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Preface for Studia Logica Special Issue (2)

This special double issue represents new ideas in argumentation theory emanating from joint work at the University of Luxembourg and Bar-Ilan University, Israel.

We take the opportunity of this preface to indicate some of the methodological principles we are studying and the subjects of future papers.

1. Critical Subsets of Extensions in Argumentation Networks

This notion is introduced in the paper *Fibring Argumentation Frames.* Given an argumentation network (S, R), where S is the set of arguments and R is the attack relation, then a subset $T \subseteq S$ is called *critical*, if for any two Caminada labellings λ_1 and λ_2 on S we have

$$\lambda_1 \upharpoonright T = \lambda_2 \upharpoonright T \Rightarrow \lambda_1 = \lambda_2$$

This means the labelling on T can be extended uniquely to all of S (see *A Logical Account of Formal Argumentation* below, for the concepts).

This concept is important in three contexts at least:

1. When we develop higher level generalisations of ordinary Dung networks and we want to give it semantics, we can embed the higher level network (call it T) inside a larger ordinary network (call it S). Then if T is a critical subset of S, then it can inherit properties and concepts from S. This is done for fibring networks (see *Fibring Argumentation Frames* below) and to give semantics for higher order attacks in extended argumentation networks (see *Semantics for Higher Level Attacks in Extended Argumentation Frames* below).
2. Given two complete extensions in S, say E_1 and E_2 and assume we want to compare them and see how different they are, then we look at critical subsets $T_i^1 \subseteq E_1$ and $T_j^2 \subseteq E_2$ and compare these subsets, for example for distance.

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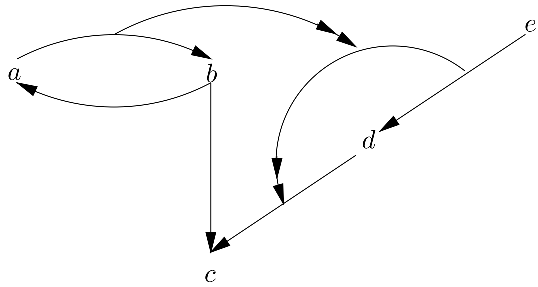

Figure 1.

3. Another possible application of critical subsets is, as stated in the paper *Meta-argumentation Modelling I* below, that they can help in the identification of auxiliary arguments in meta-argumentation (auxiliary arguments are not part of the critical subset).

2. Reactivity Idea

The idea of reactivity was introduced by D. Gabbay in 2004, and has been applied in many areas, including argumentation. It has two essential components, see Figure 1.

Figure 1 is a network. For the moment, let us ignore the double arrows. Without the double arrows, this figure can be many things, for example, a Kripke model with the arrows indicating accessibility, an argumentation network with the arrows indicating the attack relation, a neural network, etc., etc.

When dealing with such a network, we do not imagine ourselves 'walking along the arrows'. Whatever mathematics we do on the network, we do it set theoretically. For example, the extensions in argumentation theory are subsets, the Caminada labelling is a function, the definition of satisfaction in a Kripke model is a set theoretic recursive definition, etc., etc.

Our first change of point of view in the reactive approach is to imagine some starting points, and imagine ourselves walking along the arrows doing something. In the case of Kripke models we go around evaluating formulas. In the case of argumentation networks we go around attacking. The grounded extension in argumentation networks, for example, can be obtained in this way. Start from the extreme points which are not attacked and walk through the network propagating the attack. The grounded exension is the set of survivors (they are 'in').

Given this point of view, the double arrows now make sense. As we move from node e to node d in Figure 1, we activate the double arrow $(e \rightarrow d) \twoheadrightarrow (d \rightarrow c)$, and the connection $d \rightarrow c$ is cancelled.

In many areas this idea gives new semantics and new results. In the argumentation area this gives the idea of higher level attacks (see papers below) but it also gives more than that.

Consider Figure 1 and assume our starting set is $\{a, b, e\}$. So these points attack simultaneously. What happens? a and b kill each other. Since we use $a \rightarrow b$, the double arrow from $a \rightarrow b$ kills the double arrow from $e \rightarrow d$ to $d \rightarrow c$, but not before it manages to cancel $d \rightarrow c$, because e kills d. c is killed by b. The extension we get is $\{e\}$.

This is not a traditional extension. This idea will be further investigated in future papers, especially as a means of resolving loops.

3. Caminada–Gabbay Algebra

In the *Fibring Argumentation Frames* paper below, there is the idea of giving more values to the Caminada function, e.g. 'in, out, '?', '??' to distinguish between different types of loops (see *Modal Provability Foundations for Argumentation Networks*, below) or as means to solve equations and resolve loops (as hinted in *Fibring Argumentation Frames*). This idea needs to be pursued and developed.

Giving numerical values to general networks in general setting and studying their propagation properties has already been done in 2005 by Barringer, Gabbay and Woods, but not specifically in the context of argumentation networks (Bench-Capon has already introduced numerical values in argumentation before 2005). We can even talk about sets of arguments attacking or defending up to a certain degree and complete extensions relative to a certain degree.

This approach has to be developed systematically.

4. Modal and Temporal Argumentation Networks

An argumentation network is a carrier of information. In this sense it represents a possible world. Thus we can construct a family of argumentation networks and view it as a modal and temporal system and give reasonable definitions for the modal operators and the way they interact with attacks.

We know also intuitively that arguments can be time-dependent and their potency can decrease with time. Modal and temporal networks can handle that.

There is a connection with fibring networks and with higher level attacks. We shall address these issues in future papers.

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