PolicyCommons — Visualizing Arguments in Policy Consultation

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Abstract. PolicyCommons is a computer supported argument visualization tool to facilitate online deliberation on public policy. As such it supports the work of stakeholders by enabling them to navigate through arguments contained in relevant consultation and policy documents. These stakeholders include policy analysts, interest groups and the public. Specifically, PolicyCommons displays arguments about policies as browsable debate maps. Users can browse these debate maps and follow links from the visual summaries of the arguments back to the original policy documents. Thus, PolicyCommons is designed to help users make sense of the range of publicly expressed opinions about public policies. The major challenges we face in using argument visualization tools for online consultations can be clustered around the four main concepts of transparency, sense-making, readability and scalability, in this paper we show how we are addressing these challenges.

Keywords: e-participation, online policy-deliberation, argument visualization, argument mapping.

1 Introduction

One pressing challenge faced by e-participation scholars and practitioners has been presenting complex argumentation to citizens to enable better informed public debate about political issues[1]. Those who aim to see the Internet and other digital technologies transform our democracy and governance for the better have suggested that there is a need for radical new tools and techniques for presenting overviews of large-scale political discussions so that citizens can better make sense of and reflect on the opinions of each other[2]. Taking up this challenge, an agenda for research at the intersection of e-participation and computer-supported argument visualization (CSAV) has been set out in [3]. That agenda has given priority first, to investigating a methodology for design of interactive Web-based argument visualizations to allow various stakeholders navigate the complex issues in a policy-consultation; and second,

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to applying these methods and an associated application to interpreting models of policy-arguments at a level of granularity meaningful to various stakeholders.

This paper describes recent steps towards implementing the aforementioned research agenda. It introduces research and development on a prototype Web-based tool, PolicyCommons, which is used for visualizing arguments about policy proposals as browsable debate maps. Our research is aimed at the specific case where government, or a government agency, has published a green/white paper containing policy proposals and has invited comments on specific issues raised in the green/white paper. In our research, we are investigating how PolicyCommons can be used to support this type of policy consultation where documents are central to the process.

In this paper we first provide an overview of the requirements which form the basis for the design of PolicyCommons along with the inherent challenges facing such a design (Section 2). In Section 3 we briefly describe the underlying technical platform and in Section 4 we describe how we have extended this to progress the state-of-the-art. In the final section we present our conclusions.

2 Argument Visualization for Making Sense of Policy-Consultation

PolicyCommons supports the work of relevant stakeholders by enabling them to navigate through arguments contained in consultation documents - that is the green/white paper provided by government and the consultation response documents provided by other stakeholders. Stakeholders include policy analysts (who facilitate the policy consultation process) and general users such as interest groups (e.g. trade unions, umbrella organizations, academics, etc.) and the general public. Basically, PolicyCommons displays arguments about policies as browsable debate maps where users can browse the maps and follow links from the visual summaries of the arguments back to the source consultation documents. PolicyCommons has been designed to help users make sense of the range of stakeholder expressed opinions about public policies, as such, it is part of the class of tools often referred to as "sense-making" tools [4].

PolicyCommons is one of a set of tools being developed within the EU-funded IMPACT project[2]. In addition to this argument visualization tool, IMPACT is developing and integrating three other argumentation-based tools relating to the following tasks:

- *Argument reconstruction*: investigating how and to what extent arguments can be extracted and reconstructed from natural language documents.
- *Policy modeling and analysis*: using techniques from the field of AI and Law to allow stakeholders to simulate the legal effects of policy proposals.
- *Structured consultation*: using argumentation schemes to generate focused surveys to solicit public agreement/disagreement to policy proposals.

[2] IMPACT stands for Integrated Method for Policy making using Argument modeling and Computer assisted Text analysis: http://www.policy-impact.eu

The specific requirements for PolicyCommons were derived during the first step in the IMPACT project by consortium partners holding workshops and interviews with stakeholders involved in public-policy consultations. These requirements were then detailed as IMPACT project usage scenarios from the different stakeholders' perspectives. The scenarios for PolicyCommons can be summarized as:

The *Policy Analyst* should be able to:

- construct argument maps by assigning specific argumentation schemes, coding statements as elements of the argumentation scheme and labelling relationships between statements;
- publish debate maps on the web so as to enable general stakeholder interaction with them;
- support facilitation of the consultation by being able to view where arguments are missing or where conflicting arguments arise;
- at the end of a consultation period, close debate maps and generate outline consultation report based on the information in the maps.

The *General Stakeholder* should be able to:

- gain an overview of the green/white policy paper and an appreciation of the arguments contributed so far in response to the specific issues raised;
- navigate through the debate maps from high level to deeper level of detail;
- zoom in and out of specific arguments showing more or less detail;
- gain an appreciation of the underlying evidence for the arguments;
- trace back to and view the source document where an argument is located.

Online consultations on complex policy issues can involve a large number of stakeholders providing contributions. Many of these contributions can be complex documents in their own right. The scalability, understandability and transparency of use are major challenges that need to be addressed [1]. Furthermore, a specific challenge we face in using argument visualization tools to support online consultation is their current poor readability when displaying large-scale argument maps. As [5] indicates, reading argumentative structures, whether in text or in graphical form has always been a difficult skill to acquire. This is because making sense of argumentation requires both having a sense of the detail as well as having a sense of the whole.

The remainder of this paper describes in more detail how we are meeting the above requirements and challenges of scalability, understandability, readability and transparency, thus advancing the state-of-the-art in the use of computer-supported argumentation for e-participation and online policy-deliberation. But first, in the next section, we briefly describe the technical platform on which the PolicyCommons application is built.

3 Technical Platform

3.1 Reusing an Existing Open-Source Platform

Very early on in the conceptual phase of our work, we made a design-decision that rather than develop PolicyCommons from scratch we would reuse an existing CSAV platform and build on it to extend the state of the art. In particular, we decided to reuse the Cohere platform developed at the Open University [6]. Cohere is a state-of-the-art, open source, Web2.0 tool for argument analysis and argument visualization, which provides a platform for online collaborative deliberation using the familiar standard Issue-Based Information System (IBIS) framework [7]. IBIS was developed by Kunz & Rittel [8] as an information system for investigating the use of argumentation to help solve ill-structured design and planning problems. This work then evolved into a general approach to solving what the authors called "wicked problems", a class of problems into which policy development falls [9]. This term was introduced so as to distinguish the kinds of problems that social-policy planners deal with from the kinds of problems that scientists encounter—the key distinction being that in science you can prove whether your solution is correct, whereas in matters of social policy, you cannot prove that a solution or decision is the correct one; rather you can only try to persuade, through argumentation, that it is the best solution given the constraints.

The choice to use Cohere came after a review of the suitability of a number of argument visualization tools for the IMPACT project – the details of this review and rationale are given in [3].

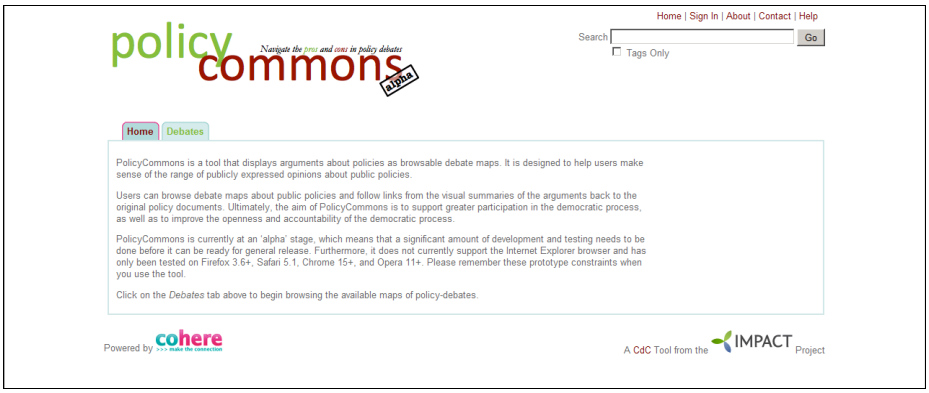

Figure 1. A screenshot of the current public PolicyCommons prototype developed on top of the Cohere platform.

Figure 1 shows a screenshot of the PolicyCommons prototype, which was launched online in September 2011. There were three objectives for doing this. Firstly we wanted the stakeholders in the project to be able to see the current state of development. Secondly, we wanted to have a publicly available tool to populate with

corpus data. Thirdly, we wanted to be able to start evaluation as soon as possible. However, even as we reuse and build on an existing CSAV platform, our aim in the research and development of PolicyCommons is to advance the state-of-the-art in computer-supported argumentation – particularly CSAV – in its application to the domain of e-participation and online policy-deliberation.

3.2 Adhering to Web Standards

With respect to the underlying technology for implementing the argument visualizations, we decided to adhere as far as possible to Web standards. For sophisticated visualizations this means a solution based on one or more of HTML5, JS, CSS, and SVG technologies. In order to accomplish this task we reviewed a number of existing libraries for data and information visualization that use Web standards. The important criteria we considered were: open source license, size of user community, adequacy of API documentation, extendibility, and support for popular browsers. We reviewed a number of leading visualization libraries, including: Canviz, D3, JavaScript InfoVis Toolkit, ProcessingJS, and Raphaël JS. Here we briefly describe the review of each library in turn.

Canviz[3] is a JavaScript library for drawing graphs to the HTML5 <canvas> element using the layout engines implemented in the Graphviz software. Graphviz itself is a popular library for laying out graphs – e.g. the popular graph-drawing program OmniGraffle uses the Graphviz engine for automatically laying out its graphs. Unfortunately using Canviz would require that the Graphviz engine is running in the background, adding another dependency to our platform. Furthermore, Graphviz does not work in a dynamic way and the visualizations are not interactive, both of which are important features for Web-based argument visualization. Canviz is distributed under an MIT license.

D3[4] is a JavaScript library for creating SVG visualizations, which has evolved from the earlier Protovis library. D3 includes many standard types of data and information visualization layouts. Furthermore, it provides mechanisms for including interactive behaviors such as "zooming" and "panning" of visualizations. In terms of license, the D3 project is distributed under a BSD license.

The JavaScript InfoVis Toolkit (JIT)[5] is a library designed specifically for creating information visualizations. The JIT uses the HTML5 <canvas> element for plotting and animating graphs.

ProcessingJS[6] is a JavaScript implementation of the Processing language for data visualization (before this, there was only a Java implementation). ProcessingJS uses the HTML5 <canvas> element to render the visualizations and provides an API for drawing shapes and manipulating them on the canvas. ProcessingJS is distributed under an MIT license.

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[3] http://code.google.com/p/canviz/
[4] http://mbostock..github.com/d3/
[5] http://thejit.org/
[6] http://processingjs.com/

Raphaël JS[7] is a library for working with vector graphics on the Web. Raphaël JS is one of the better-known SVG libraries. However, it does not seem to be used extensively for data/information visualization projects. Raphaël JS is distributed under an MIT license.

Based on the PolicyCommons requirements and the current state of Cohere we have implemented the new visualization based on **D3** [10], using the built-in layout algorithms from the D3 library for generating the argument network visualization.

4 Advancing the state-of the art in computer-supported argumentation for e-participation

4.1 Interpreting a Formal Model of Policy-Argumentation

All the IMPACT tools are based on the same computational model of argumentation using a number of predefined argumentation schemes. These argumentation schemes determine the structure of the arguments displayed in PolicyCommons. Argumentation schemes are patterns of arguments determined by the analysis of their structure and content as reconstructed from natural language texts [11]. As explained in [1] they are useful for guiding the reconstruction of arguments put forward by contributors to a debate and thus opening the arguments up to critical analysis and evaluation and also for constructing fresh arguments to put forward in support of one's own point of view, or to counter the arguments of others. All these uses are clearly relevant to supporting deliberative participation in policy consultation and supporting transparency.

The IMPACT project has, to date, focused on two argumentation schemes, – arguing from *practical reasoning* and arguing from *credible source*. The rationale for choosing these schemes and the work to determine the computation models can be found in [12, 13] which builds on earlier research into an argumentation-based tool for supporting e-participation[14]. By using these argumentation schemes, we are able to systematically address appropriate critical questions and therefore display the justification for arguments put forward in the policy-deliberation. Critical questions supported by the system reflect issues such as:

- the circumstances upon which the action is based;
- the consequences of the action;
- the social values promoted by these effects;

all of which aim to facilitate sense-making and transparency, thus supporting the general stakeholder

Similarly, the scheme 'Arguing from Credible Source' provides critical questions which reflect issues such as, 'is the expert biased?' which helps determine biased as opposed to impartial contributions to the debate.

In order to accommodate the formal models of policy-argumentation we have had to align the original PolicyCommons data model – which it inherited from the Cohere

[7] http://raphaeljs.com/

platform on which it is built – with the IMPACT model of argument. The main elements of the inherited Cohere data model are *Nodes* and *Links* (which connect two Nodes). A Node consists of free text and is assigned a type such as *Idea*, *Data*, or *Theory*, just to list some examples. Similarly, a Link can be assigned a type such as *refutes*, *supports*, or *addresses the problem*, again just to list some examples. However, Cohere provides a flexible mechanism of adding, deleting, and modifying node- and link-types while simultaneously avoiding any changes to the fundamental underlying data model or data-access API. This has been a very important feature for our ability to rapidly prototype the PolicyCommons tool. PolicyCommons is about allowing users to visualize and browse debates of policies. It is within the context of a debate that issues are raised, responses are given, and arguments are made and connected—resulting in the notion of a debate containing all of these elements of policy-argumentation. However, as stated above the original Cohere data model only comprises nodes and links— i.e. it does not have the concept of elements being grouped together in a container. As a solution, we have introduced *Debate* as a new PolicyCommons node-type and *contains* as a special link-type which is used to connect *Debate* nodes to other nodes (such that, e.g., a *Debate* contains an *Issue*). Now, when the visualization module of PolicyCommons retrieves nodes with type "Debate", they are treated differently, purely in terms of visualization, to any other node-type, even though the fundamental data model and data access API remain unchanged (examples of these different types of visualizations are given in the remainder of this section).

In addition to this concept of Debates as containing elements, to account for modeling the detailed structure of arguments we have introduced new node-types *Argument* and *Statement* (which represents the individual parts of an argument). Finally, inspired by the Practical Reasoning approach of [12–14] and to account for the model of argumentation schemes used by the rest of the IMPACT tools we have introduced the additional link-types *circumstance*, *consequence*, *goal*, and *value*, which are used to present the practical reasoning argumentation scheme.

4.2 Issue Maps – a Special Type of Information Visualization

This section concerns viewing and browsing the potentially large amounts of information contributed during a consultation. In order to allow users to get an overview of the vast amount of information and to be able to appreciate how much debate is associated with issue we have adapted a special kind of visualization called the "treemap", which has been pioneered by Ben Shneiderman [15] in the field of Information Visualization. Work in the Information Design and Information Visualization field investigates the use of visual techniques for displaying information, with suitable visual cues for helping the user to read and understand information, in much the same way that natural language has evolved linguistic cues to help readers understand narrative structure and make sense of a piece of text.

Adapting this technique, we have created *Issue Maps* which use color-coded rectangular blocks to depict issues within the debate. The different sizes of the rectangles indicate the comparative number of arguments associated with each issue.

Figure 2. A map of sub-topics of debate that group issues in the policy-consultation.

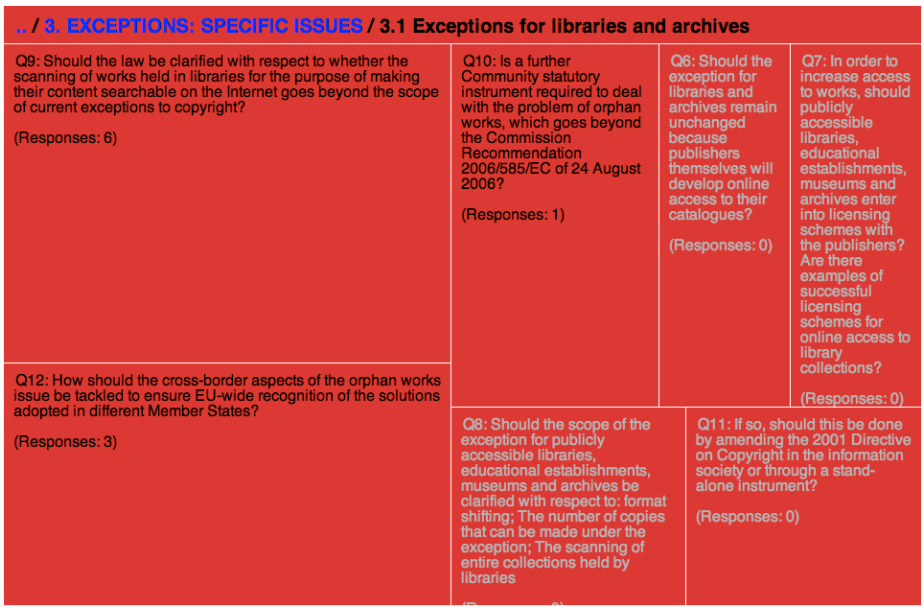

Figure 3. An Issue-Map visualization showing one group of issues in a policy-deliberation.

Getting an appreciation of the size of the debate around the different consultation questions provides guidance to the general stakeholder who can immediately get a sense of where all the 'talk' is happening but also important for the policy analysts as

it allows them to appreciate where there is a lack of contributions and therefore where facilitation is required. Users move further into the debate by clicking on a rectangle taking them to the arguments addressing that issue. Figure 2 provides a screen shot of this new type of visualization. The Figure shows how issues are grouped into particular sub-topics of debate. As explained earlier, the size of each rectangular region on the map corresponds to the relative number of responses made by stakeholders. From this view, users can click through to see the issues raised in that particular area of debate. Figure 3 shows the visualization of issues in the area of policy-deliberation dealing with "Exceptions for libraries and archives", which the user clicks from the previous view. The color-coding allows the user to see that these issues relate to the same sub-topic. Each Issue region (except those Issues without responses) is clickable, so that users can click through to view the responses and arguments made on those Issues which are of interest to them. Clicking on an Issue generates a different visualization, which we describe next.

4.3 Argument Network Maps

We have extended Cohere's capability to manipulate the layout of argument maps, particularly through the use of sophisticated layout algorithms for what are called *Argument Network Maps*. This visualization shows issues and responses as graphical text-boxes connected by labeled lines. Since these types of visualizations quickly become graphically unmanageable, we have enabled interactions typical of modern Web-based visual interfaces—e.g. interactions such as zooming, panning, and showing/hiding certain parts of the visualization.

An example of this new argument network visualization is shown in Figure 4. The Figure shows the issue, which the user is currently focusing on in a different color to the other nodes in the visualization. Clicking on the summary text in any of the boxes takes the user to the source material. Figure 5 then shows the view when the user has clicked to see the structure of the argumentation for one of the responses. Here the text-box expressing the proposed action is linked to the other text-boxes expressing the justification of the argument, where the link labels are consequence, circumstance, and value—the instantiated components of the relevant argumentation scheme.

5 Discussion: Addressing the Challenges of Computer-Supported Argumentation in Policy-Consultation

The paper began by highlighting the four major challenges facing online consultation through computer-supported argumentation as being: transparency, understandability, readability and scalability. Now we turn to discussing more explicitly how the techniques introduced and described thus far in the paper start to address these challenges. Figure 6 summarizes how the challenges are being addressed, through our approach of Issue-Map and Argument-Network visualizations, all underpinned with a notion of *document-centricity*.

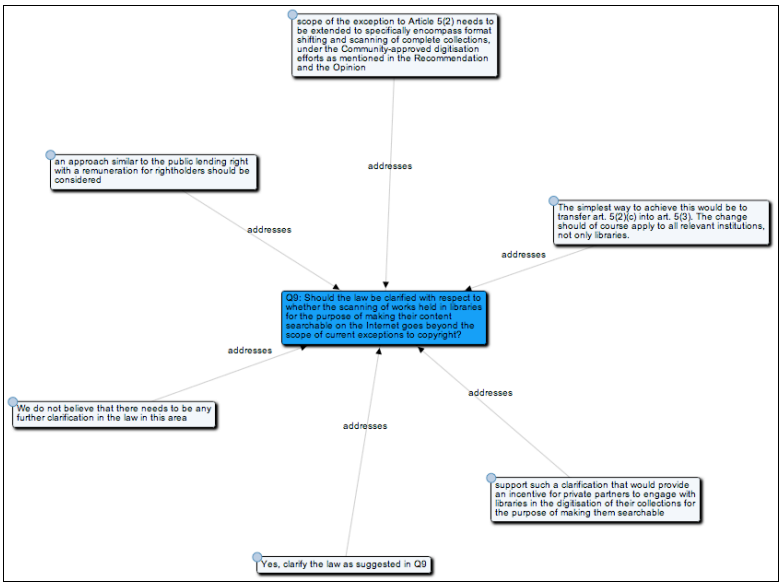

Figure 4. An example Argument-Network Visualization showing the arguments addressing a particular issue in the policy-deliberation.

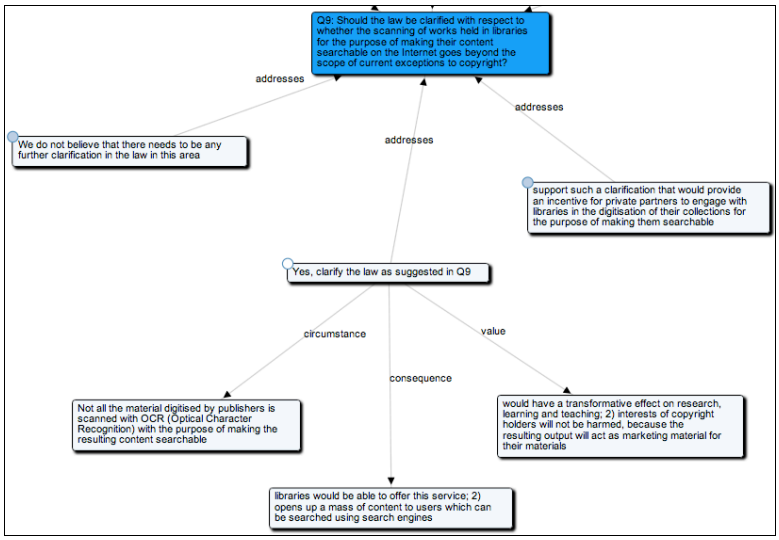

Figure 5. Zooming in to see the detailed structure of an argument responding to a policy-issue.

The document-centricity is important since the policy-consultation document is central to our underlying objectives of achieving transparency and understanding in the argument map. The main IMPACT usage scenario involves an organization publishing a green/white policy document in order to solicit feedback from relevant stakeholders. Thus, the argument network maps generated by PolicyCommons have

to be anchored in this policy paper, and all arguments generated by stakeholders are entered into the argument network maps with links to the original issue raised in the policy paper and link back to the source material from where they were derived. In this way all visualized data in PolicyCommons are centered on the consultation documents.

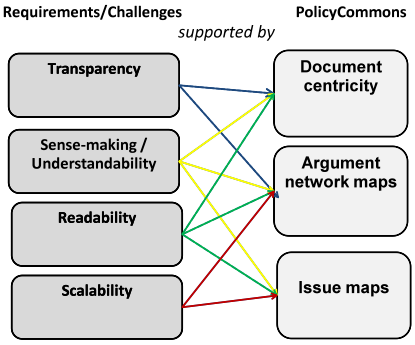

Figure 6. Summary of how the four main challenges are being addressed.

Furthermore, this document-centricity promotes sense-making for general stakeholders joining at any time during a lengthy consultation period as they can see how their arguments fit within the ongoing policy-deliberation process consultation. Finally, this document-centricity gives confidence to the policy-makers that the contributions provided by stakeholders are on-topic and relevant.

The combination of issue maps and argument network maps is a unique way of addressing all these challenges. In particular, the argument network map aids scalability through its layout manipulation and zooming capabilities. It supports transparency and sense-making by linking arguments not only to their source text but also back to the issue they address in the consultation document. The issue map supports the scalability and readability of large consultations by providing a realistic entry point for new users so that they can quickly gain an overview of the issues and contributions so far submitted, providing the ability to browse maps at different levels of granularity.

6 Conclusion

This paper has introduced and described our current research and development on a prototype Web-based tool, PolicyCommons, which is used for visualizing arguments about policies as browsable debate maps.

With regard to evaluation, we have adopted a scenarios-based workshop approach. The scenarios use short narrative clips to convey how we intend the prototype to be used by its intended users. As a general evaluation approach the scenarios have

stimulated discussion about the feasibility and desirability of any envisioned changes or other claims made about the prototype's impact. Although evaluation is on-going, preliminary results are encouraging. It is our intention to report on the full evaluation as a separate paper elsewhere.

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