Using an argument ontology to develop pedagogical tool suites

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Abstract. The teaching of argumentation theory, argumentation skills and critical thinking has only very recently enjoyed any bespoke software support for classroom activities. As software has started to become available, it has been characterised by idiosyncratic, incompatible approaches not only to data representation and processing but also to underlying theories of argument. The rise in popularity of the Argument Interchange Format ontology offers a principled solution to this problem, and we describe here three tools (OVA, Arvina and Parley) which use the AIF to provide pedagogical applications, and a sketch is given of how these tools can complement one another and can share resources.

Keywords: Argumentation Theory, Ontology, Argument Interchange Format; Dialogue

1 Introduction

The study of argumentation, both as an academic discipline, and as a domain of pedagogy, has its roots in antiquity, but has only developed as a vibrant community in the past thirty years or so. It is the starting point, the precursor or the environment in which much logic teaching begins – standard logic texts typically have chapters devoted to the identification of fallacies, the expression of propositional logic in linguistic utterances, and the analysis of natural arguments in propositional, predicate or categorical logics.

Until the late 1990s, however, software support for either scholarly investigation or practical pedagogy was extremely limited. Since that time, many authors and teachers have explored tools that might support their activity in the classroom. Early prototypes were little more than proof-of-concept demonstrators that took theories of argumentation, or in some cases, theory of the pedagogy of argumentation, and showed that it was possible to employ them in the classroom (see, e.g., [8]). Gradually, software tools for manipulating argument resources started to mature and become more robust (for a good snapshot of such systems, see [3] for a review). As it became clear through rigorous analysis that the teaching of critical thinking skills had concrete benefits for students

[9], a number of tools were developed to support argument analysis in particular (such as [7] and [5]). Harrell [2] provides a comparative review of many of these systems.

The proliferation of these tools, however, has led to challenges. Each tool is built with ad hoc and idiosyncratic conceptions of argumentation, and there is no scope for sharing and re-using resources between them. This is a serious shortcoming, because collecting and preparing resources for classroom use is a highly labour intensive task. The same problem faced the academic community in argumentation, which was struggling to develop resource sets and standards against which different theories and different techniques could be deployed. This led to a worldwide effort to develop a common language for representing argumentation which was sufficiently general to admit different philosophical conceptions of argument, whilst at the same time sufficiently precise to allow tool development and resource re-use. This representation language (or in fact, a set of languages defined against a common ontology) is now available as the Argument Interchange Format (AIF) [1]. This paper aims to show how the AIF can support not just the development of compatible tools and suites of tools with practical utility in the classroom – along with the generation of reusable learning objects within argumentation contexts, but also how the the AIF can allow the development of innovative tools that support completely new means of offering argument-based learning.

2 The Argument Interchange Format

Descriptions of the AIF are given in a number of places, as are reifications in languages such as RDF and OWL (see, e.g. [1]). We provide here just a very brief summary of the main concepts. The AIF uses a graph-theoretic basis for defining an "upper" ontology of the main components (or nodes) of arguments. Nodes are distinguished into those that capture information (loosely, these correspond to propositions), and those that capture relations between items of information, including relations of inference (which correspond to the application of inference rules), relations of conflict (which represent forms of incompatibility between propositions) and relations of preference (which represent value orderings applied to sets of propositions). The instantiated nature of these relations is emphasised in the nomenclature, so whilst information is captured in Information (I-) nodes, relations between them are captured as Rule Application (RA-) nodes, Conflict Application (CA-) nodes and Preference Application (PA-) nodes. The general forms or patterns that these applications instantiate are given in a second part of the AIF ontology, the Forms ontology. The approach follows in the philosophical tradition of Walton [12] of schematizing stereotypical patterns of reasoning and then extending the tradition into conflict and preference. It is this schematic underpinning which gives the collective name for RA-, CA- and PA-nodes: Scheme (S-) nodes. The AIF upper ontology is designed to allow specialization and extension to particular domains and projects, in an attempt to balance the needs of interchange against the needs of idiosyncratic development. The original AIF specification has also been extended to handle dialogic argumentation. By this extension, it becomes possible to represent both a dialogue and the connection between a dialogue and the structures it generates such as inference corresponding to a RA-node. A dialogue is described by locution (L-) nodes, which refer to utterances communicated during the dialogue and constitute a subclass of I-nodes; and transition application (TA-) nodes, which refer to the passage between locutions and constitute a subclass of RA-nodes. The TA-nodes are governed by the protocol of a dialogue system, recording, e.g., that a given assertion has been made in response to an earlier question. The connection between a dialogue and the structures it generates is captured by means of illocutionary application (YA-) nodes which link together either L-nodes with I-nodes, or TA-nodes with RA-nodes. For example, an YA-node may represent the relation between a speech act claim(α) with its propositional content α.

3 Critical Thinking and Argument Analysis: OVA

OVA (Online Visualisation of Argument)[1] is a tool for analysing and mapping arguments online. It is similar in principle to other argument analysis tools, including Araucaria [5] and Rationale [10], but is different in that it is an online application, accessible from a web browser, facilitating analysis of online resources.

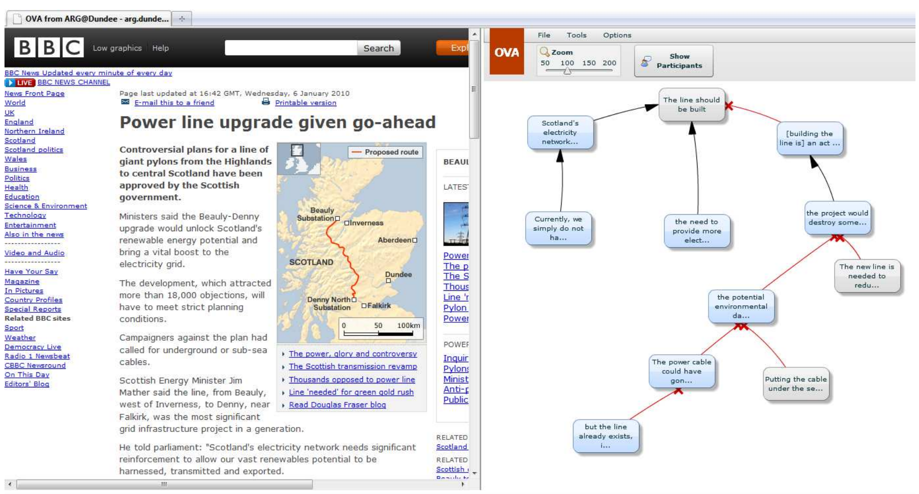

Fig. 1. OVA user interface

A web page or text file is analysed by providing its URL. The page is rendered alongside the main OVA interface, where text can be highlighted and extracted

[1] `http://ova.computing.dundee.ac.uk`

for analysis [Fig. 1]. The main components of the interface are the analysis canvas (the large, white area on the right-hand side); the web page display (on the left-hand side); and the toolbar at the top (providing tools to manipulate and save the analysis). An analysis is carried out by highlighting text on the web page, then clicking the analysis canvas; this extracts the text into a premise (represented in OVA as a node), which can be used to either support or attack other premises (or indeed, be supported or attacked itself).

OVA supports circular and divergent argumentation, and missing premises (or enthymemes) can also be reconstructed, allowing introduction of information that isn't explicit in the text being analysed. Once an analysis has been carried out, participants can be added. The participants represent the real people who promoted (or uttered) the premises used in the analysis. Finally, the resultant diagram can be exported as a JPEG image or an SVG description. OVA saves its analyses to AIF, either to a local file, or to an AIF repository such as *ArgDB*.[2]

Araucaria [5], which is in some sense a predecessor to OVA, has been downloaded over 10,000 times and is in use in schools and universities in over 60 countries. OVA, released in early 2010, has been trialled in undergraduate courses at Dundee, where it supports a critical thinking class and where early, informal feedback is very positive.

4 Dialogue & Mixed Initiative Argumentation in Pedagogy

Textbooks in critical thinking, of which [11] is typical, focus on the analytical facets of the discipline. That is, students are introduced to techniques that help them to split arguments into their component pieces, identify bias, reconstruct missing premises, identify schematic patterns and ultimately perform evaluative judgements on the quality of the arguments they encounter. Argumentation theory as an academic field has a similar tendency, given its roots in the philosophy of language and epistemology.

The creative, generative aspects are treated more rarely, both in the teaching of the subject and its academic environment more broadly. Inculcating the skills and techniques for producing high quality arguments is, rather implicitly, assumed to follow without further ado from the analytical experience that a student develops. Some other disciplines do occasionally include argument construction in their syllabi – the teaching of rhetoric, though rare, does occur in English programmes in North America and in pure rhetoric programmes worldwide. Vocations such as law and marketing may also introduce some basic techniques for argument construction. But almost without exception, these syllabi cover the creation of written arguments. Pedagogy focusing upon engagement in verbal dialogue is extremely uncommon, and this is surprising for two reasons. First, verbal argument is both very common, and when well executed, highly prized.

[2] *ArgDB* is an online corpus of argumentation, hosted at the University of Dundee and is available at `http://argdb.computing.dundee.ac.uk`

Parliamentary contributors, late night talk show panellists, and figurehead public orators often command significant respect purely in virtue of their rhetorical capabilities. Given its ubiquity and apparent importance, one would expect it to occur very commonly in a wide variety of curricula. There is also a second reason that it is surprising not to find these skills taught more extensively. From antiquity, rhetorical performance has been a central part of a rounded education, right up until the late nineteenth and early twentieth centuries. Cicero and Quintillian both offer treatises that are strongly pedagogical focusing specifically on the ability to create one's own arguments in tandem with analysing and interacting with those of an interlocutor. It is clear from these classical texts that the task is highly demanding (so we should expect to see it respected and prized), so with a strong precedent of teaching a complex and important skill, it is little short of astounding not to see it offered at every university or college. (Of course,verbal argumentation skills do appear in extramural activities quite often: both Europe and North America have strong debating – or 'forensic' – societies aimed primarily at children. But these societies do not involve formal education, and are primarily experientially based).

Technology offers a route to tackling this anomaly, and in particular, recent advances in mixed initiative argumentation offer a very exciting avenue to new pedagogical models.

4.1 Implementing Mixed Initiative Argumentation: Arvina

Arvina is a Google Wave application which builds upon the Google API to offer a rich dialogic interface to argument resources. Arvina's basic dialogue protocol is similar in scope to that offered by Magtalo [6], however using the Wave platform as a base allows a greater interaction between large groups of both virtual and real life participants.

Upon creation of an Arvina wave, a *gadget* is inserted allowing the user to choose a topic from any previously analysed AIF resources. Once selected, the AIF resource is examined to determine the participants involved in the dialogue represented and a new *robot* is added to the wave representing each of these participants. Following topic selection, the user must choose a starting point (an AIF I-node from which the dialogue can progress) and having done so is then given two options: to either ask a question and get the opinion of the artificially represented participants; or to offer their own view by either agreeing or disagreeing with the point being made. Each time a new point is put forward by either a human or a software participant, the wave is updated to show the new point, and to provide controls for interacting with that new point – i.e., to allow the user to challenge it, support it, or ask for views on it from other participants.

Arvina allows for an open mix of both artificially represented participants using knowledge assigned in an AIF resource and live participants. Any real participant may ask questions of any other participant of two forms: "Do you agree with this?" (to which robots will respond with yes or no and supply a supporting reason if one is available in the AIF); or, "Why is that the case?"

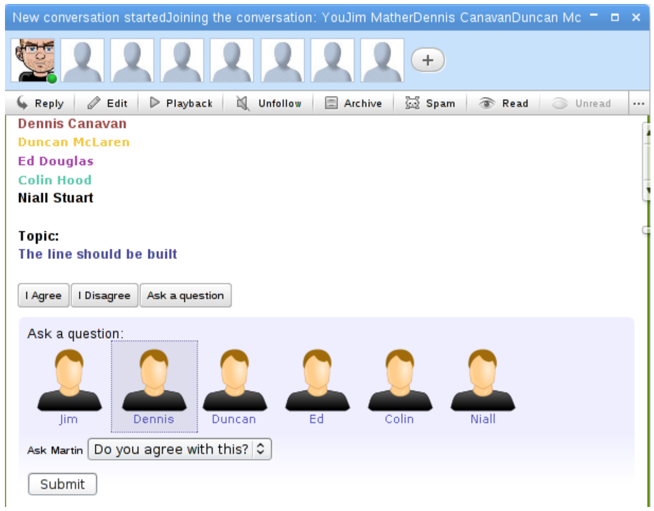

Fig. 2. Asking a question of a virtual participant

(which elicits further supporting reasons) and so uncover, in a natural way, the participants' views [Fig. 2]. This method allows a user to direct the course of the conversation and as such, rather than just being presented with a list of claims, they can instead concentrate on the areas which interest them most. Live participants can also supply their own supporting reasons, allowing the AIF resources to be expanded in a structured way.

This mechanism allows a seamless conversation to take place between live users and those being represented virtually by robots. In this way even a very simple dialogue protocol provides an interface that exploits a naturalistic style of interaction to allow intuitive, user-driven navigation of a complex interconnected web of arguments.

4.2 Implementing Pedagogical Dialogue: Parley

Parley is a prototype networked graphical software tool that supports argumentative interaction between students working in small tutorial groups. By engaging in a dialogue, on a specific topic and according to a carefully defined protocol which governs the kinds of things that can be said at any given point, the students build up a diagram of the dialogue.

The main interface to Parley incorporates a graphical canvas on which the diagram is constructed and a set of tool palettes that provide access to the utilities that manipulate the diagram. The diagram is structured as a tree with a root note representing a central thesis, and responses and responses to responses beneath it. The links record the argumentative relationship between any given node and the node to which it is responding. In the prototype, Parley allows responses to existing statements of two types: support and attack. In this way,

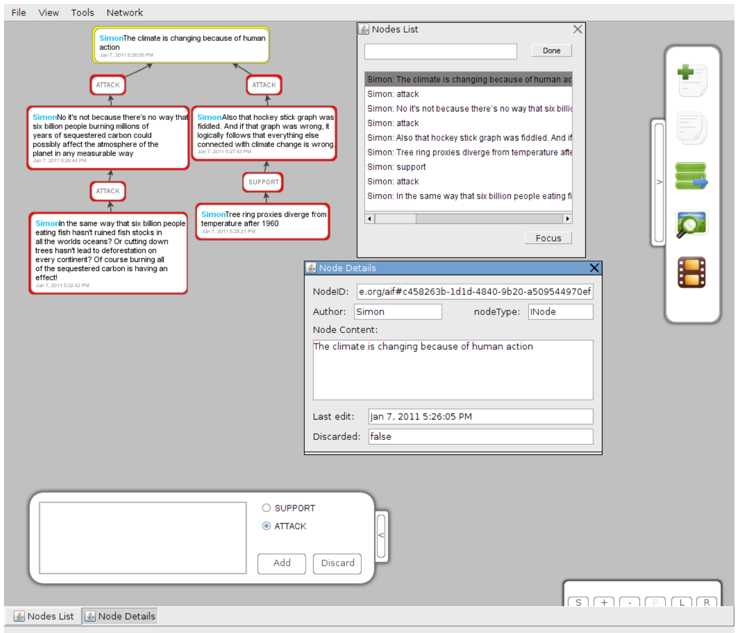

Fig. 3. The Parley dialogue tool

instead of diagramming the fine detail of an argument, Parley captures whole arguments, as they are uttered at the turn level of a dialogue, as individual nodes, showing relationships to other arguments as arrows between the nodes as the students respond to each others' points. By following a series of responses, each branch of the tree becomes a line of discussion within the dialogue, as a student puts forward an argument for or against a given position, which is responded to, and so on, until that line of discussion is exhausted and the students return to an earlier node in the dialogue in order to explore another line of discussion. In this way the dialogue continues until the students run out of things to say. Finally, the node details widget can be used to display information about any individual node within the diagram and identifies the type, author, content, modification time, and status. Currently all nodes have a type which is either an information node, for the content of utterances made by the students, or scheme node, capturing the relationship between given pair of information nodes. These nodes correspond to the equivalent AIF I-nodes and S-nodes respectively and allow Parley dialogues to be exported as AIF documents for reuse in other tools or to allow individual students to maintain their own archive of dialogues.

One of the advantages of the graphical approach used in Parley, as opposed to the text based approach taken in other pedagogical dialogue software like InterLoc [4], is that an overview of the whole dialogue can be rapidly gained without having to read the entire transcript and reconstruct the threads of discussion.

5 Concluding Remarks

We have given a brief introduction here to three tools for teaching argumentation skills in the classroom: one that is in the more traditional sphere of close analysis of argument; and two that broaden pedagogy of argument into dialogical systems. The aim has not been to give a detailed description of any of these systems, but rather to demonstrate how they can be used to complement one another in educational settings, and how resources developed for or with one tool can be re-used in very different settings with another. These benefits of compelementarity and re-use arise from the common foundation upon which they are all developed provided by the abstract ontology of the argument interchange format. As more and more tools and datasets are developed that use the AIF, so the potential for educational benefits, both within and between institutions, continues to increase.

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