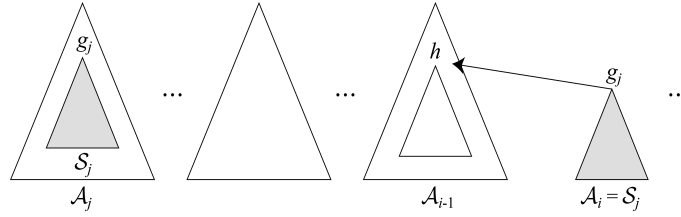


Figure 3: A non acceptable argumentation line

Let S be the set of literals such that there is a defeasible derivation from $(\bigcup_k \mathcal{A}_k) \cup \Pi$, for all \mathcal{A}_k such that $\langle \mathcal{A}_k, h_k \rangle \in \Lambda_S$, and let I be the set of literals such that there is a defeasible derivation from $(\bigcup_t \mathcal{A}_t) \cup \Pi$, for all \mathcal{A}_t such that $\langle \mathcal{A}_t, h_t \rangle \in \Lambda_I$. As we know, $S \cup I \cup \Pi$ is contradictory. Moreover, argument $\langle \mathcal{S}_j, g_j \rangle$ attacks $\langle \mathcal{A}_{i-1}, h_{i-1} \rangle$ at some literal h and considering the *counter-argument* definition, $\Pi \cup \{h, g_j\}$ is also contradictory since h and g_j disagree. Considering *Definition 2*, the set Λ_S of supporting arguments has to be concordant. Note that literal h belongs to S because $\langle \mathcal{A}_{i-1}, h_{i-1} \rangle$ is a supporting argument. For this reason, $\mathcal{A}_j \cup \mathcal{A}_{i-1} \cup \Pi$ has to be non contradictory and, since h is derivable from $\mathcal{A}_{i-1} \cup \Pi$, it is known that $\mathcal{A}_j \cup \{h\} \cup \Pi$ has to be non contradictory too. But as $\mathcal{A}_i \subseteq \mathcal{A}_j$, there exists a defeasible derivation for g_j from $\mathcal{A}_j \cup \Pi$. Therefore, $\mathcal{A}_i \cup \{h\} \cup \Pi$ is contradictory and consequently the set of supporting arguments Λ_S could not be concordant. Then, the argumentation line $\Lambda = [\langle \mathcal{A}_1, h_1 \rangle, \langle \mathcal{A}_2, h_2 \rangle, \dots, \langle \mathcal{A}_n, h_n \rangle]$ is not acceptable.

A similar reasoning follows if an interfering sub-argument is re-introduced as a supporting argument.

4 Conclusions and Current Work

This work is part of a research line devoted to analyze the correct definition of argumentative reasoning systems. We emphasize the importance of a careful study of the dialectical analyses that are carried out in these formalisms, and in this opportunity we focus on the rules for the formation of argumentation lines. In this context, we proposed a revised definition for the notion of acceptable argumentation line in DELP. The modification allows the construction of desirable argumentation lines that were avoided by the old definition. We have shown that this modification does not cause problems since it still avoids typical problematic situations of a dialectical process such as circular argumentation, infinite argumentation lines, and contradictory argumentation lines.

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