Acceptability semantics for argumentation frameworks

Leila Amgoud
IRIT – CNRS
118 route de Narbonne
F-31062 Toulouse Cedex 9, France
amgoud@irit.fr

Abstract

An argument is a reason or justification of a claim. It has an intrinsic strength and may be attacked by other arguments. Hence, the evaluation of its overall strength is mandatory. Such an evaluation is done by acceptability semantics.

In this talk, we provide the foundations of a semantics, i.e., key concepts and principles on which an evaluation is based. Each concept (principle) is described by an axiom. We then present two families of semantics: extension semantics and ranking semantics. We analyze them against the axioms shedding thus light on the assumptions and choices they made. The analysis allows also a clear comparison between semantics of the same family, and between extension semantics and ranking ones.

1 Introduction

An *argument* gives reason to support a claim that is questionable, or open to doubt. It is made of three components: *premises* representing the reason, a *conclusion* which is the supported claim, and a *link* showing how the premises lead to the conclusion. The link is hence the logical "glue" that binds premises and conclusions together.

An argument has an *intrinsic strength* which may come from different sources: the certainty degree of its reason [Amgoud and Cayrol, 2002], the importance of the value it promotes if any [Bench-Capon, 2003], the reliability of its source [Parsons *et al.*, 2011], ... Whatever its intrinsic strength (strong or weak), an argument may be *attacked* by other arguments. An attack amounts to undermining one of the components of an argument, and has thus a negative impact on its target. An evaluation of the *overall strength* (or *overall acceptability*) of an argument becomes mandatory, namely for judging whether or not its conclusion is reliable.

The evaluation of arguments has received great interest from the computational argumentation community. Indeed, two families of acceptability semantics were defined for this purpose: *extension* semantics and *ranking* semantics.

Inspired from logic programming, extension semantics were initially introduced by Dung [1995]. Starting with a set of arguments and attacks between them, they return a set of extensions, each of which is a set of arguments that are acceptable together. Some semantics allow multiple extensions while others allow only a single extension. Using a membership criterion, a qualitative acceptability degree is assigned to each argument. Examples of such semantics are the classical semantics of Dung (complete, stable, preferred, ...) and their different refinements (e.g. [Baroni *et al.*, 2005; Caminada, 2006; Dung *et al.*, 2007]).

Unlike extension semantics, ranking semantics do not compute extensions. They use scoring functions which assign a numerical acceptability degree to each argument. The degree of an argument is computed in an iterative way on the basis of the degrees of its direct attackers. Examples of such semantics are h-Categorizer [Besnard and Hunter, 2001], its generalized version [Cayrol and Lagasquie-Schiex, 2005; Pu *et al.*, 2014], game-theoretic semantics [Matt and Toni, 2008], Bbs, Dbs [Amgoud and Ben-Naim, 2013], parametrized semantics [Amgoud *et al.*, 2016], and those proposed in [Gabbay, 2012; Gabbay and Rodrigues, 2015; Leite and Martins, 2011; da Costa Pereira *et al.*, 2011].

In this talk, we compare the two families of semantics (extension semantics and ranking semantics). For that purpose, we start by providing a unified definition of semantics. Then, we present the axiomatic foundations of a semantics as developed in [Amgoud and Ben-Naim, 2016]. We recall the set of axioms that was proposed. Each axiom represents a property that a semantics would satisfy or a principle on which it should be based. Furthermore, some axioms are mandatory while others are optional and represent strategic choices. We then analyze existing extension/ranking semantics against the axioms. The analysis shows the assumptions underlying each semantics, and compares the various semantics. We show that ranking semantics take into account both the number of attackers and their strengths while extension semantics neglect the number of attackers. Unlike ranking semantics, in extension semantics the effect of an attack may be lethal.

References

[Amgoud and Ben-Naim, 2013] Leila Amgoud and Jonathan Ben-Naim. Ranking-based semantics for

argumentation frameworks. In *7th International Conference on Scalable Uncertainty Management, (SUM'13)*, pages 134–147, 2013.

[Amgoud and Ben-Naim, 2016] Leila Amgoud and Jonathan Ben-Naim. Axiomatic foundations of acceptability semantics. In *Proceedings of the International Conference on Principles of Knowledge Representation and Reasoning, KR'16*, pages 2–11, 2016.

[Amgoud and Cayrol, 2002] Leila Amgoud and Claudette Cayrol. A reasoning model based on the production of acceptable arguments. *Annals of Mathematics and Artificial Intelligence*, 34(1-3):197–215, 2002.

[Amgoud *et al.*, 2016] Leila Amgoud, Jonathan Ben-Naim, Dragan Doder, and Srdjan Vesic. Ranking arguments with compensation-based semantics. In *Proceedings of the International Conference on Principles of Knowledge Representation and Reasoning, KR'16*, pages 12–21, 2016.

[Baroni *et al.*, 2005] P. Baroni, M. Giacomin, and G. Guida. Scc-recursiveness: a general schema for argumentation semantics. *Artificial Intelligence Journal*, 168:162–210, 2005.

[Bench-Capon, 2003] Trevor Bench-Capon. Persuasion in practical argument using value-based argumentation frameworks. *Journal of Logic and Computation*, 13(3):429–448, 2003.

[Besnard and Hunter, 2001] Philippe Besnard and Anthony Hunter. A logic-based theory of deductive arguments. *Artificial Intelligence Journal*, 128(1-2):203–235, 2001.

[Caminada, 2006] M. Caminada. Semi-stable semantics. In *Proceedings of the 1st International Conference on Computational Models of Argument, (COMMA'06), IOS Press*, pages 121–130, 2006.

[Cayrol and Lagasquie-Schiex, 2005] Claudette Cayrol and Marie-Christine Lagasquie-Schiex. Graduality in argumentation. *Journal of Artificial Intelligence Research*, 23:245–297, 2005.

[da Costa Pereira *et al.*, 2011] Celia da Costa Pereira, Andreas Tettamanzi, and Serena Villata. Changing one's mind: Erase or rewind? In *Proceedings of the 22nd International Joint Conference on Artificial Intelligence, IJCAI'11*, pages 164–171, 2011.

[Dung *et al.*, 2007] P.M. Dung, P. Mancarella, and F. Toni. Computing ideal skeptical argumentation. *Artificial Intelligence Journal*, 171:642–674, 2007.

[Dung, 1995] Phan Minh Dung. On the Acceptability of Arguments and its Fundamental Role in Non-Monotonic Reasoning, Logic Programming and n-Person Games. *Artificial Intelligence Journal*, 77:321–357, 1995.

[Gabbay and Rodrigues, 2015] Dov M. Gabbay and Odinaldo Rodrigues. Equilibrium states in numerical argumentation networks. *Logica Universalis*, 9(4):411–473, 2015.

[Gabbay, 2012] Dov M. Gabbay. Equational approach to argumentation networks. *Argument & Computation*, 3(2-3):87–142, 2012.

[Leite and Martins, 2011] J. Leite and J. Martins. Social abstract argumentation. In *IJCAI 2011, Proceedings of the 22nd International Joint Conference on Artificial Intelligence*, pages 2287–2292, 2011.

[Matt and Toni, 2008] P-A Matt and F. Toni. A game-theoretic measure of argument strength for abstract argumentation. In *Proceedings of 11th European Conference on Logics in Artificial Intelligence, JELIA'08*, volume 5293 of *Lecture Notes in Computer Science*, pages 285–297. Springer, 2008.

[Parsons *et al.*, 2011] Simon Parsons, Yuqing Tang, Elizabeth Sklar, Peter McBurney, and Kai Cai. Argumentation-based reasoning in agents with varying degrees of trust. In *Proceedings of the 10th International Conference on Autonomous Agents and Multiagent Systems, AAMAS'11*, pages 879–886, 2011.

[Pu *et al.*, 2014] F. Pu, J. Luo, Y. Zhang, and G. Luo. Argument ranking with categoriser function. In *Knowledge Science, Engineering and Management - 7th International Conference, KSEM 2014, Proceedings*, pages 290–301, 2014.