Structured Reasoning to Support Deliberative Dialogue

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Abstract. Deliberative dialogue is a form of dialogue that involves participants advancing claims and, without power plays or posturing, deliberating on the claims of others until a consensus decision is reached. This paper describes a deliberative support system to facilitate and encourage participants to engage in a discussion deliberatively. A knowledge representation framework is deployed to generate a strong domain model of reasoning structure. The structure, coupled with a deliberative dialogue protocol results in a web based system that regulates a discussion to avoid combative, non-deliberative exchanges. The system has been designed for online dispute resolution between husband and wife in divorce proceedings involving property.

1 Introduction

Walton and Krabbe [17] classified six basic types of human dialogue: a) Information seeking (b) Inquiry (c) Persuasion (d) Negotiation (e) Deliberation and (f) Eristic. Deliberative dialogue involves two or more participants seeking to agree upon a course of action or decision. Participants to a deliberative dialogue advance claims and, without power plays, dishonesty or posturing deliberate on the claims of others until a consensus solution or decision is reached. The advantages of this type of human dialogue have been well documented and include improved outcomes and a sense of engagement in the process.[2, 6, 11]

McBurney and Parsons[10] cite the absence of hierarchy in deliberative dialogue as conducive to a sense of equality between participants. The non-combative and inclusive nature of a deliberative discussion with many participants with diverse points of view enables access to information otherwise not available. Traditional power based dialectic outcomes are frequently unsatisfactory leaving participants disgruntled and cynical. Consultative and participatory skills are developed by deliberative dialogues and can be carried across into other decision-making processes.

Information communication technologies have recently emerged as a convenient environment for deliberative dialogues[20]. Online deliberative discussions involve a community of participants from diverse locations using web technology. Participants to on an online discussion can deliberate on their own position and that of others posting a response.

The aim of this paper is to illustrate that knowledge based systems can facilitate online deliberative dialogue. For this to occur, the knowledge underpinning a dialogue must be structured so that vital issues are not overlooked and professional opinion, precedent and policies support all arguments. Argumentation theories have often been advanced as approaches to structuring reasoning.[1, 3, 9, 10] For example, Toulmin[16] concluded that most arguments, regardless of the domain, have a structure that consists of six basic invariants: claim, data, modality, rebuttal, warrant and backing. Yearwood and Stranieri [19] have varied this structure to yield a model that can more readily be applied to structuring reasoning for deliberative dialogues. Their model, called the Generic Actual Argument Model (GAAM) has been deployed in knowledge based systems in family law[14], nursing[15] and sentencing[4].

A deliberative dialogue support system not only requires a method to structure knowledge but also requires a way to regulate discourse. In their desiderata for a dialectical system McBurney and Parsons[11], advance specifications for a dialogue game protocol: (a) Set of topics for discussion (b) The syntax for a set of defined locutions for the topics (c) A set of rules that govern the utterance of these locutions (d) A set of rules which establish what commitments are created by the utterance of each locution (e) A set of rules governing the circumstances of the dialogue termination.

In this paper a dialogue game protocol is advanced that uses the GAAM to define topics for discussion and define a set of locutions for the topics. A protocol described in[13] is used to define a set of rules that govern utterance of these locutions and a set of rules to govern dialogue termination. The application domain is family law property proceedings. The participants to a deliberative discourse are the husband and wife of a failed marriage who are motivated to deliberate rather than combat in order to achieve a fair outcome for themselves and their children and to avoid legal costs.

The GAAM is briefly described in the next section with examples drawn from the family law domain. Following that is a discussion of two implementations for deliberative discussion between husband and wife using the family law structure and dialectical protocol in development.

2 The GAAM

The Generic Actual Argument Model is advanced by Yearwood and Stranieri[21] is a two tiered framework for structured reasoning. Firstly, a Generic Argument Structure, GAS, is used to represent the domain of the dialectic. An actual argument is a dialectical instantiation of a selected generic argument where values have been assigned by participatory deliberation. Subtrees are formed by child nodes that support decision making for ancestor nodes. Actual rule-based locutions occur within this domain.

Argument nodes are referred to as *claims*. Attributes of claims are the definition of the particular matter to be resolved, a set of possible values that each party may choose to represent their point of view, justification values and inference values.

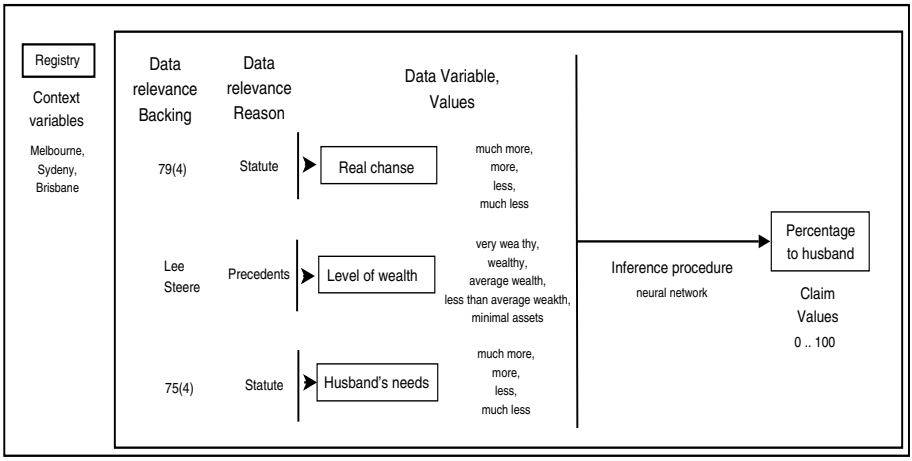

Fig. 1. A generic argument in Split-Up.

Split-Up, developed using the GAAM, models the reasoning used by Family Court judges in Australia in predicting the percentage of property that a Court is likely to award both parties to a marriage following divorce. It is based on a generic argument structure and its inference values determine a likely legal ruling. Figure 1 illustrates a generic argument from Split Up. The top level claim is the percentage split of assets. This is the main issue in dispute. The three key features relevant in an inference of percentage split are the husband's contribution to the marriage relative to the wife's, the level of wealth of the marriage and the husband's future needs relative to the wife's. In the knowledge based system, values on these three are inputs into neural network that has been trained with past cases. In the deliberation game here, the neural network is not used.

Figure 1 illustrates one generic argument. Each leaf node in that argument is a claim of another generic argument. For example, there is another generic argument that has, the *Husband's Contribution* as a claim and factors, *Husband's Direct Contribution*, *Husband's indirect Contribution*, *Husband's Negative Contribution* and *Marriage Length*, as factors. These four factors are used to infer a value on the *Husband's Contribution*. In this way a tree representing a hierarchy of factors is identified. The tree for Split Up comprises 94 factors in 35 generic arguments and was elicited from family law experts who verified the relevance of and position of each factor.

In the next section the way in which the tree underpins the facilitation of deliberative dialogue between husband and wife is illustrated.

3 Dialogue

A deliberative support system is needed to manage dialogue between participants. In its present state, Split-Up is operational for one participant. Two

solutions are in development that manage the dialectic process for two players. These are (a) a two-dimensional web-based solution and (b) a three-dimensional solution using a three-dimensional environment. Both solutions use the same structured reasoning tree. The next sub-sections discuss these solutions.

3.1 Two Dimensional Dialogue

In the web-based solution, a dialogue agent manages interaction between participants who are using the system simultaneously via web browsers from separate remote locations. Dialogue interaction occurs by a series of prompts to each user in turn. The dialogue agent is registered for user interface events and outputs *string* user prompts. Values selected by participants are stored and compared by the *GAAM* engine. Agreement is defined as an assignment of the same value to the same factor. For example if both parties beleive the *Wife's Contribution* was *much more* than that of the husband, then there is agreement. Agreement between the two participants is represented as a point in common:

$$PIC = \{C \in C : C_v^{P1} = C_v^{P2}\} \tag{1}$$

Where an issue is not agreed, dialogue continues with arguments (child nodes) relating to the matter in question (represented as a subtree in the generic argument structure). The dialogue game presents both parties with prompts for the child nodes. Where there is no subtree and a disagreement, the argument is considered irreconcilable on data and listed as a point of disagreement.

$$POD = \{C \in C : C_v^{P1} \neq C_v^{P2}\} \tag{2}$$

Transformation of a wife or husband's assertion for a matter in question is possible through a retraction dialogue. Having accessed the assertions and reasoning process of the spouse, the wife or husband may decide to change a prior assertion. The store of claims is then modified.

3.2 Dialogue Using SAM

Using the UnrealScript game engine[1] a Simulated Argument Model represents the nodes of a structured argument tree by a set of zones in a three dimensional world. Participants may virtually interact by moving through the three sequence levels of the game making decisions for each argument zone. In level one each player must make a decision for each zone. At level two the players must negotiate points of differences to find agreement where possible. Level three predicts a possible legal ruling based on the information and context of the information provided by the two participants. A dialogue D is represented by a vector containing two sub-sets *zone* and *player*.

$$\{Z, P\} \in D \tag{3}$$

[1] Epic Games.

Sub-sets of Zone are directly mapped as instantiated interactive objects.

$$Z = \{states_i, argument, values_i, justification, inference\} \tag{4}$$

The simulated model presents ludic processes for decision making. Participants can choose which matter in question to address by entering the *zone* for the matter in question. Each zone's status is indicated by lighting. Players can interact within each zone or choose not to interact. Assertions for matters in question are made by selecting the appropriate object in the zone.

The ultimate goal is agreement about the top level matter in question, the division of common assets. Rewards are earned for agreement about matters in question and for resolution of points of differences. When agreement cannot be reached, the mentor game character (an intelligent agent) makes a ruling. Retractions are made by simply revisiting the zone and selecting another object representing the revised assertion. Both solutions discussed here provide rule-based environments where dialogue cannot occur beyond the structured argument template and both solutions store and compare the player's chosen values for each argument node. In the next sub-section differences in implementation and user interaction between the two methods of dialectic are discussed.

3.3 Discussion

According to the dialogue game described by [21], a dialogue commences with either party selecting any matter from the *Issue list* for discussion. In the SAM model any party may select any matter in question at any time by selecting an object in a zone. In the web-based scenario, both parties are prompted in turn to assert a claim about the same matter in question.

In solution *a* both parties may choose from a list of assertions and in solution *b* they can agree or disagree with the statement represented in each zone. The objective in both solutions is to identify the key issues they agree on and those they disagree on.

Virtual face-to-face interaction of player avatars may occur in solution *b* while in solution *a*, interaction occurs using text messaging within a webform. The next section concludes the discussion.

4 Conclusion

The deliberative dialogue program is currently under development as an on-line web based application. Current research is in progress to extend the application to deploy a 3-D game engine environment. In this way a realistic simulated environment can be created and the effects of scenario playing in an emotionally charged domain such as divorce proceedings can be studied. Research is also in progress toward extending the deliberative discourse protocol from a 2 person game to an n-person game. This paves the way forward for electronic democracy applications where many individuals can deliberate on current affairs issues.

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