

A Model-Based Critique Tool for Policy Deliberation

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Abstract. Domain models have proven useful as the basis for the construction and evaluation of arguments to support deliberation about policy proposals. Using a model provides the means to systematically examine and understand the fine-grained objections that individuals might have about the policy. While in previous approaches, a justification for a policy proposal is presented for critique by the user, here, we reuse the domain model to invert the roles of the citizen and the government: a policy proposal is elicited from the citizen, and a software agent automatically and systematically critiques it relative to the model and the government's point of view. Such an approach engages citizens in a critical dialogue about the policy actions, which may lead to a better understanding of the implications of their proposals and that of the government. A web-based tool that interactively leads users through the critique is presented.

Keywords. model based reasoning, policy making, critiquing, deliberation

1. Introduction

Citizens may wish to respond to policy proposals made by their governments in several ways. They may simply *seek a justification* of the proposed policy; they may wish to *object* to the proposed policy; or they may want to *propose* policies of their own. Argumentation can support e-participation systems designed to meet any of these. In the first case a simple statement is all the response that is needed. For the second case it is necessary to identify, make precise, and attempt to meet the objections. These situations are addressed in work such as [6] and developed in [13] as a tool to gather opinions on particular policy justifications.²

The third case is, however, different. Here what is needed is to obtain a precise, well formulated proposal from the citizen, then critique it with respect to what is believed (represented by the model) and desired by the government. In the face of the critique, the citizen may opt to modify her proposal or to continue to support it. In this paper, we address this third case. We believe that to engage citizens in policy debates it is essential to allow them to express their own ideas and to receive feedback on possible issues with these ideas. By interacting with policy questions in this way, citizens will better

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understand why certain proposals were adopted and others rejected. It can thus serve as an important supplement to justifications of actual policy.

The important conceptual problem that needs to be addressed in this case is how to formalise the policy proposals and the domain knowledge so as to support construction of policy proposals that can then be clearly, systematically, subject to critique. Our approach makes use of argumentation schemes and semantic models, in particular, practical reasoning and Alternating Action Based Transition Systems (AATS) [11], as extended as in [1] to include values (AATS+v). In previous systems ([6] and [13]) the *system proposed a justification* and then *the user critiqued it*. Here we present a novel alternative, turning the roles on their head: we describe how the argumentation scheme and critical questions of [1] can be used as the basis of a system to help a citizen to form a justification for a policy proposal so that the *system* can react to it and provide a systematic and thorough critique. We will illustrate our approach with a running example, relating to the use of speed cameras and reuse the model originally developed in [2], and the style of critique previously prototyped in Prolog[12]. This prototype has now been re-engineered as a MySQL database with the scheme and critical questions instantiated using SQL queries; PHP is used to provide the web front end. This provides a new, robust web-based, interactive software tool. As explained above, users provide a policy proposal, which is critiqued relative to the beliefs and preferences of the government, so that they can better understand their proposal and the government position.

In section 2, we review aspects of earlier work (the practical reasoning argumentation scheme, critical questions, and running example); we also informally review components of the underlying model. In section 3, the scheme and critiques are presented as a web-based, interactive tool using PHP and SQL; this is based on a Prolog prototype [12] which provided a clear specification but a poor user interface. The tool is presented using a sequence of screen shots together with some discussion. Related work and discussion are presented in section 4.

2. Background

Argumentation schemes hail from the informal logic literature and capture stereotypical patterns of reasoning that can be expressed as arguments. Every argumentation scheme is associated with its own set of characteristic critical questions that are used to identify possible challenges to it. Such challenges can be made against the different elements of the argumentation schemes and the relations between them. The particular argumentation scheme used in our prototype is *practical reasoning* [1], which provides a justification of an action. Some examples of the critical questions related to the argumentation scheme for practical reasoning are: *Are the current circumstances as stated? Does the action have the consequences stated? Does the action promote the value?* It has been claimed that practical reasoning is the key reasoning structure in political discourse [7]. To give a precise characterisation of the scheme and its questions which can provide a suitable basis for automating a critique, the practical reasoning argumentation scheme and its critical questions were expressed in terms of the formal structure provided by Alternating Action-Based Transition Systems (AATS+v) [1]. In this section, we review the practical reasoning argumentation scheme and the AATS+v model of our example taken from [2].

2.1. Practical Reasoning

The argumentation scheme in [1] proposes an action based on an understanding of the current situation, the consequences of actions and the desire to promote particular social values. These social values exist in a preference order which may vary from person to person according to their tastes and aspirations. Unlike [1] we do not distinguish the goals realised by an action from the consequences of that action, since the distinction is unnecessary for our present purposes.

Argument Scheme AS1

Premise 1: In the current circumstances R

Conclusion: We should perform action A

Premise 2: Which will result in new circumstances S

Premise 3: Which will promote some value V.

In this scheme, R is what is true before the action, S is what is true after the action and V the reason why S is desirable. In [1] seventeen critical questions associated with *AS1* are given. The critique tool uses a subset of these questions, as we will discuss below.

In the next section, we recall the instantiation of the AATS+v concerning Road Traffic Policy developed in [2], which will be used in our example to instantiate *AS1* and identify the critical questions that give rise to the criticisms presented by our critique tool.

2.2. Instantiating the AATS+v - Road Traffic Policy

Our example is consideration of options for action to be taken by a Government in response to a policy problem, as might be found in an e-participation application. Specifically we consider an issue in UK Road Traffic policy, modelled in [2] and before that used in [6] and [3]. The number of fatal road accidents is an obvious cause for concern, and in the UK there are speed restrictions on various types of road, in the belief that excessive speed causes fatal accidents. One suggestion to reduce road deaths would be to deter motorists from speeding by introducing speed cameras, which would greatly increase detection and punishment of speeding offences. Points that might be contested are whether fines are sufficient to deter speeding, and whether speeding is an important factor in road accidents. Additionally there are civil liberties issues associated with the loss of privacy resulting from the increased surveillance. A more expensive alternative to speed cameras would be to have a programme of education for motorists which could make them more aware of the dangers of speeding, better able to control their vehicles at speed, or both.

From this brief presentation of the issue, we can see that our model must contain actions, propositions that represent the state both before and after the action, the effects of actions and values. An AATS+v conveniently captures all this information. First we describe states in terms of the relevant propositions. We have three propositions, each with a positive and a negative form:

The number of road deaths is acceptable; There are more road deaths than there should be.

Many motorists break the speed limits; Speed limits are generally obeyed.

Privacy is respected; There are unacceptable intrusions on privacy.

In the database, we specify all the possible states: we believe that the current state is: *Many motorists break the speed limits and There are more road deaths than there should be and Privacy is respected*. We consider the impact in terms of four values: human life (*Life*), compliance with the law (*Compliance*), the financial cost to the Government (*Budget*), and the impact on civil liberties (*Freedom*). The main agents involved are the *Government*, and *Motorists*, the latter considered collectively as a single agent. In some cases the consequences of action are indeterminate (or at least cannot be determined using the elements we are modelling). To account for this we introduce a third agent, termed *Nature*. The action ascribed to Nature determines the outcomes of the actions of the other agents, where these outcomes are uncertain or probabilistic; that is, Nature determines success or failure. We take the Government to be the independent agent: motorists respond to the Government action, and then Nature determines the effect of this response. The Government has three actions: introducing speed cameras, educating motorists, or doing nothing. Motorists may reduce their speed or do nothing and continue to speed. Nature has two actions according to which fatal accidents are or are not reduced as a result of the Government and motorist actions. As is usual in an AATS, the effects of actions are determined by all three actions taken together, represented as *joint actions*. The joint actions available in the database are:

- j_0 Government does nothing, motorists do nothing and nature does nothing.
- j_1 Government introduces cameras, motorists do nothing and nature does nothing.
- j_2 Government introduces cameras, motorists reduce speed and nature reduces accidents.
- j_3 Government introduces cameras, motorists reduce speed and nature does nothing.
- j_4 Government educates motorists, motorists reduce speed and nature reduces accidents.
- j_5 Government educates motorists, motorists do nothing and nature reduces accidents.

Finally, we have *transitions*, which relate a source state, a destination state, a joint action, a list of values promoted, and a list of values demoted. The joint action can only be selected where the preconditions of the action are met (e.g. where motorists are not speeding, then they cannot reduce speed) and will result in a state determined by our causal theory (e.g. where motorists reduce speed and nature reduces accidents, then motorists are not speeding and accidents are reduced). We presume that accidents are always reduced when motorists are educated since either they do not speed or can control their vehicles better. The database represents all possible instances of such transitions.

To this point, we have a model represented as a declarative instantiation of the AATS+v. In the next section we present a web-based interactive program, using PHP and SQL, which uses this model to elicit and critique a proposal provided by the user.

3. Argumentation Critique Tool

The use case for the critique tool is that there is a public debate or consultation about which option a Government should choose to solve a current problem, and citizens wish to contribute to the debate, or to better understand the issues. To this end users choose an

option, having first expressed their beliefs as to relevant aspects of the current state. They will then be asked for their beliefs about the results of the action, and the values it will promote. At each point, the system either agrees with the user's choices, or proposes its own beliefs. The user can then adopt the system's suggestions or continue with her own beliefs. We presume that there will be acceptance of the elements used to model the situation, in particular the relevant propositions, options for actions, and values. Disagreements relate to beliefs about what is true, the consequences of actions, and the values that are promoted by the actions. Additionally possible alternative ways of achieving the desired results will be suggested.

3.1. Critique

In this section we describe the elements of a critique based on our model, using a sequence of screen shots. Because of space limitations we present just the response pages after the user has input their choices. The tool can be accessed and used at <http://www.csc.liv.ac.uk/maya/ACT/index.php>. The implementation comprises a MySQL database with tables to store the information required to describe the model: thus we have tables for literals, actions, joint actions, agents, states, values and transitions. The scheme can then be instantiated by finding transitions from the current state which promote values, and the various questions can be triggered by queries which determine whether certain other conditions hold: for example whether that transition also demotes a value.

Initialising the System To provide a target for our critique, we must first find out what the user believes, and the option she supports. For our example run we assume the following Government position, expressed in the form of *AS1*.

Many motorists break the speed limits and There are more road deaths than there should be and Privacy is respected. We should introduce speed cameras to bring about Speed limits are generally obeyed and The number of road deaths is acceptable and There are additional intrusions on privacy, which will promote Life and Compliance.

However, the user of the tool is not presented with this position, rather it is implicit in the critique of the user's proposal.

Is the current state agreed? The user is asked to indicate her beliefs using radio buttons, as in Figure 1. In the Figure, the user disagrees with the system: in case of disagreement the user is presented with what the system believes and invited to continue using *either* her own *or* the system's beliefs.

Is the Option Possible in the Current State? Next, the user is presented with the options available to the government, using the screen in Figure 2. The system checks whether the selected action is compatible with the current beliefs: if so it reports that the action is possible; but if not, then the tool reports that the action is impossible and says which actions are compatible with the user's current beliefs. This reflects that the option may be available in several states, although the consequences and values promoted may vary according to the current beliefs. In the Figure, the user chooses the option *educate motorists*, which is possible in the current state.

Please select which of the following statements you believe to be true in the current situation:

many motorist break the speed limits OR speed limits are generally obeyed

there are more road deaths than should be OR the number of road deaths is acceptable

there are unacceptable intrusions on privacy OR privacy is respected

We disagree with your beliefs about the current situation.

We currently believe that:
 many motorist break the speed limits
 there are more road deaths than should be
 privacy is respected

Figure 1. Critique of Current State

What do you think the government should do in current circumstances:

do nothing

introduce speed cameras

educate motorists

The action you have chosen is currently possible. Click to continue.

Figure 2. Critique of the Action

Are the Consequences Agreed? The next screen asks for consequences, using radio buttons in the same way as the initial beliefs were obtained. Again, the user is asked to say whether the relevant propositions are true or false, and agreement or disagreement is reported. Again in the case of disagreement the user can continue using either her own or the system's beliefs about consequences.

Is the Value Promoted? Now the user is asked for the value promoted (see Figure 3). Again agreement or disagreement is registered, and the user continues: at this stage discrepancies in belief do not matter and so the user is not required to choose between her own and the Government's views.

To this point, we have considered the current state, proposed action, its consequences, and the values thought to be promoted supplied by the user and compared them to the government's position. The critique now turns to additional considerations and suggestions, such as alternatives, and reason why the effects of the action may not be as expected. These are discussed below and all illustrated in Figure 4.

Are There Negative Side Affects? Actions may demote as well as promote values, and this might give us a reason against performing the action. If the chosen transition demotes a desirable value then this should be reported to the user. In our example, the extra cost of education means that *budget* is demoted. Whether the user can accept this

Initial State:
many motorist break the speed limits
there are more road deaths than should be
privacy is respected

After (government) has performed (educate motorists):
speed limits are generally obeyed
the number of road deaths is acceptable
privacy is respected

Which values do you believe will be promoted by the above transition:

life

freedom

compliance

budget

VALUES HAVE BEEN SELECTED. Check the Selected Values

We agree that the following values are promoted by the selected transition
compliance

Agree and Continue Exit

Figure 3. Critique of Target State and Values Promoted

depends on whether she considers that compliance is more important than budget. Most serious is if the value one intends to promote is in fact demoted, since this would mean the action represents a self defeating way of advancing this value, but if the allegedly promoted value is different from the demoted value reported by the tool, then the user needs to be aware of the problem, but may may keep to her position. Thus in our example, an advocate of education can continue to hold that view, but now does so on the understanding that the budget will be exceeded.

Are there Other Ways to Promote the Value? Typically there are several ways to promote a value, and the user may find some of these alternatives preferable to the option chosen. Thus the tool draws attention to any such alternatives. In our example education is proposed as a way of promoting *Compliance*, so the critique can draw attention to the possibility of promoting that same value by introducing cameras, as shown in Figure 4. This might cause the user to change her mind, particularly since she has already been alerted to the fact that education will demote *budget*.

Could Other Values be Promoted? The tool can also identify other values that could have been promoted rather than the selected values. There may be several such values. For our current purposes, we will not object if performing the action promotes the stated value and other values as well, so the values we are interested in for this objection are those which could have been promoted from the initial state, but are not promoted by an action taking us to the destination state. Again these are only a suggestions: it is up to the users whether they wish to pursue them or not. The system notes that *budget* could have been promoted.

Will the Other Agents Do What they are Supposed To Do? Consequence and values promoted depend crucially on how the other agents will respond to what the Government

Initial State:
many motorist break the speed limits
there are more road deaths than should be
privacy is respected

After the following joint action has been performed:
government : educate motorists
motorist : reduce speed
nature : produce fewer accidents

The following consequences have occurred:
speed limits are generally obeyed
the number of road deaths is acceptable
privacy is respected

You currently believe the transition promotes the following values:
compliance

Question 4. Side effects.

The selected action will demote the following value(s): budget

Question 5. Other ways to promote the values.

Value (compliance) can be promoted by the following action(s) in the current state: introduce speed cameras

Question 6 Other values Promoted.

The following values can also be promoted in the current state: life , budget

Question 7. Other Agents' Actions.

motorist may (do nothing) and nature may (produce fewer accidents) - which will promote the following value(s): life
These actions will demote the following values: budget

Figure 4. Summary and Alternatives

does. Here we have assumed (in accordance with the best available information) that education will cause motorists to be more aware of the consequences of excessive speed and so will lead them to drive within the limits. Moreover we have assumed that observing the speed limits will reduce fatalities. Suppose, however, that the effect of education is not to increase compliance, but to cut accidents none the less, since our educated motorists speed only when it is safe to do so. Now *Compliance* will not be promoted. In such a situation, *Life* will be promoted, and *Budget* will be demoted. Here the user may dismiss the alternative behaviours as unlikely, consider that *Compliance* is unimportant if *Life* is promoted, or think the risk too great and so realise the need to change her option to ensure compliance. Having absorbed these observations, the user may run the tool again to explore a different option, or leave, hopefully wiser and better informed.

4. Related Work and Discussion

Our programme of work is directed towards providing tools to support policy argumentation using an explicit, *computational*, domain model. While policy argumentation has attracted considerable attention, the focus has typically been on the construction, presentation, relation, and analysis of *manually* constructed arguments. There is therefore very

little directly related work. Such computational support for policy making as exists has largely used simulation, whereby proposed policies are modelled in a knowledge base and their effects simulated on populations or individuals. This approach goes back to the ExpertiSZe system [10], and is still applied today: for a current version see [8].

Our approach also bears some resemblance to intelligent tutoring systems [9] that interactively engage users in making and evaluating solutions relative to some knowledge base. These tools do not concern policy, structure the interaction according to argumentation schemes and critical questions, or provide underlying semantic models, but have established the interaction style of prompting and making suggestions to the user.

We have shown how a thorough critique of a position intended to justify an action can be generated from a model of actions and their consequences expressed as an AATS+v. The above critique covers nine of the seventeen critical questions of [1]. Of the eight not covered some relate to elements of the AATS+v common to the two agents, in particular the propositions, agents and actions. The other critical questions not addressed concern goals, which are part of *AS1*, but have no real correspondence in an AATS. Such goals can be thought of as defined in terms of the basic propositions. For example one might consider a society to be civilised if road deaths are not excessive and privacy is respected. Thus the goal of a civilised society could be realised in states where these two propositions are true. The ability to define complex aspirations in terms of the basic propositions might be useful in a more complex domain.

Justifications for action are based on a wide variety of different kinds of knowledge including at least: knowledge as to what is currently the case, knowledge of actions and their effects, awareness of the effect on values, knowledge of what other agents are likely to do and knowledge of preferences between competing values. This diversity is reflected in the range of perspectives from which an action justification can be critiqued. The use of an argumentation scheme such as *AS1* enables the critique to systematically explore possible weaknesses with respect to all these aspects. Our tool enables the systematic critique to be delivered, but while it raises questions, these are not argued for or resolved: the criticisms are accepted or ignored but not debated. We currently link to external web sites offering justifications for our beliefs, but any deeper exploration would require further levels of argument and nested dialogues relating to different argumentation schemes. Each different kind of knowledge will require its type of own dialogue. Disagreement about facts [5] and preferences [4] has been investigated, but much remains to be done for discussion of preferences and for dialogues disputing causal theories, agent behaviour and evaluative assessments.

Finally there are questions of scalability. While it may be possible to capture the relevant considerations in a model (which could be quite extensive if the issue was sufficiently important to devote a reasonable amount of resource to providing the system), eventually the problem will become too slippery to capture as a complete model. We have already begun to explore how the tool can be used with partial models, in the context of Housing Policy for the city of Shanghai.

In this paper we have presented a tool designed to use an AATS+v to critique a user supplied policy choice. It is part of a wider programme of work carried out over a number of years. This tool has been motivated by several small scale evaluations carried out as part of the Parmenides project [6] and with students from the Liverpool University Management School, which suggested that the justification provided by that tool needed to be complemented by the chance for user to explore her own options. Our tool adopts

several suggestions made in these evaluations. For the future, our focus will be on further evaluation and extending the work with partial models, to explore the ability of the scale up to more complicated situations.

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