Computational Models of Argument
F. Toni et al. (Eds.)

doi:10.3233/FAIA220177

Attractor - A Java Library for Gradual Bipolar Argumentation

Nico POTYKA [a]

[a] *Imperial College London, United Kingdom*

Keywords. Gradual Argumentation, Algorithms, Implementations

Gradual argumentation frameworks (GAFs) are abstract argumentation frameworks that interpret arguments numerically [1]. Figure 1 shows a simple GAF on the left. Nodes represent abstract arguments. *Buy* and *Sell* represent decisions (buy or sell stocks of a company) and *A1*, *A2*, *A3* represent arguments given by experts. Solid edges denote attack and dashed edges support relations. Every argument has an initial weight shown in the node. Intuitively, this weight is an apriori belief in the strength of the argument when ignoring the others.

Semantically, attackers should decrease the initial weight, while supporters should increase it. Various gradual semantics have been proposed, but many of them can be seen as instances of *modular semantics* [2]. Modular semantics assign strength values using an iterative procedure that initializes the strength values of arguments with their base scores and repeatedly update the values based on the strength of their attackers and supporters. To do so, an *aggregation function* aggregates the strength values of attackers and supporters and an *influence function* adapts the base score based on the aggregate. While this process may start oscillating in cyclic graphs [2], it usually converges quickly in practice [3]. Figure 1 illustrates this procedure for the DF-QuAD semantics [4] on the right.

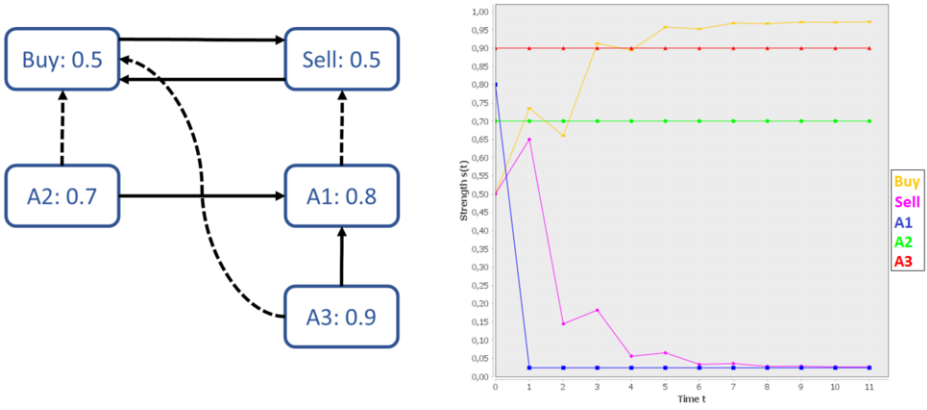

Figure 1. Example of a GAF and illustration of strength computation for DF-QuAD.

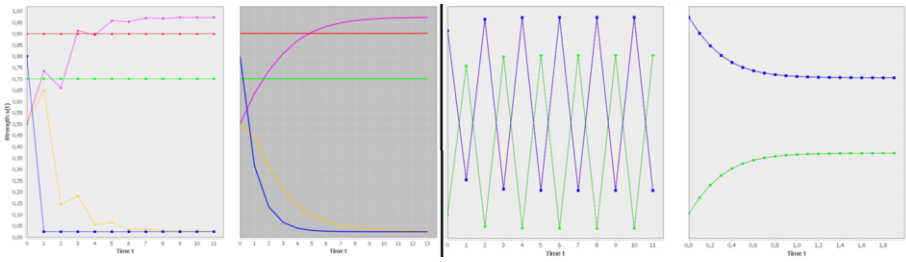

Figure 2. Discrete vs. continuized semantics.

Attractor[1] allows implementing and evaluating gradual argumentation frameworks in Java in a straightforward way. Implementation of several semantics, including DF-QuAD [4], Euler-based [5], Quadratic Energy [3] and MLP-based semantics [6] can be used out of the box. Other modular semantics can be easily implemented by combining pre-implemented aggregation and influence functions. New aggregation and influence functions can be added to implement novel modular semantics. Non-modular semantics can be integrated as well if they maintain a simple interface. Attractor also provides auxiliary functions to plot the evolution of strength values like in Figure 1 and to evaluate and plot the computational performance of different semantics and algorithms on GAFs of increasing size.

Attractor implements two reasoning algorithms that are based on the observation that gradual semantics can be seen as dynamical systems [3]. This view allows continuizing the iterative computation of strength values described above. Continuization can improve the convergence guarantees of modular semantics in cyclic GAFs without changing their semantics in convergent cases [7]. Figure 2 illustrates on the left, how the continuized semantics converges to the same strength values when the strength values under the discrete semantics converge. On the right, it shows an example from [2] where the strength values under the discrete semantics start oscillating, while its continuization finds a reasonable compromise.

References

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