Dialogical Argument as an Interface to Complex Debates

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The Magtalo prototype environment harnesses dialogue protocols to support flexible, intuitive interaction with data in complex, contentious domains and provides mechanisms for eliciting structured knowledge.

Over the past two decades, many online argumentation systems have emerged that support debate. Most of these have been studies in an academic laboratory, although a few of the larger-scale projects have seen real-world use.[1] More recently, the online community has shown spontaneous interest in argument, spurred perhaps by high-visibility arguments with strong, explicit argumentative structure such as the *Iraq Study Group Report* (www.usip.org/isg/iraq_study_group_report/report/1206).

Academic projects typically have a solid foundation in argumentation theory, enabling a rich set of argumentative moves and structures. However, these systems' presentation and framing have been a barrier to wider adoption. The online systems, in contrast, enjoy a broad user base but have little or no basis in argumentation theory. This shortcoming leaves their users with an impoverished set of moves and tools to choose from.

The Magtalo (*M*ulti*ag*en*t* *A*rgumentation, *L*ogic, and *O*pinion) prototype system blends these two styles. ("Magtalo" is Tagalog for "disagreement.") Magtalo represents arguments as knowledge structures and employs intuitive, appealing interaction based on interagent argumentation protocols. Our goals are to

- support users in a complex domain consisting of multiple, conflicting viewpoints;
- allow intuitive navigation of the disagreement space; and
- facilitate the structured expansion of the available resources through argumentation-based knowledge elicitation.

Viewpoints

To represent participants' views, Magtalo uses a multiagent system. Users and specialists can analyze preexisting arguments for their argumentative structure using tools such as Araucaria.[2] The University of Dundee's Argumentation Research Group has conducted large-scale analyses in an online corpus available at http://araucaria.computing.dundee.ac.uk. The arguments in this corpus are represented using the XML-based Argument Markup Language (AML) and can easily be read into data structures. So, with propositions corresponding to real, analyzed, natural text, an agent can automatically populate its knowledge base with its beliefs. In the same way, an agent can automatically acquire the argumentative relations between those propositions because the AML source analyses represent those relations.

By taking several corpus arguments in the same domain but articulated by different authors, we can have multiple agents storing (or representing) the viewpoints expressed in those different arguments. Of course, if multiple arguments from the corpus populate the knowledge bases of multiple agents, there's a risk that two arguments will make the same, or almost the same, claim using different text. There's no reliable way to process natural language to identify such correspondences, so the Magtalo team currently marks them manually when they

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arise. Thus, agents could end up with arguments that have overlapping sets of premises or conclusions.

With a multiagent system populated by agents representing arguments of specific authors, it's possible to interact with the data in interesting ways. The Magtalo interface (see figure 1) indicates which viewpoints are represented. The running example in the figures concerns a current debate in the UK regarding the issue of identity cards. Two prominent contributors to this debate are Martin Linton (a Labor Party member of Parliament for Battersea, part of the London borough of Wandsworth) and John Wadham (director of the lobby and campaign group Liberty). The Magtalo team has analyzed some recent arguments of these two protagonists and loaded them into two agents in the system. Magtalo uses the metaphor of a meeting, providing the user with the privileged position of chair. The user can ask individual agents for arguments for or against a given claim, ask one agent to attack the arguments of another, ask whether an agent concurs with a particular claim, and so on. The user is thus responsible for the direction of the virtual discussion within the rules of engagement for arguments in meetings—that is, the dialogue protocol.

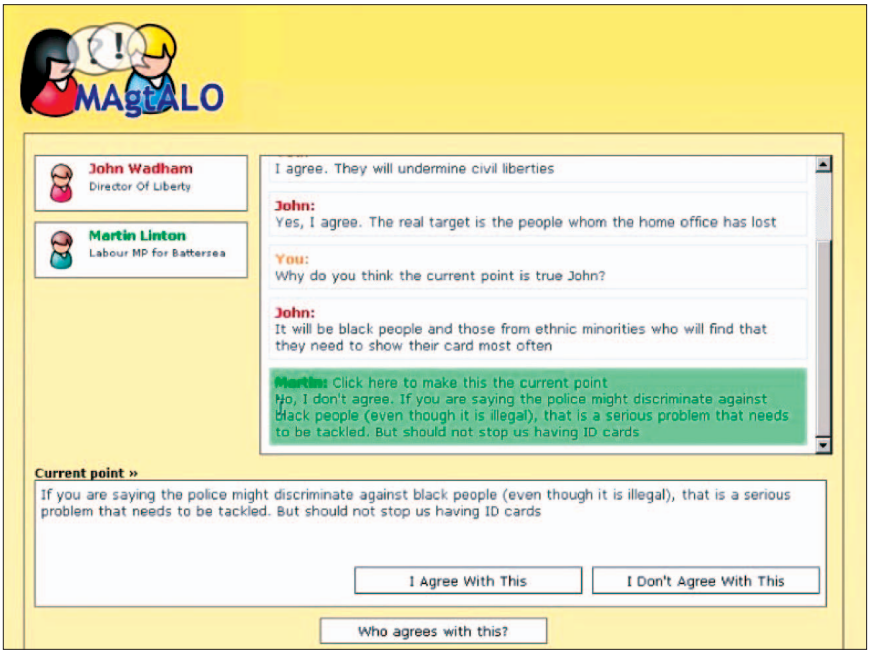

Figure 1. The main Magtalo interface.

Dialogue

One aim of Magtalo is to let participants engage in a discussion rather than an interrogation. This means that the protocol by which the players interact must allow more sophisticated behavior than simply questioning the other players and thereby exploring a knowledge base. All players must be able to interject their own opinions, especially when they disagree with something said.

So, we developed a simple dialogue game protocol to govern the kinds of things that players can say at each point in the dialogue (see the "Dialogue Games" sidebar). This protocol facilitates fair representation of each participant and lets users investigate individual standpoints, while ensuring that the burden on human participants doesn't become onerous. (Argumentation theory, rhetoric, and the communication sciences offer many theories and techniques for explaining and structuring exchanges of this sort.[3] However, dialogue games provide the right mix of abstraction from linguistic content and constraint on the role that such content plays dialectically. The abstraction is vital to obviate the need for natural-language processing; the constraint is necessary to connect and structure the propositional content.)

Dialogues begin from a fixed initial topic—for example, "identity cards are a bad idea," which appears in turn 1 of the example dialogue in table 1. This statement doesn't necessarily represent any given participant's position but serves as the focus for the dialogue. Once the user has selected the initial statement on a given topic, Magtalo presents that user with the option to agree, disagree, or find out where the other agents stand with respect to that statement. If the user either agrees or disagrees with the initial point, Magtalo invites the user to support this position with a reason, such as "they will undermine civil liberties." In table 1, the user has indicated agreement with the initial point.

Although the user is nominally in control of the dialogue, agents can automatically interject after a statement is made if the agent has a sufficiently strong *desire to speak* regarding that statement. The function that currently calculates "desire to speak" is simple: it's the difference between the number of points in support of and the number of points against the statement in an agent's knowledge base. If the value is around zero, then the agent has a low desire to speak about the point (the intuition is that the agent has "mixed feelings"). If the value is greater (or less) than zero, then the agent has a strong desire to speak for or against the point. Each agent has a threshold value, which, when exceeded, moves the agent to interject. More complex desire-to-speak functions might be possible. But, with appropriate threshold values, even such a simple mechanism provides engaging behavior. (A strong relationship exists between the desire-to-speak function and argument aggregation functions. John Fox and Subrata Das have demonstrated that, in many situations, very simple aggregation functions are all that's necessary for appropriate automated reasoning.[4])

Automatic interjection enables the dialogue to proceed with a more natural rhythm. Without such a facility, either the user must ask each agent for its view at each turn or the agents must all respond to each statement that the user and the other agents make. In either case, the resulting dialogue seems artificial and stilted. Although automatic interjection is sensitive to the threshold settings, it can make the dialogue seem far more natural. Table 1 illustrates this point when the John Wadham agent interjects, "Yes, I agree. The real target is the people whom the home office has lost," after the user has agreed with the initial point. This indicates that the John Wadham agent strongly desires to express agreement with the user's previous statement.

Once an agent has interjected, the dialogue game allows the user to agree or disagree with the current point or the last point made during the interjection, or to question the

Dialogue Games

Dialogue games are turn-taking games that structure the interactions between a dialogue's participants. Players use their turn to make moves corresponding to the kinds of things they can say—for example, asserting or conceding—and the rules specify which moves are legal during any given turn. Dialogical commitment (the propositions a player is typically willing to defend if required) is recorded in stores associated with each player and serves as the basis for formulating some rules and as a way to record each player's position.

Philosophy scholars have explored dialogue games as a way of analyzing particular types of reasoning, such as the fallacy of begging the question.[1] More recently, some researchers have used dialogue games as normative ideals for discourse in specific domains such as ethical discussion.[2] These philosophical investigations have, over the past decade or so, provided rich resources for building interagent communication protocols. One of the earliest, best known resources is James Mackenzie's game, DC,[1] which specifies three types of rules: *locutions*, *commitment rules*, and *rules of dialogue*.

Locutions

These rules specify the types of moves available:

- *Statements*. These include P, Q, and truth-functional compounds of statements such as "Not P," "If P then Q," and "Both P and Q."
- *Withdrawals*. The withdrawal of statement P is "No commitment P."
- *Questions*. The question of statement P would be "Is it the case that P?"
- *Challenges*. The challenge of statement P is "Why is it to be supposed that P?" (or simply, "Why P?").
- *Resolution demands*. The resolution demand of statement P is "Resolve whether P."

Commitment rules

These rules specify how to update commitment stores after a move. They include the following:

- *Statements, CR_S*. After statement P, unless the preceding event was a challenge, both participants' commitments include P.
- *Defenses, CR_{YS}*. After statement P, when "Why Q?" was the preceding event, both participants' commitments include P and "If P then Q."
- *Withdrawals, CR_W*. After the withdrawal of P, the speaker's commitment doesn't include P. The hearer's commitment is unchanged.
- *Challenges, CR_Y*. After the challenge of P, the hearer's commitment includes P, the speaker's commitment doesn't include P, and the speaker's commitment includes the challenge "Why P?"
- *Questions and resolution demands, CR_Q and CR_R*. These locutions don't themselves affect commitment.
- *Initial commitment, CR_0*. Each participant's initial commitment is null.

Rules of dialogue

These rules specify when moves are legal. For example, R_{Form} specifies that each participant must contribute one locution at a time, in turn, and that each locution must be either a statement or the withdrawal, question, challenge, or resolution demand of a statement. $R_{Repstat}$ stipulates that no statement may occur if it's a commitment of both speaker and hearer at that stage. R_{Imcon} stipulates that a conditional whose consequent is an immediate consequence of its antecedent must not be withdrawn. R_{Quest} states that after "Is it the case that P?" the next event must be P, "Not P," or "No commitment P." $R_{LogCall}$ requires that a conditional whose consequent is an immediate consequence of its antecedent must not be challenged.

R_{Chall} stipulates that after "Why P?" the next event must be one of the following:

- "No commitment P,"
- the resolution demand of an immediate consequence conditional whose consequent is P and whose antecedent is a conjunction of statements to which the challenger is committed, or
- a statement not under challenge with respect to its speaker (that is, a statement to whose challenge its hearer isn't committed).

$R_{Resolve}$ specifies that the resolution demand of P can occur only if one of the following applies:

- P is a conjunction of statements that are immediately inconsistent and its hearer is committed to all those statements; or
- P is of the form "If Q then R," Q is a conjunction of statements and its hearer is committed to all those statements, R is an immediate consequence of Q, and the previous event was either "No commitment R" or "Why R?"

$R_{Resolution}$ stipulates that after "Resolve whether P," the next event must be one of the following:

- the withdrawal of one of the conjuncts of P,
- the withdrawal of one of the conjuncts of the antecedent of P, or
- the consequent of P.

References

1. J.D. Mackenzie, "Question Begging in Non-cumulative Systems," *J. Philosophical Logic*, vol. 8, 1979, pp.117–133.
2. D.N. Walton and E.C.W. Krabbe, *Commitment in Dialogue*, SUNY Press, 1995.

agent that made this point in order to explore that agent's position (see figure 2). This can be as simple as asking "Why?" to determine underlying reasons and thus expose the basis for the agent's position. If the agent's point fails to persuade the user, the latter can solicit further justification from the former. A dialogue's focus generally follows the last point that was made, but by asking for further reasons, the user can switch the focus back to an earlier point to get extra, independent support for the point. This process of focus switching lets the user return to any earlier point in the dialogue by simply selecting the new focus point from the onscreen dialogue transcript.

Table 1. An example dialogue between a user and two Magtalo agents. One agent represents John Wadham of the UK's Liberty lobby and campaign group; the other represents Labor Party member of Parliament Martin Linton.

Turn	User	Statement
1	System	New discussion started! With the point "Identity cards are a bad idea."
2	User	"I agree. They will undermine civil liberties."
3	John Wadham	"Yes, I agree. The real target is the people whom the home office has lost."
4	User	"Why do you think the current point is true, John?"
5	John Wadham	"It will be black people and those from ethnic minorities who will find that they need to show their card most often."
6	Martin Linton	"No, I don't agree. If you are saying the police might discriminate against black people (even though it is illegal), that is a serious problem that needs to be tackled. But [that] should not stop us [from] having ID cards."
7	User	"I'd like to go back to the point that was made earlier: Identity cards are a bad idea."
8	User	"Do you agree with the current point, Martin?"
9	Martin Linton	"No, I don't agree. They will not undermine civil liberties."
10	User	"No, I don't agree. Storing potentially vast amounts of sensitive data about every citizen in one place presents dangers."

Turn 7 in table 1 illustrates such a focus switch. In that case, the earlier point was the dialogue's initial point, and the user further indicates a desire to explore Martin Linton's positions. With such focus switching, the user can explore new threads of reasoning and expose different arguments for and against each point made rather than being locked into a particular path through the dialogue. Again, this is an example of how the protocol facilitates maintaining a natural rhythm so that a user who is dissatisfied with a current position can return to the point of contention and explore it more.

Magtalo doesn't calculate a solution to a debate, evaluate viewpoints, or persuade a user that a particular viewpoint is superior. Such an approach might be interesting to investigate. However, it's peripheral to the main focus, which is to provide a rich, flexible, but intuitive interface that lets online users interact with and explore complex debates, thereby gaining a deeper and more sophisticated understanding of the topic. An additional benefit of using dialogue game theory as a foundation for this interface is that extracting structured knowledge from the user is considerably easier.

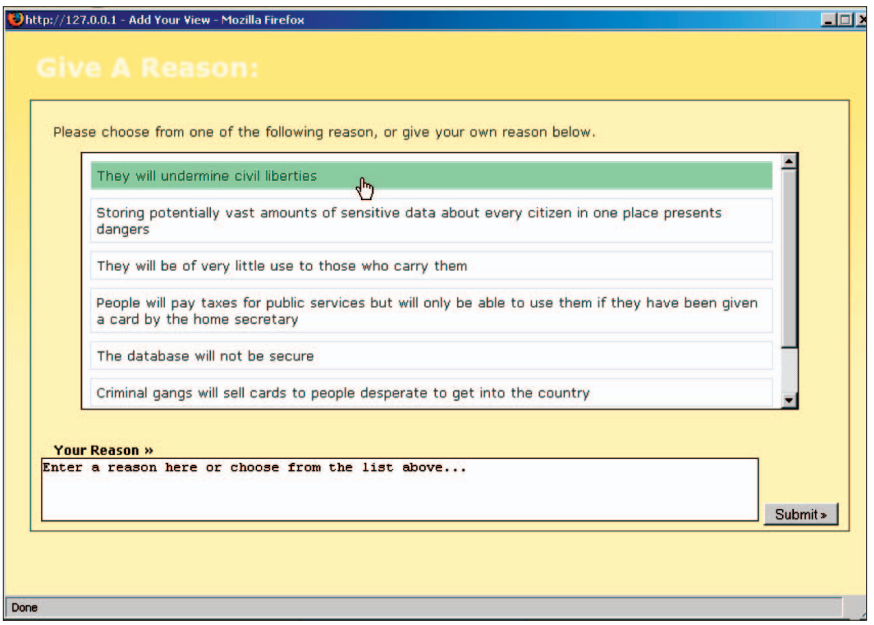

Figure 2. Asking questions in Magtalo.

Knowledge elicitation

The process of uncovering a user's position on a given topic is a form of knowledge elicitation—what Douglas Walton and Erik Krabbe call the *maieutic function* of dialogue.[5] Magtalo uses a simple dialogue game protocol to expose this knowledge and to record it into the system in a structured fashion (see figure 3). Using a dialogue game lets Magtalo capture the dialogue's underlying argumentative structure because each statement is uttered in relation to some earlier statement. For example, offering justification for agreement with a position corresponds to an inference being drawn between the two points—one giving a conclusion, the other giving a reason supporting that conclusion. Using a dialogue game protocol, therefore, helps ensure that each new entry into the dialogue is *dialogically relevant*. Such dialogical relevance is important for recording new information for reuse in future dialogues.

This approach to knowledge elicitation lets users express their positions and underlying reasons, without making them feel like they're being interrogated. The dialogues aren't heavily weighted toward any given participant, because any agent can interject at any point if its interjection threshold is exceeded. Meanwhile, the user remains in control and moves the focus back and forth, following a natural path through the dialogue. These two elements help ensure that the resulting dialogue feels natural to the user, thereby giving the user incentive to continue the discussion.

This argument-based knowledge elicitation minimizes the amount of new, typed user input by letting users select from previously recorded statements first, and then type new statements only if Magtalo hasn't already recorded something appropriate. The dialogue in table 1 represents the user's views

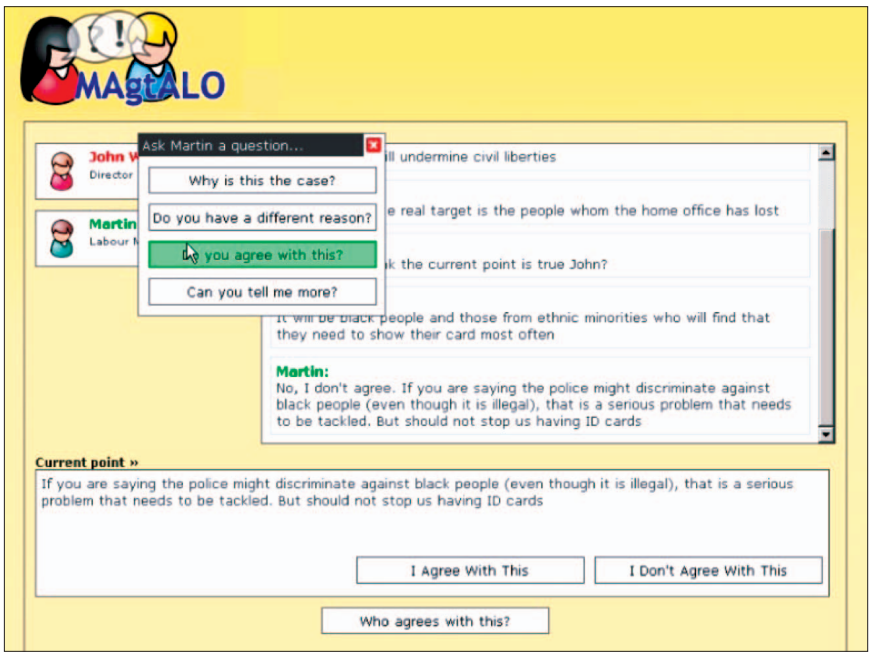

Figure 3. The Magtalo knowledge elicitation screen.

Arguing Online

Two recent systems demonstrate the growing appetite for argumentation as an explicit online device. Convinceme.net (www.convinceme.net) provides a Web 2.0 environment for constructing argumentative positions in debate. Those positions are developed through paired message boards, one pro and one con for each debate. Viewers and contributors can vote on pro and con positions, and on specific posts. Contributors to the site collect points on the basis of

- the number of votes their arguments garner in open debates,
- the total number of votes cast in head-to-head arguments, and
- a fixed number of points if their argument becomes "king of the hill"
- by attracting the most votes in a debate.

This site's focus is clearly on competitive entertainment.

Debatepedia (http://debatepedia.com) provides a Wikipedia interface to complex debate. It imposes structure and rules on contributors to encourage the construction of *logic trees*. This involves breaking down a thesis into subquestions, with each subquestion attracting a variety of evidence for and against a contributor's arguments. Debatepedia aims to collate large sets of evidence presented in an unbiased way to support a new user's rapid understanding of a complex debate.

through existing statements in the system until turn 10, at which point the user introduces a new statement as a reason for disagreement. This approach is beneficial because minimizing typing should help maintain user interest. More importantly, because existing statements can be reused, possibly in new ways, it's easier to make connections between different threads of argument on a given topic. Additionally, this approach avoids the need for natural-language processing, because Magtalo records propositional statements in their entirety. When statements are reused in new ways, it's because the user has linked the statement to some point expressed in a dialogue.

Rich, structured knowledge is thus accumulated through a lightweight, naturalistic interaction with the user. The knowledge collated during any given dialogue represents a user's position on the dialogue's topic. This knowledge is then available for subsequent dialogues, to provide the knowledge for a new agent representing the previous user. So, each time a user engages in a dialogue in Magtalo, there's a structured expansion of the knowledge base. This increases both the number of agents that can potentially take part in future dialogues and the size of the pool of statements from which the next user can select.

Researchers have suggested that argument provides a more intuitive, accessible means of presenting and assimilating complex data[4] and that it's possible to apply structured argumentation to discussions of complex domains involving real risks.[6] Magtalo uses both monologic-argument structures and dialogic-argument protocols to give the user intuitive control over navigation of a complex disagreement space. Presenting and organizing material explicitly as arguments should help users understand the relations between the various positions more easily than in sources such as newspaper reports that have a more discursive style.

The same should be true for other argument-based systems such as Debatepedia (for more on this system, see the "Arguing Online" sidebar). However, Magtalo provides a familiar interaction metaphor—chairing a meeting—and lets users actively participate in both directing the discussion and contributing to it. So, Magtalo offers an appreciable benefit over formats that allow little or no active participation with the material (for example, reports from traditional media) or that offer a weak, nonargumentative interaction model (such as wiki pages and discussion boards). Although informal, small-scale evaluations conducted at the University of Dundee suggest that this benefit is substantial, larger-scale investigations are necessary. Testing these hypotheses on specific user groups is a key step for guiding both the Magtalo project specifically and online argumentation research in general.

From a technical perspective, the underlying representations structuring Magtalo's immediate development require two key advances. First, the system should be able to use a variety of different dialogue protocols so that we can explore and evaluate them using both the representational and evaluative approach of Wells and Reed.[7] Second, we need to replace the existing machinery for processing arguments on the basis of the

Araucaria representation format AML, and instead equip agents in the system so that they can import from, and export to, the argument interchange format.[8] The AIF represents a nascent standard for argument representation. By being extended to support the AIF, Magtalo can become one of a constellation of systems that offer an interface to existing argument resources and a means of creating new ones. Moving to the AIF will also facilitate using the argument computation services under development for connecting formal and computable semantics to linguistic and interactive features of argument. For example, it will be feasible to determine the acceptability of each agent's position according to one or more argumentation semantics[9] and to provide this information to users as the dialogue progresses.

Magtalo represents the first example of an implemented online system that uses a closely specified argument-based dialogue protocol combined with a rich language for representing monologic argument to provide a tool for intuitive user exploration of a disagreement space. This approach also enables the expansion of argument resources through knowledge elicitation, which is structured by the argument dialogue protocol. The continuing aim of our research is to use advances in argumentation theory to push the practice of argumentation technology in providing tools and interfaces that have wide appeal. ■

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References

1. T.F. Gordon and N.I. Karacapilidis, "The Zeno Argumentation Framework," *Proc. 6th Int'l Conf. Artificial Intelligence and Law* (ICAIL 97), ACM Press, 1997, pp. 10–18.
2. C. Reed and G.W.A. Rowe, "Araucaria: Software for Argument Analysis, Diagramming and Representation," *Int'l J. AI Tools,* vol. 14, no. 4, 2004, pp. 961–980.
3. F.H. van Eemeren, R. Grootendorst, and F.A. Snoek Henkemans, *Fundamentals of Argumentation Theory*, Lawrence Erlbaum Associates, 1996.
4. J. Fox and S. Das, "A Unified Framework for Hypothetical and Practical Reasoning (2): Lessons from Medical Applications," *Proc. Int'l Conf. Formal and Applied Practical Reasoning* (FAPR 96), LNCS 1085, Springer, 1996, pp. 73–92.
5. D.N. Walton and E.C.W. Krabbe, *Commitment in Dialogue*, SUNY Press, 1995.
6. P. McBurney and S. Parsons, "Risk Agoras: Using Dialectical Argumentation to Debate Risk," *Risk Management*, vol. 2, no. 2, 2000, pp. 17–27.
7. S. Wells and C. Reed, "A Drosophila for Computational Dialectics," *Proc. 4th Int'l Conf. Autonomous Agents and Multiagent Systems* (AAMAS 05), ACM Press, 2005, pp. 1263–1264.
8. C. Chesnevar et al., "Towards an Argument Interchange Format," *Knowledge Eng. Rev.*, vol. 21, no. 4, 2006, pp. 293–316.
9. M. Caminada, "Semi-stable Semantics," *Computational Models of Argument: Proc. COMMA 2006*, IOS Press, 2006, pp. 121–132.

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