Studying Dynamics in Argumentation with Rob

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Abstract. The issue of handling dynamics is a central problem in Argumentation Theory. In order to understand how dynamics work, we extended the ConArg suite with *Rob*, a tool that is able to display Abstract Argumentation Frameworks and their corresponding sets of extensions, in a way suitable to understand what happens to the semantics when a modification to the graph occurs. In particular, Rob allows to inspect for a particular framework all the corresponding sets of extensions, and for every extension all the frameworks which admit it for some semantics.

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Given an *Abstract Argumentation Framework* (*AF*), it is possible to investigate on which subsets of arguments (called extensions) are accepted, w.r.t. a particular semantics. AFs allow representing information starting from a knowledge base. For instance, a debate among two political figures can be seen as a set of arguments of an AF that attack each other. If we consider the case in which new information is added to the already existent base (that is when the graph underlying the AF is modified), it is possible to study AFs from the point of view of the changes in the semantics induced by the modifications in terms of addition or subtraction of nodes and edges of the graph. It is interesting to study the modifications an AF can undergo before it changes its semantics, and in particular, we concentrate on the notion of *robustness* (first introduced in [1]), a property of the AFs that gives a measure of how many changes an AF can withstand before changing its semantics.

For facilitating the research in this field, we developed *Rob* [2] as part of a greater project called ConArg[1] [3,4,5]. Rob is meant to be an aid for studying dynamics related properties of AFs. Since the study of robustness in AFs involves the inspection of a large number of graphs, we only consider **non-isomorphic AFs**. Through the **web interface** of Rob (shown in Figure 1), we can visualize three panels, which allow analysing different aspects of AFs. Below we detail the main features of the tool.

- The central panel shows a lattice of non-isomorphic AFs, ordered by edge inclusion: there is an edge between AFs that differ for only one attack.
- By selecting an AF on this lattice, it is possible to see, on the left panel the graph underlying such AF, and on the right panel the corresponding set of extensions. This set forms a lattice in which extensions are ordered by argument inclusion. Each extension is coloured according to the semantics to which it belongs.

[1] http://www.dmi.unipg.it/conarg

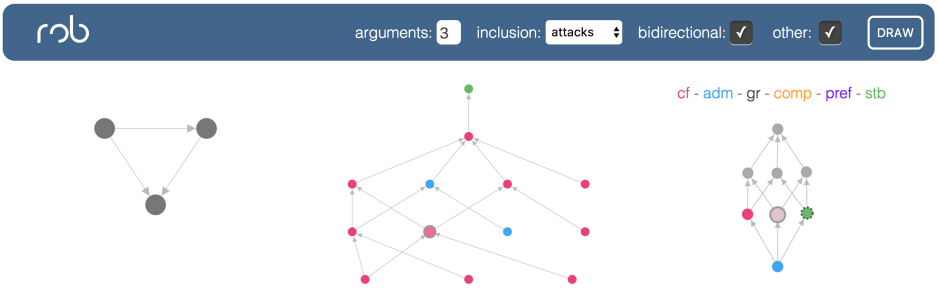

Figure 1. The web interface of Rob. From left to right: the detail of a selected AF, the lattice of all non-isomorphic AFs with three arguments, and the lattice of the extensions for the selected AF.

- By clicking on one of the extensions of the right panel, all the AFs in the central panel, that admits such extension for some semantics, are highlighted.

By using Rob as a support for our study, we obtained as a first result the definition of invariant operators w.r.t. the conflict-free and the admissible semantics [6], able to introduce changes (in terms of addition of an attack) into an AF, while preserving the whole set of extensions. These operators introduce a new possible approach for ordering AFs: instead of attack inclusion that we are currently considering, AFs could be ordered w.r.t. semantics, using invariant operators for finding adjacent AFs. By our knowledge, this is the first tool that aims to help analyse properties of AFs. Other graphical tools exist either for computing solutions [4] or for teaching, as ArgTeach [7] a tool for checking total and partial labelling of AFs. Differently from Rob, which is thought fro studying robustness, the ArgTeach platform is used for educational purposes.

Currently, we are working on a new feature of the tool that allows for representing the lattice of all extensions sets. In the future, we would like to carry out a more detailed study on subclasses of directed graphs (e.g., symmetric and simple). We plan also to extend the concept of robustness to coalitions of arguments, by studying how much a group of arguments derived from partitioning the original set is more robust than another.

References

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