

# MAGtALO: An Agent-Based System for Persuasive Online Interaction

Simon Wells and Chris Reed<sup>1</sup>

**Abstract.** This paper provides a concise introduction to the MAGtALO system. This prototype software environment provides a mechanism enabling users to engage in online debate using naturalistic dialogue underpinned by sound argumentation theory. MAGtALO is used to demonstrate how dialogue protocols can be applied to support flexible intuitive interaction within complex and contentious problem domains.

## 1 ARGUING ONLINE

Recently the online community has spontaneously demonstrated great interest in argument. This may have been spurred in part by the highly visible arguments with strong and explicit argumentative structure such as those found in the Iraq Study Group Report.

Various online systems have been deployed to exploit this interest such as *convinceme.net* and *debatepedia.com*. These systems have enabled members of the public to engage with each other and to express their opinions using web-based interaction mechanisms. In *convinceme.net* the aim is competitive, users attempt to accumulate votes, which equate to points, with the aim of accumulating the most points and thereby becoming *King of the Hill* within a single debate. However, *Debatepedia* uses a Wikipedia style interface to collate large evidence sets to support a user in exploring and understanding a complex debate topic. What both of these systems have in common is that they both provide high quality Web 2.0 based interfaces and environments to support user interaction. The interfaces arguably contribute to the construction of the broad userbases which underpin these systems but the underlying argumentation theory is often impoverished, having small sets of moves which the users can make and limited tools for interacting with the argumentative content.

Even where systems have not been designed to explicitly support the dialectical nature of argumentative dialogue, users will try to fit in a rudimentary yet intuitive argumentative structure. This occurs often in blog comments and in the BBC's *Have Your Say* webpage in which users will often manually copy and paste earlier posts into their own response to specify the exact point to which they are responding. Users obviously want a way to structure their interactions and responses so that they can explore the arguments of others whilst making their own explicit in relation. Such capabilities are not however explicitly supported by the current crop of weblog commenting or fora software. MAGtALO (MultiAGenT Argument, Logic and Opinion) is a word for disagreement used in the Tagalog language spoken in the Republic of the Phillipines, and disagreement is also a natural state of affairs in complex and contentious real world domains.

The MAGtALO system adopts the intuitive and appealing interaction mechanisms found in extant online debate systems and marries them with cutting edge research into the representation of argument, as structures of knowledge, and argumentation, in terms of structured protocols for interaction. It has been suggested that argument provides an intuitive and accessible way to present and assimilate complex data [2], and that structured argumentation can be applied to discussion of complex domains involving real risks [5]. 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).

## 2 MAGtALO Architecture

MAGtALO consists of a multiagent-based backend server and a web-based user-facing interface which is shown in figure 1. The web interface is AJAX-based and incorporates client-side javascript to ensure that a responsive user interface is provided to the user.



Figure 1. The main MAGtALO interface

The interface is written in PHP and is served from a standard Apache web server, MySQL database, and Hypertext Pre-Processor AMP software stack. The interface enables a user to engage in a persuasive dialogue with a number of software agents using simple, in-

<sup>1</sup> School of Computing, University of Dundee, email: {swells,chriss}@computing.dundee.ac.uk

tuitive dialectical-game based interaction protocols. Given an initial topic the user is provided with various choices, such as to agree or disagree with a given position, or to provide a reason for their stated position. The agent back-end uses the Jackdaw University Development Environment (JUDE), an academic-oriented distribution of the Jackdaw Multiagent System (MAS) platform developed by Calico Jack Ltd [3]. JUDE is a Java-based, lightweight, flexible, and industrial-strength agent development platform that takes a modular, dynamically extensible approach to agent development. The agent backend supports the storage of user positions for later reuse in subsequent dialogues, and provides the mechanism whereby a user receives an appropriate response from the pre-stored arguments. The software agents respond to the points made in the dialogue, either by the user or by other agent participants as required, utilising information stored in their belief databases and a *desire to speak* function which controls how much an agent wishes to make an utterance at any given point in the dialogue.

### 3 ARGUMENTS & POINTS OF VIEW

MAgtALO uses agents in a multiagent system to represent the views of participants. Pre-existing arguments are analysed in terms of their argumentative structure using tools such as Araucaria [6]. Arguments are stored using AML, the XML-based Argument Markup Language, and are read into the agents respective belief databases. For a given domain, arguments from various perspectives can initially be analysed and stored as AML. Agents can then have their beliefs automatically populated not only with propositions that correspond to real, analysed natural text, but also with the argumentative relations that hold between those propositions. For MAgtALO this process involves finding several corpus arguments that are in the same domain but that have been articulated by different, possibly conflicting, authors. Given multiple points of view, garnered from specific authors who hold particular positions with respect to the domain, it is possible to interact with the data in interesting ways. Interaction in MAgtALO utilises the specific metaphor of a meeting, with the user holding the privileged position of chair. The user is therefore able to interact with specific agents, eliciting their personal views about a particular point, asking for arguments *pro* or *con* a given position, asking an agent to attack the arguments of another, or whether they concur with the current claim, and so on. The user therefore has some control over the direction of the dialogue modulo the rules of the interaction protocol.

### 4 PERSUASIVE DIALOGUE

One aim of MAgtALO is to enable the participants to engage in a, possibly persuasive, 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, building a pool of answers associated with the participants, and thereby exploring the agent knowledge bases. Each participant, including the user(s) and any agents, must be able to interject with their own opinions, especially when something is said with which they disagree. To support this kind of behaviour, two approaches were taken. The first utilises a simple dialogue game protocol that was developed to govern the kinds of things that the players can say at each point in the dialogue. Dialogue games are basically turn-taking games which can be used to structure the interactions between a dialogue's participants, enabling the participants to, for example, construct a position with respect to the point at issue. Dialogue games are based on the notion that a particular class of utterances can be classified as *speech*

*acts* [7] or *performatives* and that when uttered they have the characteristics of actions. In a dialogue game the kinds of moves that can be made, and hence the kinds of things that can be said correspond to particular speech acts. For example, the influential game, 'DC' due to Mackenzie [4] includes the statement, withdrawal, question, challenge, and resolution demand performatives. In addition to the performatives, dialogue games are commitment based meaning that when a participant makes a move it affects their commitment with respect to the content of that move. For example, in DC uttering a statement causes the speaker to become committed with respect to that statement. Dialogue games also specify a protocol for how a dialogue can legally develop, for example, specifying that after a question, the next move must be either a statement or withdrawal. Dialogue games have been used to analyse various errors in reasoning such as the fallacy of begging the question [4] and as normative ideals for discourse in specific domains such as ethical discussion [8]. A fragment of the dialogue game protocol can be seen in figure 2 in which the user is asking the agent Martin a question. In response to the current point, the user is able to ask Martin to supply a reason for the current point, or to supply further reasons if the proffered reason is not sufficient, or Martin can be asked whether he agrees or whether he can expand on his current position.

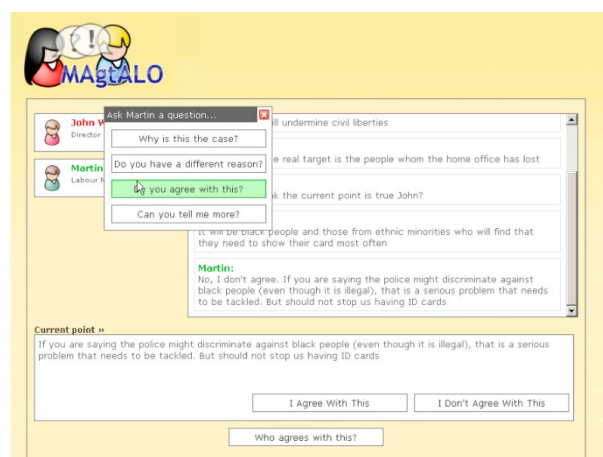


Figure 2. Dialogical interaction in MAgtALO

The second approach was to introduce the notion of a desire-to-speak function, which is incorporated into the agent participants of the dialogue, and enables them to automatically interject after a statement is made that exceeds their desire-to-speak threshold. The function is simple and merely calculates the difference between the number of points in support of a statement and the number of points against within an agents knowledge base. 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 agents knowledge base. If the value is around zero then the agent has mixed feelings regarding the point. If the value is greater or lesser than zero, then the agent has strong feelings either for or against the point. Each agent has a threshold value set which enables the strength of feeling for a given point to be determined individu-

ally. If the threshold is exceeded then the agent will automatically express its viewpoint in the dialogue at that point. Fox and Das [2] have demonstrated that very simple aggregation functions are often all that is required for appropriate automated reasoning in many situations, a mechanism such as automatic interjection can therefore make the dialogue seem much more natural. The aim of Magtalo is not to calculate a "solution" to a debate, or to evaluate points of view, or even particularly to persuade a user that a particular viewpoint is superior but is mainly to provide a robust software environment in which complex domains can be explored. During this process however it is likely that a user, exposed to arguments that they had not previously considered might find themselves persuaded to adjust their position. Though such things may be interesting to investigate (as is hinted at, at least in part, in section 7), 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.

## 5 KNOWLEDGE ELICITATION

The process of uncovering a users position on a given topic is a form of knowledge elicitation, what [8] 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 using AML. These AML records can subsequently be loaded into a MAgtALO Agent so that subsequent dialogues can occur in which the arguments of the current participant become the beliefs of an intelligent software agent representing the views of the original participant. 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 position corresponds to an inference being drawn between the two points, one giving a conclusion and the other giving a reason in support of the conclusion. The use of a dialogue game protocol therefore ensures 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.

Using this approach the amount of new, typed user input is minimised by allowing the user to select from previously recorded statements first, then allowing the user to type in new statements only if there is nothing appropriate already recorded. The benefit of this approach, as well as maintaining user interest by minimising 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

## 6 Example Dialogue

An example MAgtALO dialogue can be seen in figure 4. In this dialogue there is a single user and two MAgtALO agents, one representing John Wadham of Liberty who is very much opposed to the

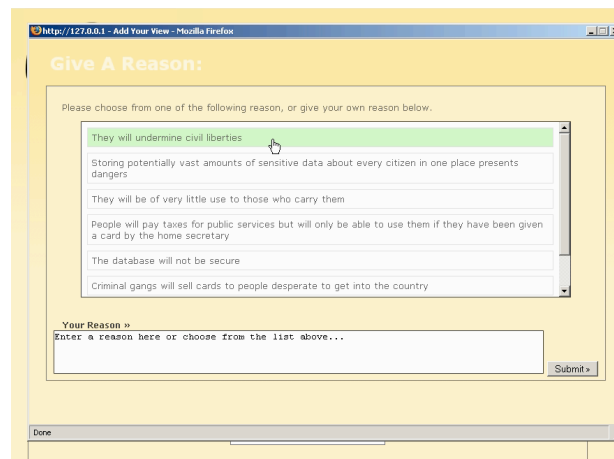


Figure 3. Knowledge elicitation in MAgtALO

introduction of identity cards, and the other representing the Labour MP Martin Linton, who argues in favour of identity cards. The dialogue begins at turn 1 from a fixed initial topic. In this case the system introduces the topic of the dialogue with the statement "identity cards are a bad idea". This does not represent the position of any given participant but merely provides the focus for the dialogue. Once the initial topic has been selected, the user is presented with the option to agree, to disagree, or to find out where the other agents stand with respect to it. In the example the user selects to agree and is then invited to support their position with a reason. In turn 2 the user does so and selects to reuse an existing reason from the system to support their position. Automatic interjection is used to help the dialogue seem more natural and this is demonstrated in turn 3 where the John Wadham agent interjects to agree with the user and proffers a reason for so-doing. This indicates that the John Wadham agent had a strong desire-to-speak in agreement with the user's last statement.

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 asking, *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 user then responds in turn 4 by using a dialogue system move to attempt to elicit a further reason from the John Wadham agent who responds in turn 5 with a further reason. It is at this point that the Martin Linton agent automatically interjects to disagree in turn 6 with the statement made in turn 5. 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 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 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. The user, in turn 8, then directs a question towards the Martin Linton agent who responds in turn 9. In turn 10 the users disagrees with the Martin Linton agent but the reason that the user produces is not already available in the system and is a new statement entered into the system through the knowledge elicitation process discussed in section 3. The example therefore demonstrates the major facilities of the MAGtALO system, including knowledge elicitation, automatic interjection, and guidance of the dialogue through the use of a dialogue game protocol.

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	"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	"It will be black people and those from ethnic minorities who will find that they need to show their card most often"
6	Martin	"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	"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"

**Figure 4.** An example dialogue on the topic of identity cards.

## 7 FUTURE DIRECTIONS

It has been suggested that argument provides a more intuitive and accessible means of presenting and assimilating complex data [2], and that structured argumentation can be applied to discussions of complex domains involving real risks [5]. 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 debatapedia. 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 specifically, and the online argumentation research area in general.

From a technical perspective there are two key aspects to MAGtALO's future development. The first aspect is to allow the system to use a variety of dialogue protocols. This enables various protocols both to be explored and evaluated using real-world data and for protocols to be developed and deployed that are specific to the needs of the audience. The second aspect is to replace the existing argument processing machinery, currently based upon Araucaria's AML [6], with the ability to import from, and export to, the argument interchange format (AIF) [1] a nascent format for argument representation and interchange. The adoption of AIF enables MAGtALO to become just one system in a possible constellation of online argumentation systems, enabling users to both interact with existing argument resources and to create new ones.

The aim of this research is to exploit advances in argumentation theory by applying them in tools and interfaces that have wide popular appeal. MAGtALO is the first implemented example of an online system that uses a closely specified argument-based dialogue protocol combined with a rich monologic argument representation language to enable users to intuitively explore a *space of disagreement*.

## ACKNOWLEDGEMENTS

The implementation work on Magtalo was carried out by John Lawrence, an MSc student in the School of Computing during 2006. John can be contacted at [mail@johnlawrence.net](mailto:mail@johnlawrence.net) A video showing how Magtalo can be used, and a live demonstration version of the system, are available online at [arg.computing.dundee.ac.uk](http://arg.computing.dundee.ac.uk)

## REFERENCES

- [1] C. Chesnevar, J. McGinnis, S. Modgil, I. Rahwan, C. Reed, G. Simari, M. South, G. Vreeswijk, and S. Willmott, 'Towards an argument interchange format', *Knowledge Engineering Review*, **21**(4), 293–316, (2006).
- [2] John Fox and Subrata Das, 'A unified framework for hypothetical and practical reasoning (2): Lessons from medical applications', in *Practical Reasoning: Proceedings of the International Conference on Formal and Applied Practical Reasoning (FAPR-96)*, eds., Dov M. Gabbay and Hans Jurgen Ohlbach, LNAI 1085. Springer, (1996).
- [3] Calico Jack Ltd. <http://www.calicojack.co.uk>, 2008.
- [4] J. D. Mackenzie, 'Question begging in non-cumulative systems', *Journal of Philosophical Logic*, **8**, 117–133, (1979).
- [5] P. McBurney and S. Parsons, 'Risk agoras: Using dialectical argumentation to debate risk', *Risk Management*, **2**(2), 17–27, (2000).
- [6] C. Reed and G.W.A. Rowe, 'Araucaria: Software for argument analysis, diagramming and representation', *International Journal of AI Tools*, **14**(3-4), 961–980, (2004).
- [7] J. R. Searle, *Speech Acts*, Cambridge University Press, 1969.
- [8] Douglas N. Walton and Erik C. W. Krabbe, *Commitment in Dialogue*, SUNY Press, 1995.