A principle-based Analysis of Weakest Link in Prioritized Structured Argumentation

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Abstract. Pollock proposed to determine the strength of the link towards a conclusion via the minimal of the strengths of the inference [10, 11],, which corresponds with the weakest link. Later, various authors discussed the dilemma between weakest link and last link [2, 6, 7, 12]. There is a basic division between approaches for prioritized rules which give for the prioritized of the benchmark triangle example of dean and professor with the conclusion teach and conclusion not-teach [1], and which of these approaches to use in which situation is one of the main challenges in the area [8, 9]. These two approaches correspond roughly to the last link interpretation and the weakest link interpretation [6], though the precise formulation of last link and weakest link is still an open problem. AS-PIC+ tries to accommodate both in combination with democratic and elitist. Dung therefore introduced an axiomatic approach for structured argumentation [3, 4], and presented some axioms for the last link principle, as well as a canonical attack relation, and criticized other approaches. However, in existing literature, little attention has been paid to the axiomatic analysis of the weakest link principle. This gives rise to the following research question:

How to axiomatize weakest link principle in formal argumentation? This overall question can be divided into two sub-questions: *first, which axioms proposed by Dung are violated by weakest link principle [3, 5]? Second, which axioms can we add instead?*

Different from the last link, when considering the weakest link, we only need to know the priorities of the rules used for the arguments, and then to compare the order of preference, while the structure of arguments and the interacted conflicting relation are ignored. There already exist some counterexamples to such ignorance, which motivate us to argue, even for the weakest link, the focus on the structure of arguments is also needed. Unsurprisingly, prior studies have noted the importance of the weakest link. Young et al gave a representation result for the weakest link and used examples to show the definition of elitist order in AS-PIC+ is insufficient [12, 13], because it only compares sets of defeasible rules and ignores the structure of how arguments are constructed. They then define the disjoint elitist order to ignore the shared rules. Moreover, Liao et al gave similar results but used other examples to demonstrate that the Young approach cannot be extended to preorders [6]. However, the definition of the weakest link is still an open problem: Until now, there are at least two kinds of interpretations of the weakest link, one is greedy and the other one is optimization [6]. Thus, it is valuable to analyse the weakest link through some principles.

Keywords: prioritized structured argumentation · weakest link · principle-based analysis.

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