

# TOAST: online ASPIC<sup>+</sup> implementation

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**Abstract.** In this paper, we present TOAST, a system that implements the ASPIC<sup>+</sup> framework. TOAST accepts a knowledge base and rule set with associated preference and contrariness information, and returns both textual and visual commentaries on the acceptability of arguments in the derived abstract framework.

**Keywords.** Structured argumentation, abstract argumentation, ASPIC<sup>+</sup>

## 1. Introduction

The ASPIC<sup>+</sup> framework of [4] built on the work of [1] and instantiates Dung's abstract approach to argumentation [3] by providing structure to arguments, while still allowing an abstract framework to be derived and, ultimately, evaluated using many established acceptability semantics.

In this paper, we present TOAST<sup>1</sup>, a software implementation of ASPIC<sup>+</sup>, which allows a knowledge base, rules, preferences and contrariness to be processed into arguments and attacks from which a Dung-style framework can be derived and evaluated.

## 2. The TOAST system

TOAST is implemented entirely in Java, with argument evaluation performed by the Dung-O-Matic web service [6]. Attacks between arguments are generated using the contrariness function, with successful attacks (i.e. defeat) being calculated by applying preferences. It is the defeat relations that are sent to Dung-O-Matic, along with the arguments, for evaluation.

### 2.1. Usage

#### 2.1.1. Web form

The web form allows a user to submit a knowledge base, rule set, contrariness and preferences to construct an argumentation system and theory. Options are provided that allow the resultant argumentation theory to be considered under four different semantics, using either the last-link or weakest-link principles for

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<sup>1</sup>The Online Argument Structures Tool

argument semantics evaluation. When processing is completed, textual and visual commentaries on the acceptability of arguments in the abstract framework derived from the system are returned.

### 2.1.2. Web service

A web service interface has been provided to allow TOAST to integrate with other software systems. The service accepts and returns JSON; a string containing the components of an argumentation system is posted to the service, which then returns a string listing the arguments, the defeat relations between them and the extension(s) of the derived framework under the requested semantics.

## 3. Applications

### 3.1. The Argument Web

There exists a connection between the Argument Interchange Format (AIF) and the ASPIC<sup>+</sup> framework [2]. This can see TOAST deployed as a component in the argument web, allowing evaluation of natural arguments gathered using tools such as OVA and Arvina [7].

### 3.2. Medical reasoning

TOAST has already been deployed in a medical domain by [5]. The system is used in two ways — the first is to establish if there is sufficient evidence to substitute missing data with data that is available; the second, and core function, is to pose critical questions of the completed analyses to establish the credibility of results, and whether or not they are consistent with other projects or previous conclusions.

## References

- [1] L. Amgoud, L. Bodenstaff, M. Caminada, P. McBurney, S. Parsons, H. Prakken, J. van Veenen, and G.A.W. Vreeswijk. Final review and report on formal argumentation system. Deliverable D2.6, ASPIC IST-FP6-002307, 2006.
- [2] F. Bex, H. Prakken, and C. Reed. A formal analysis of the AIF in terms of the aspic framework. In P. Baroni, F. Cerutti, and G.R. Simari, editors, *Proceedings of the Third International Conference on Computational Models of Argument (COMMA 2010)*. IOS Press, 2010.
- [3] P. M. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77:321–357, 1995.
- [4] H. Prakken. An abstract framework for argumentation with structured arguments. *Argument and Computation*, 1:2:93–124, 2010.
- [5] P.R. Quinlan, A. Thompson, and C. Reed. An analysis and hypothesis generation platform for heterogeneous cancer databases. In *COMMA 2012 (Under review)*, 2012.
- [6] M. Snaith, J. Devereux, J. Lawrence, and C. Reed. Pipelining argumentation technologies. In *Proceedings of the third international conference on Computational Models of Argument (COMMA 2010)*, 2010.
- [7] M. Snaith, J. Lawrence, and C. Reed. Mixed initiative argument in public deliberation. In *Proceedings of the fourth international conference on Online Deliberation (OD 2010)*, 2010.