Using dialogical argument as an interface to complex debates

SIMON WELLS AND CHRIS REED

Over the last two decades, an enormous number of online argumentation systems have been developed that support humans in arguing with one another on specific topics. Many of these have been studies in the academic laboratory, though a few of the larger-scale projects have been used in the wild.

More recently, spurred perhaps by high visibility arguments with strong, explicit argumentative structure such as the Iraq Study Group Report, there has been spontaneous interest in argument coming from the online community. Two high profile systems are Convinceme.net and Debatepedia.com. Convinceme.net uses paired message boards to collect the arguments pro and con an issue. These arguments are then voted upon with the most popular becoming king of the hill. Debatepedia.com uses a Wikipedia style interface to enable users to build logic trees in which a thesis is broken down into a series of sub-questions with the aim of collating a body of evidence regarding an issue and to help users to rapidly understand a complex debate.

The academic projects typically have a sound argumentation theoretic basis, which makes for a rich set of argumentative moves and structures—but the presentation and framing of the systems has 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 leaving their users with an impoverished set of moves and tools that they can use.
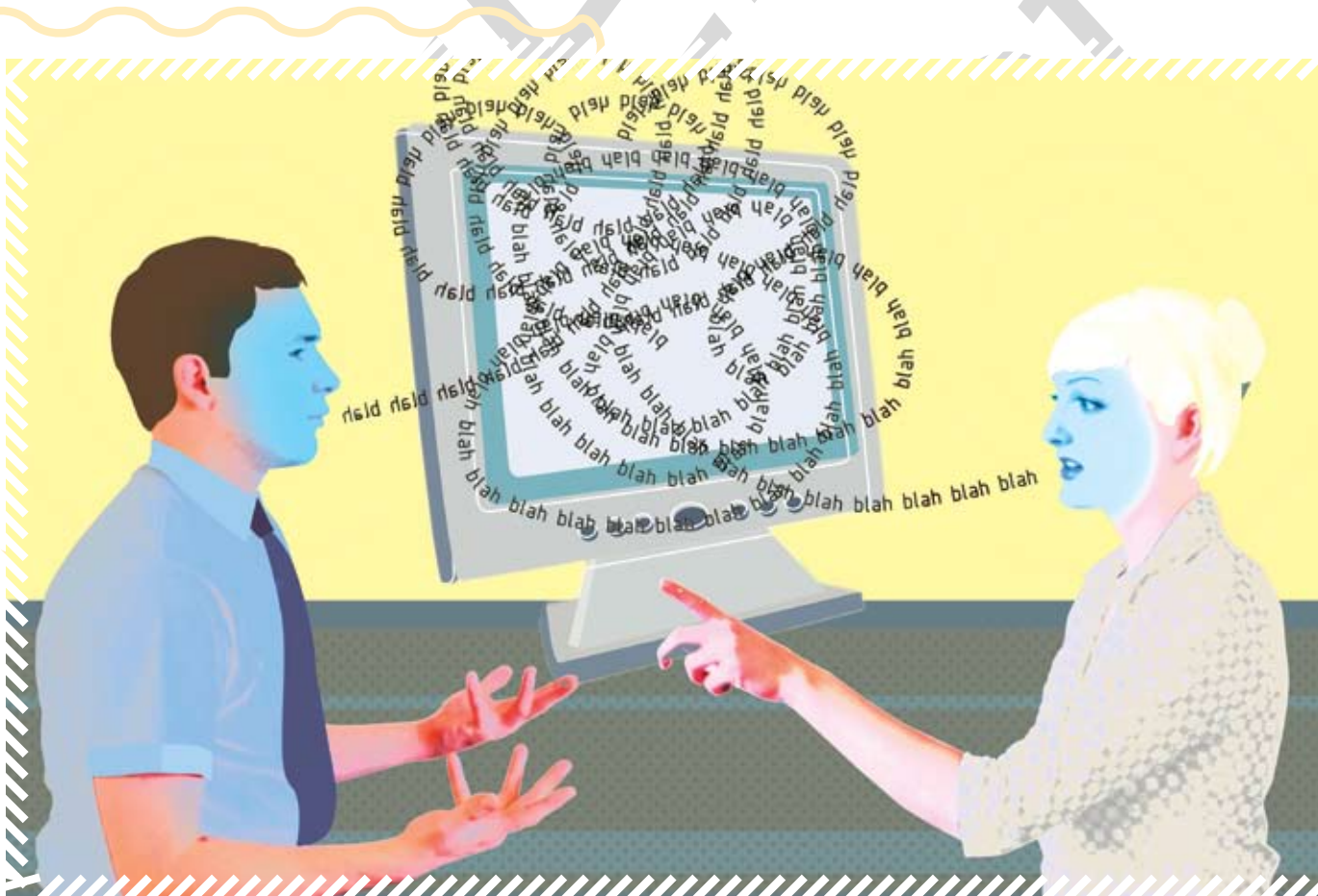
© DIGITAL VISION & ARTVILLE

Figure 1

The Magtalo (MultiAGenT Argumentation, Logic and Opinion) prototype system uses agents in a multi-agent system to represent the views of participants. Magtalo (a Tagalog word meaning disagreement) represents arguments as knowledge structures and employs intuitive, appealing interaction based upon inter-agent argumentation protocols.

Points of view

Pre-existing arguments can be analysed for their argumentative structure using tools like Araucaria (Reed+Rowe 2004). The Argumentation Research Group at Dundee has conducted large scale analyses which are available in an online corpus (at araucaria.computing. dundee.ac.uk). The arguments in this corpus are stored using the XML-based Argument Markup Language (AML), and can easily be read into data structures. In this way, an agent can have its beliefs automatically populated with propositions that correspond to real, analyzed, natural text. In the same way, an agent can automatically acquire the argumentative relations between those propositions, as they are represented in the AML source analyses.

By taking several corpus arguments that are in the same domain, but that have been articulated by different authors, it is possible to have multiple agents "representing" the points of view expressed in those different arguments. Of course, if multiple arguments are taken from the corpus and used to populate the beliefs of multiple agents, there is the risk that two arguments make the same (or almost the same) claim using different text. There is no reliable way to process natural language to identify such correspondences, so the Magtalo team currently mark them manually where they arise. In this way, agents may end up with arguments that have overlapping sets of premises or conclusions.

With a multi-agent system populated by agents representing sets of arguments of specific authors, it becomes possible to interact with the data in interesting ways. The interface provides an indication of which points of view are represented. (The running example shown in the figures concerns a current debate in the UK regarding the issue of identity cards. Two prominent contributors to the debate are Martin Linton, Labour MP for Battersea, and John Wadham, director of the lobby and campaign group Liberty. Some of the recent arguments of these two protagonists have been analyzed and loaded into two agents in the system.) Magtalo uses the metaphor of a meeting, and provides the user with the privileged position of chair. The user can ask individual agents for arguments pro or con a given claim, or can ask one agent to attack the arguments of another, or can ask whether an agent concurs with a claim, and so on. The user

is thus responsible for the direction of the virtual discussion modulo the rules of engagement for arguments in meetings–i.e., the dialogue protocol.

Dialogue

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

To enable this kind of behaviour a simple dialogue game protocol was developed to govern the kinds of things that the players can say at each point in the dialogue. A dialogue game is simply a two-player, turn-taking game in which the moves of the game correspond to the types of utterance that a player can make and form a protocol which regulates player interaction. The Magtalo protocol has been developed to ensure that each participant is fairly represented and that individual standpoints can be investigated, while ensuring that the burden on the human participant does not become onerous. Although there are many techniques and theories available in argumentation theory, rhetoric, and the communication sciences for explaining and structuring exchanges of this sort (vanEemeren-et al., 1996), 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 is illustrated in turn 1 of Fig. 4. This topic does not necessarily represent any given participant's position but serves as the focus for the dialogue. Once the initial topic has been selected, the user is presented with the option to agree, disagree, or to find out where the other agents stand with respect to it. If the user selects either to agree or disagree with the initial point then they are invited to support their position with a reason such as that "they will undermine civil liberties." In Fig. 4, the user has opted to indicate their agreement with the

initial point.

Although the user is nominally in control of the dialogue, agents may 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 is the difference between the number of points in support and the number of points against the statement within an agent's knowledge base. If the value is around zero then the agent has mixed feelings regarding the point. If the value is greater (or less) than zero, then the agent has strong feelings for (or against) the point. Each agent has a threshold value which enables the strength of feeling for a given point to be determined individually. If the threshold is exceeded then the agent will automatically express its viewpoint in the dialogue at that point.

Though it is possible to imagine more complex desire-to-speak functions, we have found that even such a simple mechanism provides engaging behaviour with appropriate threshold values. (Notice that there is a strong relationship between the desire-to-speak function and argument aggregation functions. Fox and Das have demonstrated that very simple aggregation functions are often all that is required for appropriate automated reasoning in many situations). Automatic interjection enables the dialogue to proceed with a more natural rhythm. Without such a facility either the user must ask each agent for their view at each turn, or else the agents must all respond to each statement that the other agents and the user make. In either case the resulting dialogue seems artificial and stilted.

Though sensitive to the threshold settings, automatic interjection can make the dialogue seem much more natural. This is illustrated in Fig. 4, in which the agent associated with John Wadham interjects with "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 John Wadham has a strong desire to speak in agreement with the last statement made by the user.

Once an agent has interjected, the dialogue game allows the user to either agree or disagree with the current point, the last point that was made during the interjection, or to question the agent that made the point to explore that agent's position. This can be as simple as ask-

Figure 2

Figure 3

ing, Why?, in order to get underlying reasons and so expose the basis for the agent's position. If the agent's point failed to persuade the user, further justification can be solicited. The focus of a dialogue generally follows the last point that was made, but by asking for further reasons the user is switching focus back to an earlier point to get extra, independent support for the point. This process of focus switching allows the user to return to any earlier point in the dialogue,

simply by selecting the new focus-point from the dialogue transcript displayed on screen.

Such a switch of focus is illustrated in turn 7 of the dialogue in Fig. 4, whereby the user indicates that they wish to return to an earlier point. In this case the earlier point is the initial point of the dialogue and the user further indicates that they wish to explore Martin Linton's positions. The result of such focus switching is that the user is able to explore

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 should not stop us 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 danges"

Figure 4

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 enables a natural rhythm to be maintained in which, when the user is dissatisfied with the current position, they can return to the point of contention and explore it some more.

Magtalo is not in the business of calculating a "solution" to a debate, or of evaluating points of view, or of persuading a user that a particular viewpoint is superior. Though such things may be interesting to investigate (as is hinted at, at least in part, in the section on directions), they are peripheral to the main focus, which is squarely upon providing a rich, flexible, but intuitive interface by which online users can interact with and explore complex debates, thereby gaining a deeper and more sophisticated understanding of the topic. One rather more direct additional benefit of using the theory of dialogue games as a foundation upon which to build such an interface is that the process of extracting structured knowledge from the user is made significantly easier.

Knowledge elicitation

The process of uncovering a user's position on a given topic is a form of knowledge elicitation—what Walton and Krabbe refer to as the maieutic function of dialogue. Magtalo uses a simple dialogue game protocol to expose this knowledge and to record it into the system in a structured fashion.Use of a dialogue game enables the underlying argumentative structure of the dialogue to be captured. This is because each statement is uttered in relation to some earlier statement. For example, offering justification for agreement with a posi-

tion corresponds to an inference being drawn between the two points, one giving the conclusion and the other giving a reason in support of that conclusion. The use of a dialogue game protocol therefore helps to ensure that each new entry into the dialogue is dialogically relevant.

Such dialogical relevance is important to enable new information to be recorded for reuse in future dialogues. This approach to knowledge elicitation enables the user to express their position and underlying reasons, without the interaction feeling like an interrogation. The dialogues are not heavily weighted towards any given participant because any agent may interject at any point if their desire-to-speak 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 to ensure that the resulting dialogue feels natural to the user and thereby gives the user some incentive to continue with the discussion.

The amount of new, typed user input is minimized by allowing the user to select from previously recorded statements, and then to type in new statements only if there is nothing appropriate already recorded. In Fig. 4, the user's views are represented by existing statements in the system until turn 10, at which point the user introduces a new statement as a reason for their disagreement. The benefit of this approach, as well as maintaining user interest by minimizing typing, is that existing statements are reused, possibly in new ways so connections can be made between different threads of argument on a topic.

Additionally, this approach avoids the need for natural language processing as propositional statements are recorded

in their entirety. When statements are reused in new ways it is because the user has linked the statement to some point expressed within 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 topic of the dialogue. This knowledge can then be reused in subsequent dialogues to provide the knowledge for a new agent representing the last user. Therefore each time a user engages in a dialogue within Magtalo, there is a structured expansion of the knowledge base, which increases the number of agents who can potentially take part in future dialogues, in addition to also increasing the size of the pool of statements from which the next user can select.

Directions

It has been suggested that argument provides a more intuitive and accessible means of presenting and assimilating complex data and that structured argumentation can be applied to discussions of complex domains involving real risks. In Magtalo, both monologic argument structures and dialogic argument protocols are used to give the user intuitive control over navigation of a complex disagreement space. Presenting and organising material explicitly as arguments should mean that users find it easier to understand the relations between the various positions in comparison to sources which have a more discursive style (such as newspaper reports).

One would expect the same to be true for other argument-based systems such as debatepedia. But providing an intuitive interaction metaphor with which the user is expected to be familiar (chairing a meeting), and allowing the user active participation in both directing the discussion and contributing to it, it is further expected that Magtalo should offer an appreciable benefit over formats that allow little or no active participation with the material (such as reports from the traditional media) or that offer a weak, non-argumentative interaction model (such as or Wiki pages and discussion boards). Although informal, small-scale evaluations conducted at Dundee suggest that this benefit is substantial, larger scale investigations are required. Testing these hypotheses on specific user groups is a key step for guiding both the Magtalo project spe-

cifically, and the online argumentation research area in general.

From a technical perspective there are two key advances in the underlying representations that structure Magtalo's immediate development. First is to allow the system to use a variety of different dialogue protocols, so that such protocols might be explored and evaluated, using both the representational style and evaluative approach of Wells and Reed, 2005.

Second is to replace the existing machinery for processing arguments based on the Araucaria representation format AML, and instead equip agents in the system with the ability to import from, and export to, the argument interchange format (Chesnevar-etal 2006). The AIF represents a nascent standard for argument representation: by extending Magtalo to support the AIF, it becomes one of a constellation of systems that can offer an interface to existing argument resources, and provide a means of creating new suchresources. By moving to the AIF, it will also become easier to make use of argument computation services that are now under development, forconnecting the linguistic, textual analysis, elicitation and interaction with underlying formal models and semantics. It will, for example, become feasible to compute acceptability of each agent's position according to one or more argumentation semantics (Caminada 2006), and provide this information to users as the dialogue progresses.

Magtalo represents the first example of an implemented online system that uses an argument-based dialogue protocol combined with a rich monologic argument representation language to provide a tool for intuitive user explo-ration of a space of disagreement. As an additional benefit of the approach, it is possible to expand the argument resources through knowledge elicitation that is structured by the argument dialogue protocol. The continuing aim of the research is to use the advances in the theory of argumentation to push the practice of argumentation technology in providing tools and interfaces that have wide appeal.

Acknowledgements

Read more about it

M. Caminada, "Semi-stable semantics.," in *Proc. 1st Int. Conf. on Computational Models of Argument*, Liverpool, UK, 2006, pp. 121–130.

C. Chesnevar, et al., "Towards an argument interchange format," *Knowledge Eng. Rev.*, vol. 21, no. 4, pp. 293–316, Dec. 2006.

J. Fox and S. Das, "A unified framework for hypothetical and practical reasoning (2): Lessons from medical applications," in *Proc. of the Int. Conf. on Formal and Applied Practial Reasoning*, 1996, pp. 73–92.

T.F. Gordon and N.I. Karacapilidis, "The zeno argumentation framework," in Proc. Int. Conf. on Artificial Intelligence and Law, 1997, pp. 10–18.

P. McBurney and S. Parsons, "Risk agoras: Using dialectical argumentation to debate risk," *Risk Management*, pp. 17-27, 2000.

C. Reed and G.W.A. Rowe, "Araucaria: Software for argument analysis, diagramming and representation," *Int. J. Artifical Intelligence Tools*, vol. 14, 2004.

F.H. van Eemeren, R. Grootendorst, and F.A. Snoek Henkemans, *Fundamentals of Argumentation Theory*. Mahwah, NJ: LEA, 1996.

D.N. Walton and E.C.W. Krabbe, *Commitment in Dialogue*. Albany, NY: SUNY Press, 1995.

S. Wells and C. Reed, "A drosophila for computational dialectics," in *Proc. Int. Conf. on Autonomous Agents and Multi-Agent Systems*, 2005, pp.1263-1264.

About the authors

Simon Wells (swells@computing.dun-dee.ac.uk) is a postdoctoral fellow in the School of Computing, University of Dundee. He has focused on the representation and processing of philosophical theories of argumentative dialogue in the context of multi-agent systems.

Chris Reed (chris@computing.dundee.ac.uk) is head of research in the School of Computing at the University of Dundee and runs the Argumentation Research Group, which works on applied and theoretical aspects of argumentation and its relation to computer science, linguistics and philosophy.