

# Argumentation in Artificial Intelligence Bibliography with Selected Annotations

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## Observations on aims and scope

The breakdown of selected articles, special issues, introductions etc. presented below is intended to give a broad flavour of work in argumentation relating to AI. It is not intended to (nor could it) be comprehensive. It is almost certainly the case that some important material has been overlooked: the absence of any particular contribution should not be seen as either a comment on its merits or significance.

The bibliography is divided into categories, however, many articles could be regarded as relevant to a number of different topics, so there is a degree of subjectivity in the classification.

## 1 Introductions, Surveys, Books

1. T. J. M. Bench-Capon and P. E. Dunne. Argumentation in artificial intelligence. *Artificial Intelligence*, 171, 619–641, 2007  
The introduction to the special issue of AI Journal on *Argumentation in AI* that appeared as volume 171(10–15). It should be noted that this complements the survey of Chesnevar *et al.* [5]: in total these two articles give a detailed overview of argumentation related work in AI from the early 1980s to the present.
2. T. J. M. Bench-Capon and P. E. Dunnes (eds). *Proc. 1st COMMA*, FAIA 144, IOS Press, 2006
3. P. Besnard, S. Doutre and A. Hunter. *Proc. 2nd COMMA*, FAIA 172, IOS Press, 2008

The first two volumes of proceedings from the recently established International Conference on Computational Models of Argument. The third volume (also in the FAIA Series of IOS Press) will be available from September 2010 (eds: P. Baroni, M. Giacomin, and G. Simari).

4. Ph. Besnard and A. Hunter. *Elements of Argumentation*. MIT Press, 2008.  
The currently definitive presentation of deductive argumentation techniques.
5. C. I. Chesnevar, A. G. Maguitman and R. P. Loui. Logical models of argument. *A.C.M. Computing Surveys*, **22**:337–383, 2000  
Probably the first (and still important) survey of the use of argumentation techniques in AI. Establishes its relevance to non-monotonic logics and is the best overview of work prior to the development of Dung’s abstract AF approach.
6. I. Rahwan and G. R. Simari, editors. *Argumentation in Artificial Intelligence*. Springer-Verlag: Berlin, Germany, 2009.  
Recent volume of invited contributions covering very wide spectrum of argumentation related work. Contains survey articles from almost all of the leading experts in the field and offers accessible introductions to the major specialist subfields of argumentation and AI.
7. I. Rahwan and P. McBurney. Argumentation Technology. *IEEE Intelligent Systems*, 22:21–23, 2007  
Brief introduction to the special issue of *IEEE Intelligent Systems* on argumentation.
8. C. Reed and T. Norman. *Argumentation Machines*. Kluwer Academic Publishers: Dordrecht. 2003  
A book surveying argument in AI from a variety of perspectives, including multiagent systems, decision support, persuasion, law and rhetoric.
9. B. Verheij Virtual Arguments TMC Asser Press, IT & Law Series, No. 6, 2005  
An overview of issues in the design of software support for argumentation with a focus on applications in law.

## 2 Abstract Argumentation - Foundations

1. 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.

Seminal article presenting and analysing abstract argumentation frameworks. A watershed in the computational treatment of argumentation.

2. J. Fox, P. Krause and M. Elvang-Goransson. Argumentation as a general framework for uncertain reasoning. In: *Proc. 9th Conf. on Uncertainty in AI*, pages 114–121, 1993

Important early proponent of argumentation as a technology for real-world reasoning issues.

3. J. L. Pollock. Defeasible Reasoning. *Cognitive Science*, **11**:481–581, 1987

4. J. L. Pollock. A theory of defeasible reasoning. *Int. Jnl. of Intell. Sys.*, **6**:33–54, 1991

5. J. L. Pollock. How to reason defeasibly. *Artificial Intelligence*, **57**(1):1–42. 1992

In many respects, Pollock’s work was the major instrumental factor in bringing the importance of argumentation and defeasible reasoning to the attention of audiences outside philosophy and to AI researchers in particular. This paper describes the construction of a general-purpose defeasible reasoner that is complete for first-order logic and provably adequate for Pollock’s argument-based conception of defeasible reasoning.

6. R. Reiter. A logic for default reasoning. *Artificial Intelligence*, **13**:81–132, 1980

Develops the theory of default logic presenting one of its widely used formal bases.

7. G. R. Simari and R. P. Loui. A mathematical treatment of defeasible reasoning and its implementation. *Artificial Intelligence*, **53**(2–3):125–157, 1992

An early and influential presentation of a formal approach to defeasible reasoning based on argumentation.

8. G. Vreeswijk. Abstract Argumentation Systems. *Artificial Intelligence*, **90**:225–279, 1997

Presents a theory of argumentation systems modelling these as collections of “defeasible proofs”. The introduction, additionally, provides a useful comparative survey of formal argumentation systems up to and including Dung’s work.

9. D. N. Walton. *Argumentation Schemes for Presumptive Reasoning*. Erbaum: Mahwah, NJ. 1996

An account of presumptive or defeasible argument in the informal logic tradition. Its approach makes use of argument schemes and critical questions. It describes some sixteen schemes for presumptive reasoning and their associated critical questions in detail.

10. D. N. Walton and E. C. W. Krabbe. *Commitment in Dialogue: Basic Concepts of Interpersonal Reasoning*. Univ. of New York Press. 1995

Presents one of the first systematic attempts to construct a taxonomy of dialogue types and aims.

### 3 Assumption-based and Deductive Argumentation

1. T. Alsinet, C. Chesnevar, L. Godo and S. Sandri. Modeling defeasible argumentation within a possibilistic logic framework with fuzzy unification. In *Proc. 11th IPMU*, pages 1228–1235, 2006

2. T. Alsinet, C. Chesnevar, L. Godo, S. Sandri and G. Simari. On the computation of warranted arguments within a possibilistic logic framework with fuzzy unification. In *Proc. 11th NMR*, pages 227–236, 2006

Two papers building on concepts of possibilistic logic as an approach to argumentation.

3. S. Benferhat, D. Dubois and H. Prade. Argumentative inference in uncertain and inconsistent knowledge bases. In *Proc. 9th UAI*, pages 411–419, 1993

4. S. Benferhat, D. Dubois and H. Prade. Nonmonotonic reasoning, conditional objects and possibility theory. *Artificial Intelligence*, **92**:259–276, 1997

5. S. Benferhat, D. Dubois and H. Prade. Possibilistic and standard probabilistic semantics of conditional knowledge bases. *Jnl. of Logic and Computation*, **9**(6):873–895, 1999

Uncertainty in argumentation has motivated the use of probabilistic models. These three articles provide a good analysis of such approaches.

6. P. Besnard and A. Hunter. A logic-based theory of deductive arguments. *Artificial Intelligence*, **128**(1–2):203–235, 2001
7. P. Besnard and A. Hunter. Practical first-order argumentation. In *Proc. 20th AAAI*, pages 590–595, 2005  
Representative contributions describing work on the deductive argumentation model.
8. A. Bondarenko, P. M. Dung, R. A. Kowalski and F. Toni. An abstract, argumentation-theoretic approach to default reasoning, *Artificial Intelligence*, **93**(1–2):63–101, 1997  
Dung’s argument systems have concepts of “argument” and “attack” as atomic concepts. This article introduces assumption-based frameworks: these take “assumptions” as atomic so allowing various approaches to deriving arguments and attacks (in the sense of Dung) from sets of these. Presents further evidence that non-monotonic logics can be treated in a uniform fashion as different instances of assumption-based argumentation frameworks.
9. C. Chesnevar and G. Simari. A lattice-based approach to computing warranted beliefs in skeptical argumentation frameworks. In *Proc. IJCAI07*, pages 280–285, 2007
10. A. Hunter. Making argumentation more believable. *Proc. 19th AAAI*, pages 269–274, MIT Press, 2004
11. A. Hunter. Towards higher impact argumentation. *Proc. 19th AAAI*, pages 275–280, MIT Press, 2004  
These two papers give a formal account of audiences, to explain how different perspectives can affect what people believe.
12. M. Wooldridge, P. E. Dunne and S. Parsons. On the complexity of linking deductive and abstract argument systems. In *Proc. 21st AAAI*, 2006.  
Analysis of the costs in moving from deductive concepts of argument and attack to explicit representations within Dung’s AF formalism. Presents several notions of equivalence and canaonical framework.

## 4 Abstract Argument Frameworks – Semantics

1. P. Baroni and M. Giacomin. Solving semantic problems with odd-length cycles in argumentation. In *Proc. 7<sup>th</sup> European Conf. on Symbolic and*

*Quantitative Approaches to Reasoning With Uncertainty (ECSQARU)*, volume 2711 of *LNAI*, pages 440–451. Springer-Verlag, 2003.

2. P. Baroni and M. Giacomin. Resolution-based argumentation semantics. In *Proc. 2nd COMMA, FAIA 172*, pages 25–36, IOS Press, 2008.

Motivated by the observation that many interpretative issues in extension-based semantics are caused by the presence of mutually attacking arguments, this develops a “parametric semantics” obtained by “resolving” such attacks, i.e. considering the (set of) AFs that result by discounting exactly one attack from each mutually attacking pair. The “resolution-based grounded semantics” turns out to have a number of key properties of interest (particularly in respect of the ideas given in the two papers below).

3. P. Baroni and M. Giacomin. A systematic classification of argumentation frameworks where semantics agree. In *Proc. 2nd COMMA, FAIA 172*, pages 37–48, IOS Press, 2008.
4. P. Baroni and M. Giacomin. On principle-based evaluation of extension-based argumentation semantics. *Artificial Intelligence*, 171:675–700, 2007  
Important contribution to continuing debate on “most suitable” extension-based semantics: advocates evaluating proposals w.r.t. a number of intuitive natural criteria rather than through their suitability to deal with very specific individual examples.
5. P. Baroni and M. Giacomin. Semantics of abstract argument systems. In I. Rahwan and G. R. Simari, editors, *Argumentation in Artificial Intelligence*, pages 25–44. Springer, Berlin, 2009.

Survey article giving a valuable overview of AF semantics.

6. P. Baroni, M. Giacomin and G. Guida. SCC-recursiveness: a general schema for argumentation semantics. *Artificial Intelligence*, **168**(1–2):162–210, 2005.

Presents and reviews properties of extension-based semantics derived from the strongly-connected component (SCC) decomposition of an AF: an important instance of which is the CF2 semantics.

7. M. Caminada. Semi-stable semantics. In P. E. Dunne and T. J. M. Bench-Capon, editors, *Computational Models of Argument (Proc. COMMA 2006)*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 121–130, IOS Press, 2006

Introduces semi-stable semantics and analyses their basic properties.

8. S. Coste-Marquis, C. Devred and P. Marquis. Prudent semantics for argumentation frameworks. In *Proc. 17th ICTAI*, pages 568–572, 2005  
Presents the so-called “prudent semantics” whereby two arguments are in conflict if one “indirectly attacks” the other.
9. P. M. Dung, P. Mancarella and F. Toni. Computing ideal sceptical argumentation. *Artificial Intelligence*, 171:642–674, 2007  
Introduces “Ideal semantics” – a unique status semantics offering some advantages over grounded and sceptically preferred semantics. Models and properties described in both ABF and AF settings.
10. P.-A. Matt and F. Toni. Basic influence diagrams and the liberal stable semantics. In *Proc. 2nd COMMA*, FAIA 172, IOS Press, pages 228–239, 2008.  
A treatment of argumentation and their application within classical decision theory.

## 5 Algorithms and Complexity

1. P. Baroni, P. E. Dunne, and M. Giacomin. Computational properties of resolution-based grounded semantics. In *Proceedings of the Twenty-First International Joint Conference on Artificial Intelligence (IJCAI-09)*, pages 683–689, Pasadena, CA, 2009.  
Establishes that the semantic advantages of resolution-based grounded semantics (as presented in [2] of the preceding section) do not entail significant computational costs: a number of standard decision questions remaining polynomial time decidable despite the shift from unique status (grounded extension) to multiple status (resolution-based grounded).
2. P. Baroni, P.E. Dunne and M. Giacomin. On extension counting problems in argumentation frameworks. (to appear *Proc. 3rd COMMA, Univ. of Brescia, Italy, September 2010*)  
One of the few studies of *counting* (as opposed to listing) extensions of a given form. Presents both intractability results and special cases which can be solved in polynomial time.
3. P. Besnard, A. Hunter, and S. Woltran. Encoding deductive argumentation in quantified Boolean formulae *Artificial Intelligence*, 173:1406–1423, 2009

4. M. Caminada. An algorithm for computing semi-stable semantics. In *Proc. of ECSQARU 2007, 9th European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty*, pages 222–234, Hammamet, Tunisia, 2007.
5. M. Caminada. An algorithm for Stage Semantics. (to appear *Proc. 3rd COMMA, Univ. of Brescia, Italy, September 2010*)
6. S. Coste-Marquis, C. Devred and P. Marquis. Symmetric argumentation frameworks. In L. Godo, editor, *Proc. 8<sup>th</sup> European Conf. on Symbolic and Quantitative Approaches to Reasoning With Uncertainty (ECSQARU)*, volume 3571 of *LNAI*, pages 317–328. Springer-Verlag, 2005.  
Identifies a further class of AFs which are computationally tractable (in addition to acyclic AFs which were established as such in Dung’s paper),
7. S. Coste-Marquis, C. Devred, S. Konieczny, M.-C. Lagasquie-Schiex and P. Marquis. On the merging of Dung’s argumentation systems. *Artificial Intelligence*, 171:730–753, 2007  
Important contribution as one the few (possibly only?) serious treatments, to date, of the question of how to “combine” different AFs into a single integrated framework. Illustrates that “obvious” mechanisms such as majority decisions, i.e. an attacks  $\langle x, y \rangle$  is included if it is included in most of the frameworks to be merged, have drawbacks; also presents some ideas on suitable techniques.
8. Y. Dimopoulos, B. Nebel and F. Toni. Preferred arguments are harder to compute than stable extensions. In *Proc. 16th IJCAI*, pages 36–43, 1999
9. Y. Dimopoulos, B. Nebel and F. Toni. Finding admissible and preferred arguments can be very hard. In A. G. Cohn, F. Giunchiglia and B. Selman, editors, *KR2000: Principles of Knowledge Representation and Reasoning*, pages 53–61, 2000
10. Y. Dimopoulos, B. Nebel and F. Toni. On the computational complexity of assumption-based argumentation by default reasoning. *Artificial Intelligence*, **141**:57–78, 2002

The basis provided in Bondarenko *et al.* (1997) allows concepts of credulous and sceptical reasoning, preferred and stable extensions to be developed for a number of non-classical logics. In studying the complexity of these problems a significant element is shown to be the complexity of “derivability” in the associated logic. One consequence is that sceptical reasoning under some

logics can be shown complete for rather higher levels of the polynomial-time hierarchy.

11. Y. Dimopoulos and A. Torres. Graph theoretical structures in logic programs and default theories. *Theoretical Computer Science*, **170**, 209–244, 1996  
Obtains complexity classifications for most of the canonical decision decision problems within the extension-based semantics defined by Dung in AFs. Presents (what was described in the tutorial) as the “standard translation” from CNF formulae to AFs. It should be noted that its terminology differs quite radically from that of Dung, however, these are not difficult to relate. A more detailed discussion of the contribution of this work expressed in the terminology of AFs may be found in Dunne and Bench-Capon (2002).
12. S. Doutre and J. Mengin. Preferred extensions of argumentation frameworks: query answering and computation. In *First Intern. Joint Conf. Automated Reasoning (IJCAR 2001)*, pages 272–288. LNAI, 2083, Springer-Verlag, June 2001.
13. P. E. Dunne. On concise encodings of preferred extensions. *Proc. 9th Non-monotonic Reasoning Workshop (NMR’2002)*, Toulouse, pages 393–398, 2002  
Complexity-based consideration of whether the set of all preferred extensions of an argument system can be represented by a description which is both length efficient and admits efficient testing as to whether a set of arguments *is* a preferred extension: motivation is to determine to what extent precomputation of all preferred extensions *once* is a feasible approach.
14. P. E. Dunne. TPI-disputes and proof by clausal tableaux. Tech. Report ULCS-02-008, Dept. of Computer Science, Univ. of Liverpool, 2002  
Establishes that the “simulation” construction presented in [20] is “optimal”.
15. P. E. Dunne. Computational properties of argument systems satisfying graph-theoretic constraints. *Artificial Intelligence*, 171:701–729, 2007  
Considers a number of graph-theoretic restrictions of AFs and their effect on complexity of canonical decision questions. While some (planarity, bounded degree) do not lead to improved methods, others (bipartite, bounded treewidth) produce polynomial time cases. Presents indications that value-based frameworks pose significant challenges in identifying practical algorithmic solutions.

16. P. E. Dunne. The computational complexity of ideal semantics I: abstract argumentation frameworks. In *Proc. 2nd Int. Conf. on Computational Models of Argument*, volume 172 of *FAIA*, pages 147–158. IOS Press, 2008.
17. P. E. Dunne. The computational complexity of ideal semantics. *Artificial Intelligence*, 173:1559–1591, 2009  
Presents near complete classification of computational complexity of decision and construction questions for ideal semantics. Deals with both AF (first paper) and ABF contexts. Full proofs and constructions in the second paper.
18. P. E. Dunne. Tractability in Value-based Argumentation Technical Report, ULCS-10-001, Dept. of Comp. Sci., Univ. of Liverpool, January 2010, (full version of paper to appear in *Proc. 3rd COMMA, Univ. of Brescia, Italy, September 2010*)  
Identifies general classes of VAFs for which subjective and objective acceptance are polynomial time decidable irrespective of the number of values.
19. P. E. Dunne and T. J. M. Bench-Capon. Coherence in finite argument systems. *Artificial Intelligence*, **141**:187–203, 2002.  
Complexity classification proving the problem of deciding if  $\mathcal{H}$  is coherent, i.e. every preferred extension is also stable, to be  $\Pi_2^p$ -complete. A similar classification of SA (left open in the study of Dimopoulos and Torres) follows from this result.
20. P. E. Dunne and T. J. M. Bench-Capon. Two party immediate response disputes: properties and efficiency. *Artificial Intelligence*, **149**:221–250, 2003  
Detailed study and formalisation of the TPI-dispute protocol introduced in Vreeswijk and Prakken (2002) (see below, under *Dialogue & Proof Approaches*). Introduces the concept of *dispute complexity* as the number of moves needed to win an argument. Main technical contribution shows TPI dialogues establishing an argument is *not* credulously accepted can be viewed as a very weak propositional proof calculus and thus may require exponentially many (in the number of arguments) rounds to reach a conclusion.
21. P. E. Dunne and T. J. M. Bench-Capon. Complexity in value-based argument systems. *Proc. 9th European Conf. on Logics in Artificial Intelligence. (JELIA'04)*, LNAI, 3229, Springer-Verlag, pages 360–371, 2004

Classifies the complexity of deciding Subjective and Objective Acceptance that were left open in Bench-Capon’s original presentation of VAFs. Also introduces the problem “*critical pair*” concerned with deciding whether a given argument is subjectively accepted with one specific ordering of a pair of values but indefensible when this order is reversed. This problem being demonstrated to be “harder” than deciding Subjective or Objective Acceptance.

22. P. E. Dunne and M. Caminada. Computational complexity of semi-stable semantics in abstract argumentation frameworks. In *Proc. 11th JELIA*, volume 5293 of *LNAI*, pages 153–165. Springer-Verlag, 2008.  
Gives bounds on the complexity of canonical decision problems for semi-stable semantics. The gap between lower and upper bounds for credulous and sceptical acceptance in this paper has subsequently been closed by Dvorak and Woltran ([26], below).
23. P.E. Dunne, A.J. Garcia, D.C. Martinez and G.R. Simari. Computation with varied-strength attacks in abstract argumentation frameworks. (to appear *Proc. 3rd COMMA, Univ. of Brescia, Italy, September 2010*)
24. P. E. Dunne, S. Modgil, and T. Bench-Capon. Computation in extended argumentation frameworks. to appear, *Proc. 19th ECAI*, 2010
25. P. E. Dunne and M. Wooldridge. Complexity of abstract argumentation. In I. Rahwan and G. Simari, editors, *Argumentation in Artificial Intelligence*. Springer-Verlag: Berlin, Germany, 2009.  
Introductory survey reviewing work in computational complexity.
26. W. Dvorak and S. Woltran. Complexity of semi-stable and stage semantics in argumentation frameworks. *Inf. Proc. Lett.*, 110:425–430, 2010  
Optimal improvement of lower bounds obtained in [22]: presents another variant of standard translation for this purpose.
27. W. Dvorak, S. Szeider, S. Woltran. Reasoning in argumentation frameworks of bounded clique-width. (to appear *Proc. 3rd COMMA, Univ. of Brescia, Italy, September 2010*)
28. U. Egly and S. Woltran. Reasoning in argumentation frameworks using quantified Boolean formulas. In P. E. Dunne and T. J. M. Bench-Capon, editors, *Computational Models of Argument (Proc. COMMA 2006)*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 133–144, IOS Press, 2006

29. R. Hirsch and N. Gorogiannis. The complexity of the warranted formula problem in propositional argumentation. *Jnl. of Logic and Computation*, 20:481–499, 2010

One of a select number of contributions dealing with complexity issues in deductive argumentation. Establishes that deciding if an argument is “warranted” is PSPACE-complete.

30. E.J. Kim, S. Ordyniak, and S. Szeider. Algorithms and complexity results for persuasive argumentation. (to appear *Proc. 3rd COMMA, Univ. of Brescia, Italy, September 2010*)

Offers another class of VAFs for which SBA and OBA are tractable – this class being distinct from those described in [18]. Is also of interest in proving that two cases, conjectured to be tractable in [15] are NP-complete.

31. B. Verheij. A labelling approach to the computation of credulous acceptance in argumentation. In: *Proc. IJCAI-07*, pages 623–628, 2007

Labelling schemes have proven to be a valuable mechanism in developing computational methods for determining argument status in AFs. Verheij has been one of the main proponents of such techniques, this article providing a good overview of the principal ideas involved.

32. G. Vreeswijk. An algorithm to compute minimally grounded and admissible defence sets in argument systems. In P. E. Dunne and T. J. M. Bench-Capon, editors, *Computational Models of Argument (Proc. COMMA 2006)*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 109–120, IOS Press, 2006

## 6 Developments of Abstract AFs

1. L. Amgoud and C. Cayrol. A reasoning model based on the production of acceptable arguments. *Annals of Math. and AI*, **34**:197–215, 2002

Introduces the model of *Preference-Based Argumentation Frameworks* (PAF). These together with the VAF model of Bench-Capon are one of the main mechanisms which seek to extend Dung by accounting for concepts of attacks which only succeed if the position promoted is not outranked by the position attacked.

2. P. Baroni, F. Cerutti, M. Giacomin, and G. Guida. Encompassing attacks to attacks in abstract argumentation frameworks. In *Proc. ECSQARU*, volume 5590 of *LNAI*, pages 83–94. Springer-Verlag: Berlin, Germany, 2009.

Describes a development of the attack relation in Dung whereby this can involve arguments attacking already defined attacks.

3. H. Barringer, D. M. Gabbay, and J. Woods. Temporal dynamics of support and attack networks: From argumentation to zoology. In *Mechanizing Mathematical Reasoning (LNCS Volume 2605)*, pages 59–98. Springer-Verlag: Berlin, Germany, 2005.

Describes one approach to use of quantitative weights on attacks.

4. T. J. M. Bench-Capon. Persuasion in practical argument using value-based argumentation frameworks, *Jnl. of Logic and Computation*, **13**(3):429–48, 2003.

Introduces *Value-based Argumentation Frameworks* establishing uniqueness of preferred extension, efficient computational properties, and defining the ideas of Subjective and Objective Acceptance.

5. T. J. M. Bench-Capon, S. Doutre and P. E. Dunne. Audiences in argumentation frameworks. *Artificial Intelligence*, **171**:42–71, 2007

Describes a dialogue based proof procedure for argumentation in VAFs. Also describes complexity-theoretic and algorithmic work from earlier papers.

6. C. Cayrol and M.C. Lagasquie-Schiex. Gradual valuation for bipolar argumentation frameworks. In *8th European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty (ECSQARU-2005)*, pages 366–377, LNAI, 3571, Springer-Verlag, 2005.
7. C. Cayrol and M.C. Lagasquie-Schiex. On the acceptability of arguments in bipolar argumentation frameworks. In *8th European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty (ECSQARU-2005)*, pages 378–389, LNAI, 3571, Springer-Verlag, 2005.
8. C. Cayrol, C. Devred and M.C. Lagasquie-Schiex. Handling controversial arguments in bipolar argumentation systems. In P. E. Dunne and T. J. M. Bench-Capon, editors, *Computational Models of Argument (Proc. COMMA 2006)*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 261–272, IOS Press, 2006

Bipolar AFs broaden Dung’s notion of “attack” to include a relation between arguments whereby one argument “supports” another. These three articles propose semantics, describe algorithms and analyse the properties of AFs where this additional binary relationship between arguments is given.

9. P. E. Dunne and T. J. M. Bench-Capon. Identifying audience preferences in legal and social domains. *Proc. DEXA'04*, LNCS 3180, Springer-Verlag, pages 518–527, 2004  
Presents an efficient algorithm by which the set of audiences consistent with a given  $S$  being a preferred extension in a VAF can be recovered.
10. P. E. Dunne, A. Hunter, P. McBurney, S. Parsons, and M. Wooldridge. Inconsistency tolerance in weighted argument systems. In *Proc. 8th AAMAS*, pages 851–858, 2009.  
Introduces the model of weighted argument systems whereby attacks have an associated numerical weight reflecting the “cost” of ignoring the attack. Describes extension-based semantics and derives complexity results for these.
11. T. F. Gordon, H. Prakken and D. Walton. The Carneades model of argument and burden of proof. *Artificial Intelligence*, 171:875–896, 2007  
Defines the Carneades model of argument structure and evaluation: a basis for dealing with procedural and dialogical aspects of argumentation processes.
12. D. C. Martinez, A. J. Garcia and G. R. Simari. On acceptability in abstract argumentation frameworks with an extended defeat relation. In P. E. Dunne and T. J. M. Bench-Capon, editors, *Computational Models of Argument (Proc. COMMA 2006)*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 273–278, IOS Press, 2006
13. D. Martinez, A. Garcia, and G. Simari. An abstract argumentation framework with varied-strength attacks. In *Proceedings of the 11th International Conference on Principles of Knowledge Representation and Reasoning (KR'08)*, 2008.  
Describe the augmentation of AFs to so-called AFs with varied strength attacks (AFV): in these the attack relation is considered as partitioned into  $k$  sets  $\{A\}_i$  ( $1 \leq i \leq k$ ), with an additional element describing an ordering relation over  $\{1, \dots, k\}$ . The approach thereby allows concepts of “stronger” and “weaker” defences of an individual argument to be formulated. Complexity issues in this model are the subject of [23] in the relevant section above.
14. P. 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 *LNAI*, pages 285–297. Springer, 2008.

15. S. Modgil. An abstract theory of argumentation that accommodates defeasible reasoning about preferences. In *Symbolic and Quantitative Approaches to Reasoning with Uncertainty*, volume 4724 of *LNCS*. Springer, 2007.
16. S. Modgil. Labellings and games for extended argumentation frameworks. In *Proc. 21st IJCAI*, pages 873–878, 2009.
17. S. Modgil. Reasoning about preferences in argumentation frameworks. *Artificial Intelligence*, 173(9–10):901–934, 2009.  
Introduces the model of *Extended Argumentation Frameworks* (EAFs) whose main innovation is the inclusion of a binary relation between arguments and attacks. Illustrates how this approach unifies various aspects both of preference and value-based techniques.
18. S. Modgil and T. Bench-Capon. Integrating object and meta-level value based argumentation. In *Computational Models of Argument: Proceedings of COMMA 2008*, pages 240–251. IOS Press, 2008.
19. S. H. Nielsen and S. Parsons. Computing preferred extensions for argumentation systems with sets of attacking arguments. In P. E. Dunne and T. J. M. Bench-Capon, editors, *Computational Models of Argument (Proc. COMMA 2006)*, volume 144 of *Frontiers in Artificial Intelligence and Applications*, pages 97–108, IOS Press, 2006.  
More detailed consideration of properties of an approach whereby Dung’s notion of attack is developed from a purely binary level to one in which attacks are from an arbitrary (non-empty!) set of arguments to a single argument.

## 7 Dialogue & Proof Approaches

1. A. Artikis, M. Sergot and J. Pitt. An executable specification of a formal argumentation protocol. *Artificial Intelligence*, 171:776–804, 2007.
2. T. J. M. Bench-Capon. Specification and implementation of Toulmin dialogue game. In: J. C. Hage *et al.* (ed.): *Legal Knowledge Based Systems*, pages 5–20, 1998.  
Gives a complete set of moves for a game based on Toulmin’s schema, together with an operational semantics for them, and describes an implementation of the game in Prolog.

3. C. Cayrol, S. Doutre and J. Mengin. Dialectical proof theories for the credulous preferred semantics of argumentation frameworks. In *Sixth European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty (ECSQARU-2001)*, pages 668–679. LNAI, 2143, Springer-Verlag, 2001
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These articles address algorithms for computing preferred extensions via a dialogue game. This game is couched in terms of the general classification presented in [14].
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Presents dialogue style proof procedures for credulous reasoning in assumption-based frameworks, introducing backward reasoning as a mechanism for guiding the dialogue development.
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Examines to what extent the “loser” of a dispute can exploit dialogue rules and their opponent’s strategy in order to delay having to concede defeat.

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 Considers the question of “move selection” for participants in a dialogue, reviewing notions of what can be said to constitute a “best” move.
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13. H. Jakobovits. *On the theory of argumentation frameworks* Ph. D. thesis, Dept. of Comp. Sci., Vrije Univ. Brussels, 2000
14. H. Jakobovits and D. Vermeir. Dialectic semantics for argumentation frameworks. In *Proc. 7th ICAIL*, pages 53–62, 1999  
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 Although not directly concerned with argumentation, is influential in presenting one of the first dialogue games, Describes important notions such as commitment stores, locutions etc that have been adopted in computational realisations of dialogue protocols. Based on standard propositional logic, it is particularly intended to explain certain fallacies, especially begging the question.
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## 8 Agent-based Negotiation: Dialogue & Decision

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23. I. Rahwan and K. Larson. Pareto optimality in abstract argumentation. In *Proceedings of 23rd Conference on Artificial Intelligence (AAAI'08)*. AAAI Press, 2008.
24. S. D. Ramchurn, C. Sierra, L. Godo and N. R. Jennings. Negotiating using rewards. *Artificial Intelligence*, 171:805–837, 2007
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## 10 Visualisation Tools

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## 12 Miscellaneous Treatments

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Good representative article presenting argument and dialogue from the game-theoretic perspective favoured within economics.
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Useful comparative study of the links between extension-based semantics in AFs and standard game-theoretic concepts of solution. This thesis is available on-line via [http://www.phil.uu.nl/preprints/ckiscripties/SCRIPTIES/034\\_r](http://www.phil.uu.nl/preprints/ckiscripties/SCRIPTIES/034_r)
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## 13 Web Resources

1. <http://www.argkit.org/>  
Java Library developed by Matt South at Oxford, providing extensive range of tools for programming AF based applications and graphical display of these.
2. <http://www.argugrid.org/>  
Home page of the EU Framework VI, Argumentation Grid Project.
3. <http://araucaria.computing.dundee.ac.uk/doku.php>  
Chris Reed’s *Araucaria* argumentation visualisation tool and supporting documentation.
4. <http://www.cs.ucl.ac.uk/staff/a.hunter/projects/af/>  
Home page for Tony Hunter’s EPSRC *Argumentation Factory* project.

5. <http://www.argumentation.org/>  
Home page for the recently completed EU ASPIC project.
6. <http://carneades.berlios.de/>  
Tom Gordon's *Carneades Framework* and supporting software.
7. <http://www.doc.ic.ac.uk/~dg00/casapi.html>  
The PROLOG based CaSAPI (Credulous and Sceptical Argumentation – Prolog Implementation) suite produced by Dorian Gaertner and Francesca Toni for the ARGUGRID project.
8. <http://cohere.open.ac.uk/> and <http://compendium.open.ac.uk/>  
Simon Buckingham Shum's research group at the Open University (UK) have developed a number of useful tools for argumentation support. COHERE provides a visual tool to create, connect and share ideas; COMPENDIUM offers a software tool for mapping information, ideas and arguments.
9. <http://www.comma-conf.org/>  
Home page of the International Conference on Computation Models of Argument.
10. [http://lidia.cs.uns.edu.ar/delp\\_client/](http://lidia.cs.uns.edu.ar/delp_client/)  
Defeasible Logic Programming support produced Guillermo Simari's group.
11. <http://www.wietskevisser.nl/research/epr/>  
Epistemic and Practical Reasoner developed by Wietske Visser with support from Henry Prakken and Gerard Vreeswijk.