SUPPORTING ARGUMENT IN E-DEMOCRACY

Dan Cartwright[1], Katie Atkinson[1], and Trevor Bench-Capon[1]

Abstract

Methods of argument representation can be exploited in systems for e-democracy. In this paper we discuss a particular method of argument representation, known as an argumentation scheme, and some issues concerning the relations between arguments represented using such schemes. We show how this method of argument representation has been implemented in a practical system designed for the public to critique policy proposals.

Keywords: e-Democracy, Argumentation Schemes, Decision Support Tools

1.   Introduction

There are a growing number of systems available for e-Democracy that are designed to engage citizens in political debate. There is wide variation amongst these systems concerning the way in which information is analysed and presented. For example, some systems offer discussion boards with threaded topics that are easy to join and use. One such example is the policy-debating forum used on the Scottish Highland Youth Voice system [6]. Such systems allow for freedom of expression, but there is little structure imposed on the opinions submitted. Other tools exist to identify and map the arguments in a debate and such tools are useful for the purposes of debate visualisation, but they do not always provide inference and evaluation mechanisms. Furthermore, it is often left to the users to make logical connections between the arguments they put forward in a debate, and this can present validation and usability issues. Crucially, because users are provided with little guidance on how to structure their arguments, it is often difficult to see precisely how different contributions relate to one another. Another approach is to use more structured opinions in accordance with particular methods of argument representation, such as argumentation schemes. Such schemes represent stereotypical patterns of reasoning that can be instantiated and subsequently challenged by posing critical questions associated with the schemes. Araucaria [7] is a system which takes as input an argumentation scheme and presents as output a graphical map of the arguments. Another example of a decision support tool which implements argumentation schemes is Carneades [5] which supports persuasion dialogues in which two or more participants try to resolve a difference of opinion by trying to persuade the other(s) to adopt their own point of view. Arguments in the system model argumentation scheme instantiations. One issue with tools that make use of argumentation schemes is that these schemes do not have precisely defined semantics. Rather, the systems allow for free text input and although this makes it very easy for users to express themselves, it makes it difficult to verify that the critical questions have

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[1] The University of Liverpool, email:{D.R.Cartwright, K.M. Atkinson, tbc}@liverpool.ac.uk

the appropriate relevant semantic content. In this paper we show how we can impose some semantic constraints on the different elements of argumentation schemes, and how this facilitates their use in a system for e-Democracy. Section 2 discusses argumentation schemes in detail. Section 3 provides an overview of the e-Democracy system we are developing that makes use of such schemes. In Section 4 we discuss how we have implemented a catalogue of schemes for use in this system and we present a worked example in Section 5. The paper concludes in Section 6.

2. Argumentation Schemes for e-Democracy Systems

Argumentation schemes, a well-established method of argument representation [2, 8], present themselves as a flexible method for expressing arguments. The schemes provide some structure for arguments yet are not so rigid that they cannot be understood by laypersons. Argumentation schemes represent stereotypical patterns of reasoning whereby the schemes contain premises that presumptively licence a conclusion. The presumptions can then be tested by posing the appropriate critical questions associated with the scheme. In order for the presumption to stand, satisfactory answers must be given to any such questions that are posed in the given situation.

A number of schemes have been suggested in the literature (see for example, [8]) to cater for the most common types of argument. By way of an example, consider the following scheme, described in [8], which is named "Argument from Expert Opinion" and is stated as follows:

Person E is an expert in Domain D. E asserts that A is known to be true. A is within D. Therefore, A may (plausibly) be taken to be true

There are a number of critical questions associated with this argumentation scheme which challenge the presumptions present in the scheme. For example, one critical question asks *"Is E a genuine expert in domain D?"*, while another asks *"Did E really assert A?"*. By responding to these questions, we can determine whether a particular audience (person or group of people) agrees with the argument. If the audience does not agree with the argument, the nature of the critical questions allows us to pinpoint exactly which part of the argument the audience disagrees with.

Argumentation schemes do not necessarily represent standalone arguments; the use of schemes also raises another interesting question; how does one respond to the critical questions associated with argumentation schemes? In a real world setting, it is often natural to respond to these kinds of questions using another argument, possibly of a different type. For example, consider one of the critical questions associated with the "Argument from Expert Opinion" scheme given earlier, which asks *"Is E a genuine expert in domain D?"*. Obviously, a "Yes or No" answer to this question is appropriate, but in real-world argumentation one would expect an argument to be provided to support this answer. For example, let us consider an example argument instantiated using the following argumentation scheme for practical reasoning, first introduced in [1]:

In the current circumstances R, we should perform action A, to achieve new circumstances S, which will realise some goal G, which will promote some value V

This argumentation scheme is used to provide a justification for carrying out a particular action A. For the purposes of this example, we consider an argument based around the action of installing speed limiting devices in motor vehicles. We instantiate the lettered elements of the argumentation scheme (i.e. circumstances R, action A, new circumstances S, goal G and value V) as follows:

> *In the current circumstances **there is a high death toll on UK roads,** we should **install speed-limiting devices in cars,** to achieve **a reduction in speeding vehicles,** which will realise less accidents on UK roads, which will promote **saving lives***

The proponent of this argument may wish to support the presumptions presented in this scheme, which can be challenged by the critical questions. For example, one of the critical questions is "*Are the circumstances really as described?*". The proponent of the argument may want to support this presumption by providing a supporting argument, instantiated using a different argumentation scheme. For the purposes of this example, we consider a response to this critical question which is instantiated using the "Argument from Expert Opinion" scheme, which supports the statement which suggests that, in the current circumstances, there is a high death toll on UK roads:

> *The Department for Transport is an expert in road traffic statistics*
> *The Department for Transport asserts that there were 2,500 deaths on UK roads in 2006*
> *The number of fatalities on UK roads is within the domain of road traffic statistics*
> *Therefore, the fact that there were 2,500 road deaths in 2006 may plausibly be taken to be true.*
>
> *The fact that there were 2,500 fatalities on UK roads in 2006 supports the statement that there is a high death toll on UK roads.*

The final sentence is a kind of "justification" statement, which is not part of the original argumentation scheme. An additional critical question "*Does X justify Y?*" (where X is the conclusion of the supporting argument and Y is the statement in the original argument) is also added to the scheme's critical questions. It ensures that the conclusion of the supporting argument does actually support the statement in the original argument.

Now, if the critical question "*Are the circumstances really as described?*" is posed (i.e. "*Is there really a high death toll on UK roads?*"), the supporting evidence instantiated using the "Argument from Expert Opinion" scheme is presented as a response to this question.

The interaction of different argumentation schemes through responses to critical questions allows more in-depth representation and analysis of debates. As a result, we can determine more precisely not only which parts of an argument cause most disagreement, but also why they cause disagreement.

3.   Overview of Parmenides

Parmenides is intended as a system for deliberative democracy whereby the government is able to present policy proposals to the public so that users can submit their opinions on the justification presented for the particular policy. The system makes use of two particular mechanisms for argument representation and evaluation. Firstly, argumentation schemes, as described in the previous section, are

used to structure and relate the opinions gathered. Despite the use of such a structured model of argument, usability is promoted as such schemes remain quite close to natural language representation. Secondly, argumentation frameworks [4], which are mechanisms used in the computational modeling of arguments, are used to evaluate the arguments of concern to a debate and determine the ones that are most acceptable to users of the system.

The argumentation scheme used in the first version of Parmenides was the practical reasoning scheme presented in the previous section. This scheme has previously been described in [2], and it is an extension to Walton's sufficient condition scheme for practical reasoning [8]. The version of the scheme used in Parmenides is modified slightly in that "new circumstances S" are removed from the scheme to prevent confusing users of the difference between "new circumstances" and "goals". There are sixteen critical questions associated with the original practical reasoning argumentation scheme, although only a subset of them are relevant in the implementation of the modified scheme used in Parmenides. Examples of the critical questions include "*Are the circumstances as described?*", "*Does the goal promote the value?*", and "*Are there alternative actions that need to be considered?*". The full list of critical questions can be found in [2].

The Parmenides system consists of four main components, which are summarised below:

- *Debate creator* – A PHP-based webpage interface that allows debate administrators to create a new debate by instantiating elements of the argumentation scheme. The system then creates the relevant website and database source files to allow people to participate in the created debate.

- *Parmenides interface* - The second component is the webpages, which allow people to actually participate in the debate. The opinions given by users are written to a back-end database.

- *Administration tools* – These tools allow administration of the Parmenides system, including an interface which allows argumentation schemes to be quickly and easily added into the system.

- *Analysis tools* – A set of Java-based analysis tools, which analyse the data users submit by using Argumentation Frameworks and Value-based Argumentation Frameworks [3].

We discuss these components in the remainder of this section, apart from the administrative tool for adding argumentation schemes into the system, which we discuss in the next section of this paper.

3.1 Debate Creator

To create a debate, the debate administrator accesses the Debate Creator website and enters the details of the debate that he wishes to create. These details include the elements required to instantiate the proposal for action using the argumentation scheme (for example, the current circumstances, the proposed action, and the goals of the action) as well as evidence to support these statements which may be instantiated using other argumentation schemes, and technical data related to the debate (for example, database settings). One example of a debate which has been successfully implemented using the debate creator is the speed camera debate, discussed further in Section 5.

Once the debate administrator has created the debate by instantiating all of the required details, he can proceed to create the website and database source files for the debate. These files allow the public to participate in the debate and provide a repository of data in which the responses are stored.

3.2 The Parmenides interface and analysis tools

When users wish to participate in the debate, they can access the debate through a webpage interface on which they are presented with the policy proposal for the particular debate. The proposal sets out a justification upholding a particular action for the topic under discussion, with the justification being structured in the form of the practical reasoning argumentation scheme. Users are then led in a structured fashion through a series of web pages that pose the appropriate critical questions to determine which parts of the justification the users agree or disagree with. The users express their opinions by giving "Yes" and "No" answers to the critical questions associated with the argumentation scheme, which are posed to the user on successive pages of the website. Users are not aware (and have no need to be aware) of the underlying structure for argument representation but it is, nevertheless, imposed on the information they submit. This enables the collection of information which is structured in a clear and unambiguous fashion from a system that does not require users to gain specialist knowledge before being able to use it.

All opinions submitted to Parmenides are written to the back-end database. A number of successfully implemented debates are available online[2] for the interested reader to view and/or participate in. The debates available include one based around the proposed action of installing more speed cameras on UK roads, and another based around the justification for invading Iraq in 2003.

The Parmenides Java-based analysis tool takes the individual critiques of the policy justification that the users have submitted to the database, and computes a set of statistics that reflect the analysis. The analysis tools are discussed further in relation to a particular example in Section 5.3.

4.   Scheme Catalogue

In order to facilitate the structured use of argumentation schemes in Parmenides, we have developed a number of tools to assist with the input, storage, and usage of schemes within the system. These tools are as follows:

- *Argumentation scheme entry interface* – This element of the Parmenides administration portal allows argumentation schemes to be added into the system. The user is guided through the addition process, which ensures that the semantics of the scheme are applied correctly.

- *Argumentation scheme catalogue* – This is a database of all of the argumentation schemes present in the system. It also contains information on the particular schemes, including a description of the schemes and a description of the types of argument that they can represent.

4.1 Argumentation scheme entry interface

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[2] URL for the Parmenides system: http://cgi.csc.liv.ac.uk/~parmenides/

The argumentation scheme entry interface is a recent addition to the Parmenides toolset, developed to allow easy and correctly formatted entry of argumentation schemes. The person entering the argumentation scheme into the system (herein referred to as the "administrator") must firstly specify the name of the argumentation scheme and the scheme statement. He or she must also choose the number of "user-specified elements" in the argumentation scheme, i.e. the number of elements in the scheme that must be supplied by the user who is instantiating it. For example in the "Argument from Expert Opinion" scheme presented in Section 2, the user must provide the name of the expert, the domain in which the expert has expertise, and the fact asserted by the expert. This scheme therefore has three user-specified elements, which are denoted in the argumentation scheme by the phrases "Expert E", "Domain D" and "Fact A" respectively.

After entering these basic details, the administrator then goes on to provide the user-supplied elements in the argumentation scheme. After entering the user-specified elements, these are matched up with the relevant parts of the scheme statement to ensure that they have been entered correctly. This string matching allows users to quickly see whether the relevant parts of the scheme have been marked-up correctly as user-specified elements.

On the next webpage, the administrator must enter all of the critical questions associated with the scheme. Again, after the questions have been entered, the user-supplied elements in the question texts are detected and marked for approval by the administrator (see Figure 1).

Scheme Name:	Argument from Correlation to Cause
Scheme Statement:	There is a positive correlation between Statistic A and Statistic B. Therefore Statistic A causes Statistic B.
User-supplied elements:	1. Statistic A 2. Statistic B
Location of elements in CQs:	There is a positive correlation between Statistic A [1] and Statistic B [2] There are a significant number of instances of the correlation between Statistic A [1] and Statistic B [2] There is good evidence that the relationship between Statistic A [1] and Statistic B [2] goes from Statistic A [1] to Statistic B [2], and not just Statistic B [2] to Statistic A [1]. It can be ruled out that the correlation between Statistic A [1] and Statistic B [2] is caused by a third factor If there are any intervening variables, it can be shown that the relationship between Statistic A [1] and Statistic B [2] is not mediated by other causes

Figure 1 – *Adding an argumentation scheme to Parmenides*

Once the administrator has entered these details, he is given the opportunity to provide further explanatory information for the scheme that he has added. This information includes a description of the scheme and typical uses of the scheme. The information provided is stored in the argumentation scheme catalogue, which we describe next.

4.2 Argumentation scheme catalogue

The argumentation scheme catalogue is intended as a central repository of information regarding the argumentation schemes that are available within the Parmenides system. When entering a scheme using the tool discussed in Section 4.1, administrators are given the option to provide details of the scheme,

which are stored in the catalogue. When a debate administrator chooses to support a part of his argument with evidence instantiated using a different argumentation scheme, he can view the catalogue before choosing which scheme to use. Information available in the scheme catalogue includes the name of the scheme, the scheme statement, a general description of the scheme, typical usage of the scheme (i.e. what kinds of debate it is suited to representing), and a description of each user-provided element in the scheme. The argumentation scheme catalogue can be accessed through the debate creation interface to assist debate administrators in choosing the appropriate scheme.

The "typical usage" of the scheme may, for example, contain a description of the type of critical question that the argumentation scheme is good for responding to. We have performed an analysis of critical questions associated with a number of argumentation schemes and identified which particular schemes are suited to responding to each question. As this analysis continues, the results of it will further influence the content of the scheme catalogue.

5.   Worked Example

In this section, we give an example of a debate involving argumentation scheme interactions which we have created and successfully implemented in the Parmenides system[3]. This debate concerns the further introduction of speed cameras on UK roads, as has been a recent focus of media attention.

5.1 Specifics of the speed camera debate

In this debate the action of deploying more speed cameras on UK roads is proposed. There are three justifications for carrying out this particular action, relating to three different social values promoted by the consequences of the action. As per all arguments within the Parmenides system, these justifications are based around the argumentation scheme for practical reasoning. The justifications are as follows:

1. In the current situation *there is a high death toll on UK roads*. We should *install more speed cameras*. Our goals are *to reduce the number of deaths on UK roads*. This will promote *saving lives*.

2. In the current situation *many drivers break the speed limits*. We should *install more speed cameras*. Our goals are *to reduce the number of drivers breaking the speed limits*. This will promote *law and order*.

3. In the current situation *the government makes money from fining speeders*. We should *install more speed cameras*. Our goals are *to increase government revenues*. This will promote *government wealth*.

These statements can have supporting arguments associated with them. For the purposes of this example, we will focus on the supporting argument associated with the statement "*Our goals are to reduce the number of drivers breaking the speed limits*", which is instantiated using the "Consequences from Experiment" argumentation scheme, stated as follows:

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[3]   Interested readers can view and participate in the speed camera debate online at *http://cgi.csc.liv.ac.uk/~parmenides/speedcam*

"In the current circumstances, according to Source S, Statistic T was Figure 1.
After carrying out the action of Action A, according to Source S, Statistic T was Figure 2.
Therefore it can be assumed that carrying out Action A affects Statistic T."

The instantiation associated with this particular statement uses evidence stated by the City Council, who have asserted that installing speed cameras causes a reduction in road death statistics:

> *In the current circumstances, according to the City Council, Road deaths were 0.1%. After carrying out the action of installing more speed cameras, according to the City Council, Road deaths were 0.05%.*
> *Therefore it can be assumed that installing more speed cameras affects Road deaths.*

5.2 Critiquing the argument and its supporting evidence

Figure 2 – *Critique of supporting evidence*

Once the debate is entered into the system using the debate creator, it can be viewed on the Parmenides website through a standard web browser. The user is given the opportunity to critique each element of each justification that makes up the initial position of the debate by responding to the appropriate critical question. If the user *disagrees* with any statement that is supported by evidence, then he is given the chance to critique the underlying evidence.

Returning to our example, we now consider a user that expresses his disagreement with the presumption that installing more speed cameras will reduce the number of speeding drivers. This user is then presented with the supporting evidence and given the chance to critique this by responding to the relevant critical questions, as shown in
Figure 2.

The first four questions posed to the user are the critical questions associated with the argumentation scheme which has been used to instantiate the evidence. The final question is a critical question added to all evidence statements. The purpose of this critical question is to ensure that the evidence justifies the statement that it is supporting.
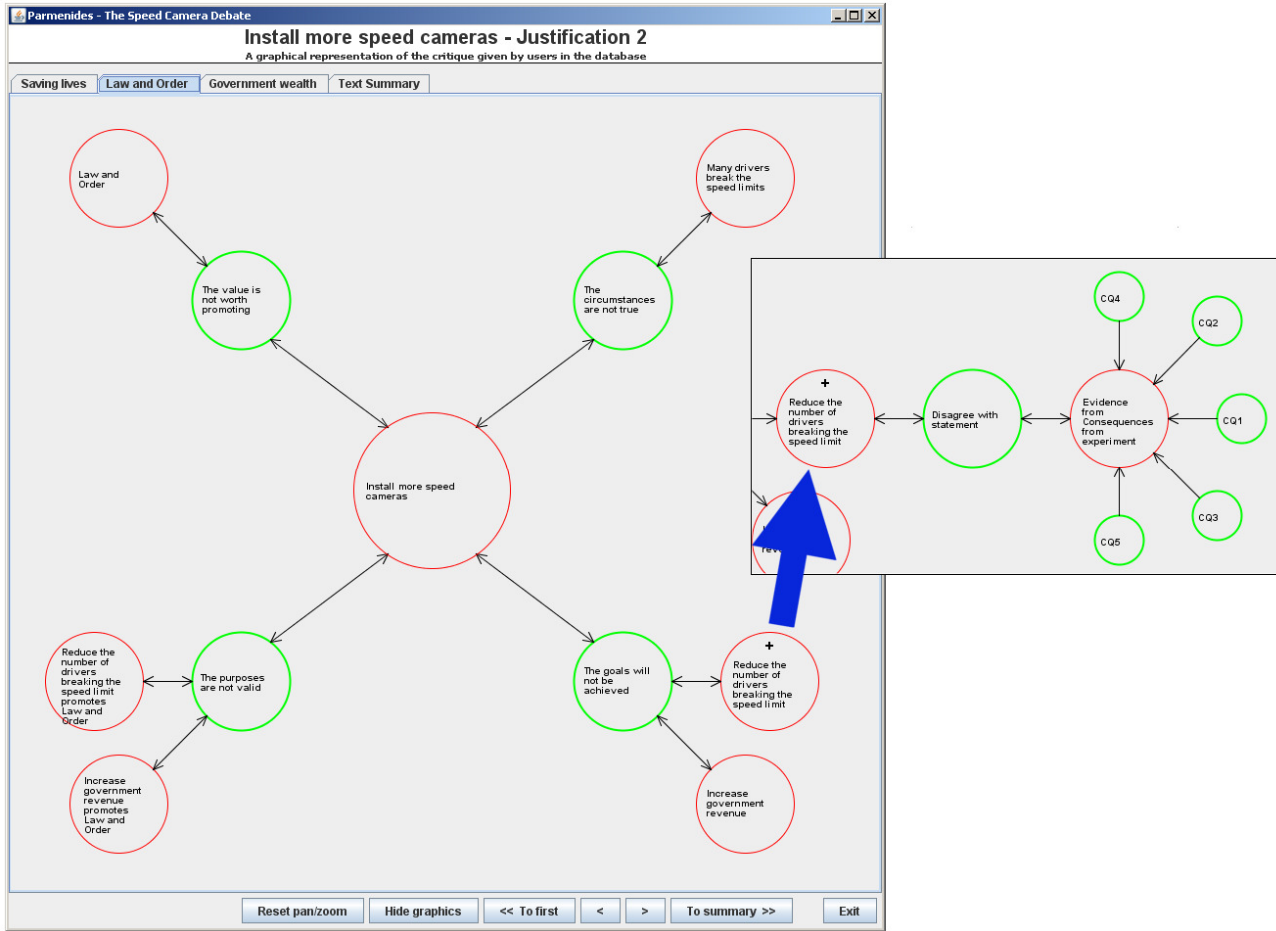
5.3 Analysing the results of user critiques

Figure 3 – *Parmenides debate analysis tool*

The Java-based analysis tools developed for use with the Parmenides system allow visual representation of the opinions submitted by users. The tools have recently been extended to provide analysis of the argumentation scheme interaction present in the system. Analysis is provided in terms of abstract Argument Frameworks (AFs) [3, 4]. These are a useful method of argument representation in which the attacks between arguments can be viewed and analysed in order to determine an "acceptable" set of arguments representing a consistent opinion.

The analysis tool firstly shows an overall argumentation framework for each justification that makes up the original position (classified by the unique social value represented by each justification). Each element of the justification (circumstance, goal, purpose and value) is represented in a separate branch of the framework. If a particular element has supporting evidence associated with it, a "+" is displayed near the top of the respective node, clicking which expands the branch to allow viewing of the evidence and critical question responses associated with it. An example of one of the frameworks associated with a justification from the speed camera debate is displayed in Figure 3.

A green node (respectively red) represents a statement that the majority of debate participants expressed agreement (respectively disagreement) with. Where a critical question is contained within a green node, it indicates that users expressed agreement with the critical question and thus the attack against the associated argument succeeds. By hovering the mouse over a node, the user can see exactly what percentage of respondents agree or disagree with the particular statement represented by the node.

This fine-grained analysis allows us to not only see which elements of the justification are most commonly agreed (or disagreed) with, but also gives some indication of the reasons for the agreement (or disagreement). This is achieved by analysing the responses to the argument's supporting evidence.

6.   Concluding remarks

We have discussed how a particular method of argument representation can lend structured support to a system for e-democracy. We hope to develop the scheme catalogue further to enable richer debates to take place using a wide range of interacting argumentation schemes. As for evaluation, the system is currently being tested in co-operation with researchers at the University of Brescia in Italy, who are running a live debate on the system for students of the university to participate in.

References

[1]   K. Atkinson. *What Should We Do?: Computational Representation of Persuasive Argument in Practical Reasoning*. PhD thesis, Department of Computer Science, Liverpool University, 2005.

[2]   K. Atkinson, T. Bench-Capon, and P. McBurney. Computational representation of practical argument. *Synthese*, 152(2):157–206, 2006.

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

[4]   P. M. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77(2):321–357, 1995.

[5]   T. F. Gordon, H. Prakken, and D. Walton. The Carneades model of argument and burden of proof. *Artificial Intelligence*, 171(10–15):875–896, 2007.

[6]   A. Macintosh, E. Robson, E. Smith, and A. Whyte. Electronic democracy and young people. *Social Science Computer Review*, 21(1):43–54, 2003.

[7]   C. Reed and G. Rowe. Araucaria: Software for argument analysis, diagramming and representation. *International Journal on Artificial Intelligence Tools (IJAIT)*, 13(4):961–979, 2004.

[8]   D. N. Walton. *Argumentation Schemes for Presumptive Reasoning*. Lawrence Erlbaum Associates, Mahwah, NJ, USA, 1996.