The Policy Modeling Tool of the IMPACT Argumentation Toolbox

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Abstract. In this paper we present an overview of the policy modeling tool of the argumentation toolbox being developed in the European IMPACT project. The tool is a web version of the Carneades argumentation system extended with support for comparing policy alternatives in deliberative democracy application scenarios. The tool can be also be used as a legal expert system shell, for example in applications for helping citizens to assess their rights to social benefits, in much the same way as some commercial rule-based systems, but goes further towards realizing the vision of isomorphic modeling by being based on the state-of-the-art in Artificial Intelligence and Law and Computational Models of Argument fields.

Keywords. policy deliberations, computational models of argument, e-participation

1. Introduction

In this paper we present an overview of the policy modeling tool of the argumentation toolbox being developed in the European IMPACT project. IMPACT is a European Framework 7 project on the ICT for Governance and Policy Modeling theme. The project began January 1, 2010 and will run for three years.[1] IMPACT is conducting original research to develop and integrate formal, computational models of policy and arguments about policy, to facilitate deliberations about policy at a conceptual, language-independent level. These models will be used to develop and evaluate a prototype of an innovative argumentation toolbox for supporting open, inclusive and transparent deliberations about public policy on the World-Wide-Web.

Four prototype tools are being developed for the IMPACT argumentation toolbox:

1. Argument Reconstruction Tool
2. Structured Consultation Tool
3. Policy Modeling Tool
4. Argument Visualization and Tracking Tool

The first three of these tools support the process of getting arguments and assessments of arguments into the system. The argument reconstruction tool supports analysts with the task of finding and modeling relevant arguments in large numbers of articles and comments in natural language on the Web. The structured consultation tool uses formal models of argumentation schemes to generate surveys on the web which help the general public to voice their opinions, evaluate previous arguments, and ask

[1] Grant Agreement No 247228. For further administrative details about the project, see the project website: http://www.policy-impact.eu.

critical questions, by simply completing interactive forms. The argument visualization and tracking tool helps users to browse, understand and keep track of arguments which have been entered into the system using the other tools. The tool is a web application for displaying, browsing and querying interactive diagrams of arguments, called "argument maps".

The focus of this paper is the policy modeling tool. It uses computational models of policies, applying methods from Artificial Intelligence and Law and Computational Models of Argument, to help users to analyze and understand the legal effects of alternative policies in particular fact situations or cases. It helps users to "get arguments into the system" in an indirect way. By helping users to better understand the proposed policies, they are better able to contribute informed arguments to the policy debate. The tool is an interactive web application that works much like a rule-based expert system or "wizard". Users engage in a simple kind of dialogue with the system, using menus and forms.

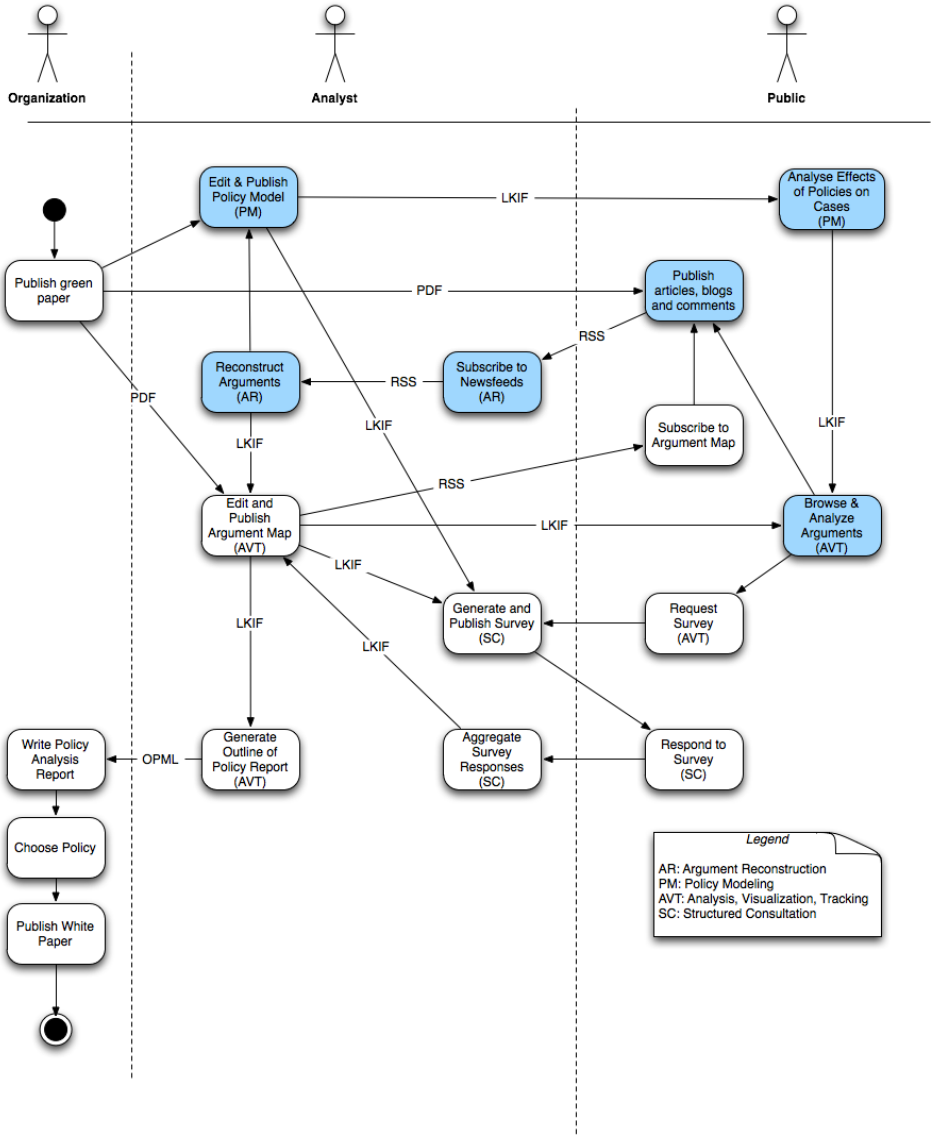

Figure 1. Process Model

Figure 1 is a process model showing how all the tools of the IMPACT system are used together to support policy deliberations. The highlighted tasks are relevant for the policy modeling tool. Suppose that welfare benefits are at issue and that several new welfare policies have been proposed. First, a computational model of these welfare policies is constructed by the analysis and published on the web ("Edit and Publish Policy Model"). Next, public users (citizens and other stakeholders) can use these models to assess the legal effects of the alternative welfare policies on cases, for example to determine whether single mothers would be entitled to a benefit, by using the web user-interface of the tool ("Analyze Effects of Policies on Cases"). This is done

by selecting and loading models of the policies and entering the relevant facts of the case by completing a series of forms. Figure 2 shows a screen shot of the web user interface for entering case facts of the current prototype. Questions are asked by the system in a goal-directed way, using the rules of the policies, to assure that only relevant questions are asked. When sufficient facts have been gathered, the system produces a diagram visualizing relationships and dependencies between the facts of the case, the rules of the various policies, and the legal conclusions that can be drawn from these policies ("Browse and Analyze Arguments"). Figure 3 shows a screen shot of the argument map displayed by the current prototype.[2] The policy modeling tool is able to compute preferred policies serving the interests of the user, by achieving desired legal effects.[3] The cases entered by the user will be able to be saved back to a database on the server and published on the Web, to make them available to other participants in the policy debate. Care will be taken to assure that the privacy of users is protected, by not storing any personal information. The Policy Modeling tools also will provide a way for users to take part in a survey, to express their opinion about which policy is preferable, and to view the aggregated results of the survey. After having analyzed the effects of the proposed policies, the user should be in a better position to make an informed contribution to the policy deliberations, for example by posting an argument on his web log ("Publish articles, blogs and comments.") The argument can include links to any cases he constructed and published using the policy modeling tool. Clicking on such a link would launch the policy modeling with this case displayed. The facts of the case can then be modified, in order to explore the effects of the policies on other cases, without having to enter all the facts from scratch.

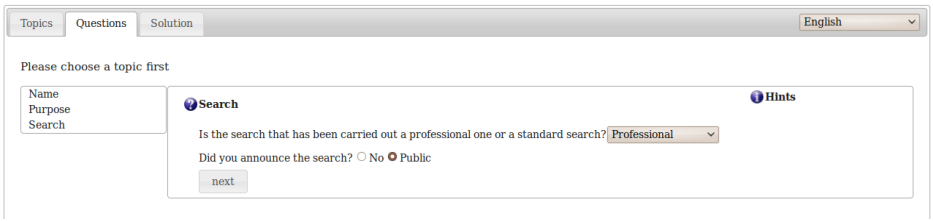

Figure 2. User interface for entering case facts

[2] In this prototype the statements are shown in a formal language. In the final version, the statements will be displayed in the user's choice of natural language. The analyst can manually provide templates for the most important languages. If a template has not been provided, an external translation web service is used to produce text in the requested language.

[3] 1The preferred policies are computed using a form of "abduction".

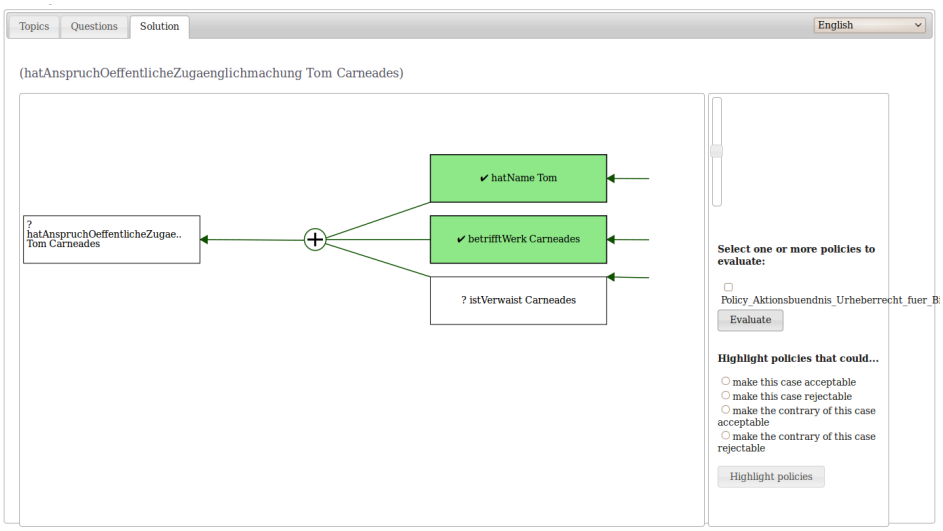

Figure 3. User interface displaying a map of the resulting arguments

2. System Architecture and Implementation Status

The system architecture of the IMPACT argumentation toolbox, shown in Figure 4, has been designed to ensure the usability, interoperability and portability of all of the argumentation tools being developed in the project, while complying with relevant standards.

Formal models of arguments are interchanged among the four tools using an XML Schema based on and derived from the argumentation part of the Legal Knowledge Interchange Format (LKIF) (Gordon 2008). LKIF is an XML schema for representing and interchanging rules and arguments that was developed by some of the IMPACT partners in a prior European project, ESTRELLA (IST-2004-027655).

The tools of the argumentation toolbox are web applications, with a three-tiered, client-server architecture, with a relational database backend. The server-side of the tools are packaged and published as RESTful web services, following World-Wide Web Consortium (W3C) standards.

The client-side of the IMPACT argumentation tools are implemented as Rich Internet Applications using W3C standards, in particular Asynchronous JavaScript and XML (Ajax). Web components are packaged as web widgets using Googles iGadget specification. Gadgets are small web applications that can be stored locally on the client computer and run outside a browser in a special web container or may be included by other platforms supporting the gadget specification. This enables the web user interfaces of the IMPACT tools to be published on pages of eParticipation and other web sites and portals and be used with any standards-compliant web browser, without requiring plug-ins.

To ensure that all IMPACT web clients have a common look and feel, they are all implemented using the jQuery JavaScript library. A custom stylesheet has been developed, using the jQuery User Interface CSS Framework, to enable widgets of the

tools to have a common, attractive look and feel. The jQuery library was chosen because it is open source, mature, well documented and widely used. A set of guidelines and principals for the developers of IMPACT tools has been developed, to address usability, ergonomics, accessibility, security, internationalization and other issues.

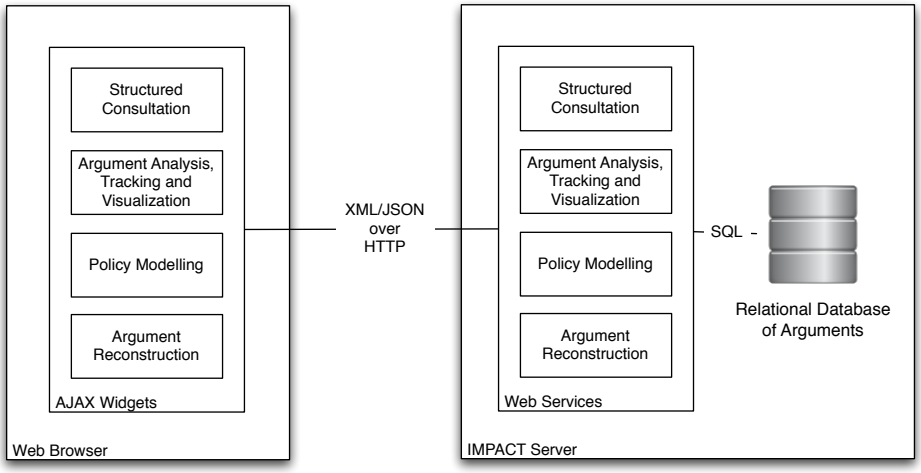

Figure 4. System Architecture

The system architecture described above applies to all the tools of the IMPACT toolbox. However, the way the web services of the tools are implemented varies from tool to tool. The policy modeling web service is based on our prior work on the Carneades argumentation system (Gordon 2010), but with the following major changes and extensions:

- Carneades was first ported from Scheme to Clojure[4], another Lisp dialect, to enable it to run on the Java Virtual Machine and make use of the extensive set of available Java libraries, for example for interacting with databases via the Java Database Connectivity library (JDBC) and for implementing web services and applications.
- We have developed and implemented an original method for a kind of "abduction" from a set of arguments, interpreted as defeasible rules in a propositional (nonmonotonic) logic (Ballnat and Gordon 2010). This work provides the foundation for reasoning about the differential effects of alternative policy proposals in the policy modeling tool.
- Next we have refactored Carneades to more cleanly separate its modules for argument construction and argument evaluation. It is now easier to implement and "plug in" modules for other computational models of structured argument, such as ASPIC+ (Prakken 2010). We intend to validate this architecture during the IMPACT project by implementing

[4] http://www.clojure.org/

and offering ASPIC+ in addition to Carneades' own model, called Carneades Argument Evaluation Structures (CAES).

- We have designed and implemented a Domain Specific Language (DSL) in Clojure for visualizing directed graphs, similar to the "dot" language used by the Graphviz system (Ellson et al. 2001), called LACIJ[5], for the purpose of generating visualizations of argument graphs for the Web, using the Structured Vector Graphics (SVG) web standard for 2D vector graphics[6].
- A new XML format for interchanging arguments, called the Carneades Argument Format (CAF), has been developed. CAF is based on the LKIF schema for arguments, but has been extended to provide better support for metadata about the sources of arguments and simplified by omitting the parts of LKIF for representing rules. Metadata is represented using the Dublin Core Metadata Element Set.[7]
- Policies are represented in a new Domain Specific Language (DSL) for defeasible inference rules (also called "argumentation schemes") in Clojure[8]. The language provides a way to specify templates for translating formulas into positive or negative assertions, as well as questions, in several natural languages, as required by the IMPACT application scenarios for European policy debates. The language supports the isomorphic modeling of legislation, as a hierarchy of sections. Rules ("schemes") can be included at every level of the hierarchy. Metadata, using the Dublin core attributes, can be associated with the rulebase as a whole, as well as each section and scheme. This metadata also enables links to the original legal sources to be included within the model.
- Carneades now has a relational database backend for storing and managing arguments, along with metadata describing and linking the arguments to their source documents. The database schema is isomorphic to CAF, to enable CAF files to be imported into a database, and exported from a database, with no loss of information.
- A RESTful web service[9] for creating, reading, updating and deleting arguments from the database has been implemented. Data is exchanged between the web service and clients using the JSON language[10], which is based on JavaScript and thus ideal for Rich Internet applications written in JavaScript using AJAX.[11] This web service will be extended to provide access to all features of Carneades for constructing, evaluating and visualizing arguments on the Web.

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[5] https://github.com/pallix/lacij

[6] http://www.w3.org/Graphics/SVG/

[7] http://dublincore.org/documents/dces/

[8] Carneades no longer uses LKIF or some other XML format for representing legal rules. An OASIS Technical Committee has been proposed for developing an XML standard for legal rules, called LegalRuleML, which we intend to support when it is finished. (See http://lists.oasis-open.org/archives/tc-announce/201111/msg00014.html).

[9] http://en.wikipedia.org/wiki/Representational_state_transfer

[10] http://www.json.org/

[11] http://en.wikipedia.org/wiki/Ajax_(programming)

A prototype of the policy modeling tool with all of the above features is nearing completion and can be demonstrated.

3. Related Work

The Carneades argumentation system, upon which the policy modeling tool is based, and which is being extended during the course of the IMPACT project to meet requirements of policy deliberation application scenarios on the Web, has been inspired by and builds upon a large body of work in the fields of AI and Law, computational models of argument and web-based groupware for argumentation. It would exceed the bounds of this research abstract to mention all relevant prior work. It will have to suffice to list some of the main influences.

The inference engine for constructing arguments from defeasible rules (argumentation schemes) is based on prior work on nonmonotonic logics and legal reasoning in the AI and Law field. The main direct influences include (Prakken 1997; Hage, Verheij, and Lodder 1993) not to mention my own prior work beginning with Oblog (Gordon 1987) and later the rule language of the Pleadings Game (Gordon 1994). A good summary of this line of research is (Prakken et al. 1998).

The Carneades computational model of argument is one of the few systems to model legal proof standards, such as preponderance of the evidence and beyond reasonable doubt (Gordon and Walton 2009). This work was inspired by (Freeman and Farley 1996). Recently, the ASPIC system has been extended to support proof standards (Prakken and Sartor 2011). For some time, the relationship between Carneades and the leading computational model of argument, Dung abstract argumentation frameworks, was unclear. But this relationship has been clarified in a series of articles (Brewka and Gordon 2010; Governatori 2011; van Gijzel and Prakken 2011).

Finally, the new parts of Carneades for supporting argumentation on the web were inspired and informed by a number of systems, in particular Cohere (Buckingham-Shum 2008), the vision of a World-Wide Argument Web (Rahwan, Zablith, and Reed 2007), Gregor Betz' ArguNet system[12], as well as my own prior work on the Zeno system (Gordon and Richter 2002).

4. Conclusions and Future Work

This short paper has outlined our ongoing work in the IMPACT project on building a policy modeling and analysis tool, based on state-of-the-art methods from Artificial Intelligence, Computational Models of Argument and groupware for argumentation on the World Wide Web. The policy modeling tool builds on our prior work on the Carneades argumentation system, but to meet the new requirements of the

[12] http://www.argunet.org/

IMPACT project for supporting policy deliberations on the web, Carneades was ported to the Java platform, to take advantage of its better support for building web applications, extended with support for a kind of abduction, useful for deriving policies with desired effects, and repackaged as a web service with a relational database backend. The services provided by the policy modeling tool for evaluating alternative policies will help participants in policy debates to better understand the effects of policies on cases, more easily formulate informed opinions about policy issues and contribute higher quality, constructive and rational arguments.

The IMPACT project continues for another year. In this time, we will develop the second prototype of the policy modeling tool. This next version will support the collection of feedback from users on their preferred policies and provide a convenient way for users to "vote" on the policies and have their votes recorded, anonymously, in the Carneades database on the IMPACT toolbox server. In addition, a way will be provided for users to publish cases in the database, in an anonymous form that respects privacy, along with their policy preferences, to enable other users to access and reuse the cases. The published cases will be assigned a URL by the system, to enable anyone to reference and link to the cases on the Web, for example in weblog and discussion forum articles about the policy issues. This feature will provide an easy way for users to back up their policy arguments with evidence and enable others to reproduce, understand and confirm the claimed effects of policies on cases.

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