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Appendix

A. Tools

A.1. List of social and Semantic Web tools considered

In this section we draw from our review of thirty-seven online argumentation tools: AGORA: Participate – Deliberate, ArgDF, Arguehow, Argument Blog-

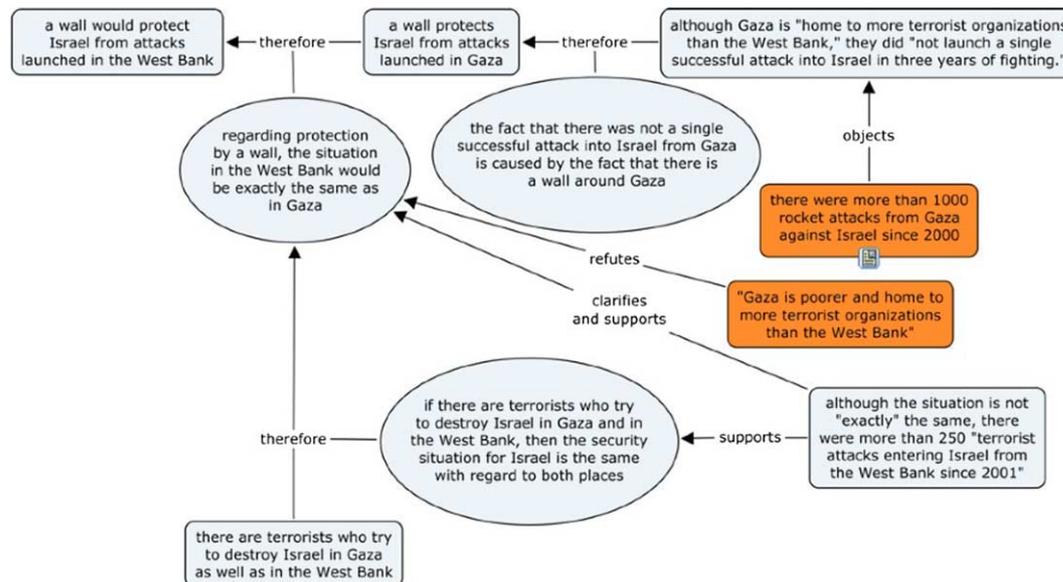


Fig. 24. A sample LAM map, from [86]. (Color figure online)

ging, Argumentum, Argumentations.com, Argunet, Avicenna, bCisiveOnline, Belvedere, Cabanac's annotation system, Climate CoLab, Cohere, Competing Hypotheses, ConsiderIt, ConvinceMe, CoPe_it!, CreateDebate, Debate.org, Debategraph, Debatepedia, Debatewise, DiscourseDB, Dispute Finder, Hypernews, LivingVote, MAGTALO, Opinion Space, Online Visualisation of Arguments, Parmenides, POnline, REASON, Riled Up!, SEAS, Trellis, TruthMapping, and Videolyzer. For further details about our inclusion criteria, see Section 9, page 179.*

A.2. AGORA: Participate – Deliberate

Michael Hoffman's system, AGORA: Participate - Deliberate [86], uses Logical Argument Mapping [87] (Fig. 24), providing support for representing deductively valid arguments, using one of seven schemes: modus ponens; modus tollens; disjunctive syllogism; not-both syllogism; conditional syllogism; equivalence; and constructive dilemma. It relies on concept mapping software called CmapTools⁷⁵.

A.3. ArgDF

ArgDF⁷⁶ is a Semantic Web-based argumentation system using the AIF-RDF ontology described above

⁷⁵<http://cmap.ihmc.us/>

⁷⁶<http://argdf.org/>

Fig. 25. ArgueHow offers structured discussion. (Color figure online)

[147,148,212]. ArgDF uses Sesame RDF for storage and querying and Phesame for communicating with the Sesame through PHP pages.

A.4. ArgueHow

ArgueHow⁷⁷ (Fig. 25) is a argument-based discussion board aimed at a general audience. Its purpose is to help find the best points supporting a position. Discussion points are sorted by votes for ('Credits') and against ('Cruds') them. ArgueHow has a unique way

⁷⁷<http://arguehow.com/>

*Briefly: Tools were considered in-scope if they were:

- collaborative

(i.e. involved sharing information among multiple parties who could build upon each others' work in some way),

- Web-based

(i.e. allowed display of information on the Web),

- and had argumentative discussion components.

of handling reputation: users start with a reputation of 50, which increases or decreases according to the votes their points accrue. Votes are weighted: for instance, points with 10 ‘cred’ or ‘crud’ votes change less in response to further votes, and votes on users’ first 20 discussion points affect their reputation less than later contributions, allowing them to learn the system.

A.5. Argument blogging

The idea of argument blogging was proposed by Wells, Gourlay and Reed [201] as a way to bring blogs into the WWAW, based on standard Web technologies, and augmented by argument specific technologies. In addition to AIF, argument blogging relies on the AIF Database (AIFDB) and Dialog Game Description Language (DGDL). AIFDB is a MySQL database for storing AIF documents which can be serialized as RDF and accessed via a RESTful Web service. DGDL [149,203] is a grammar for describing the rules of dialogue games.

Argument blogging uses text from the current Web as a departure point for the WWAW. When browsing the Web, users select text and click a JavaScript bookmarklet, to indicate whether they will attack an inference, support or refute the selected text. This generates a fragment of embeddable JavaScript the user can paste onto his/her blog. Once a blogger opts in to the WWAW by adding JavaScript to a webpage, the page displays a badge which links back to argument blogging server, where the distributed dialog can be visualized or exported as text.

Earlier work on semantic blogging predates the WWAW but focused more attention on the visualization of reply graphs of messages from multiple blogs [93] or the possibilities for inference [39].

A.6. Argumentum

Argumentum⁷⁸ is an argument-based discussion site aimed at airing discussions. Debaters add topics and their arguments are colored to indicate the supporting (green) and opposing (red) arguments (Fig. 26). Comments, but not their replies, are similarly colored to indicate agreement or disagreement. Users sometimes want to agree or disagree without leaving comments; currently this leaves a default comment that says “Type the reason why you oppose...”

⁷⁸<http://arg.umentum.com/>



Fig. 26. In Argumentum, users can indicate support for an argument with money. The left-hand color bars indicate the supporting (green) and opposing (red) arguments. (Color figure online)

Argumentum’s most unique feature is that users can put their “2 cents” in literally: credibility, earned with good arguments, is measured in ‘cents’ and can be spent to influence a debate result. Users can also contribute arguments without starting from the Argumentum website, using bookmarklets⁷⁹ or through Gmail and Facebook⁸⁰. Further, loggers and publishers can also contribute using Argumentum buttons or widgets.

A.7. Argumentations.com

Argumentations⁸¹ serves analysts who want to develop arguments collaboratively. Arguments, which are classified as either claims or open-ended issues, can be added or edited; an example is shown in Fig. 27 on the facing page. To help suggest topics and build arguments, users can import news stories and extract statements (declarative sentences) from stories.

Argumentations offers several unique features. First, arguments – whether claims or open-ended issues – are evaluated depending on their type. *Claims* are evaluated with a truth value and confidence. *Open-ended issues* are evaluated based on Desirability, Importance, Volatility, Likelihood, and Confidence. Second, along with tag clouds, Argumentations uses ‘tag spheres’ (Fig. 28 on the next page). Further, arguments can be opened in Silverlight. Finally, they offer some interesting tutorials which display mindmaps⁸².

⁷⁹<http://arg.umentum.com/share>

⁸⁰<http://arg.umentum.com/wiki/more-ways-to-argue>

⁸¹<http://www.argumentations.com/>

⁸²<http://www.argumentations.com/Argumentations/Help/Tutorials/Tutorials.aspx>

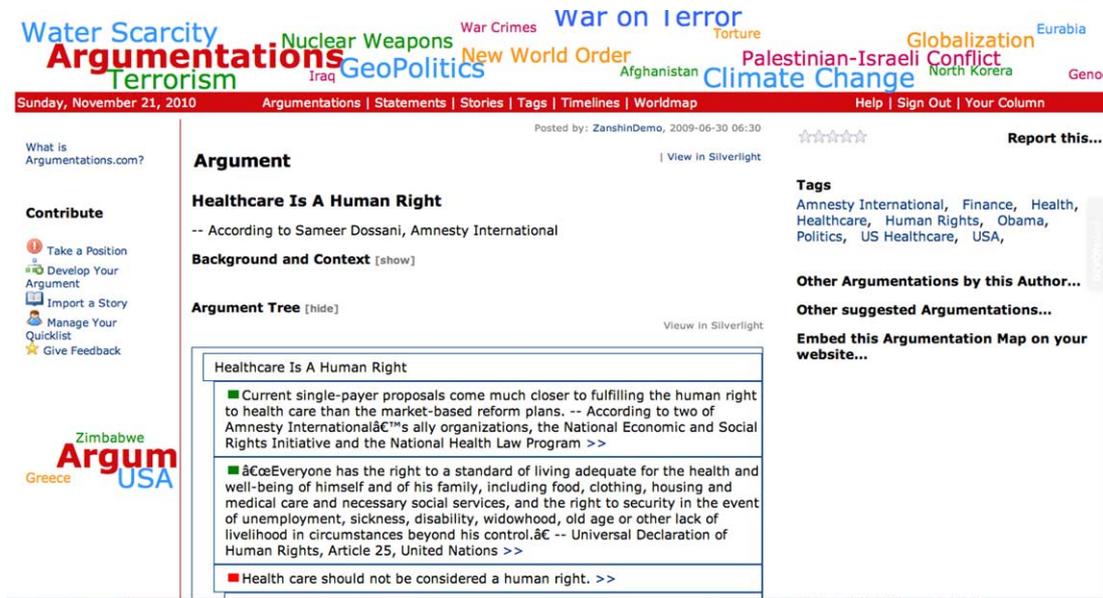


Fig. 27. In Argumentations, colored dots indicate the supporting (green) and opposing (red) arguments. (Color figure online)

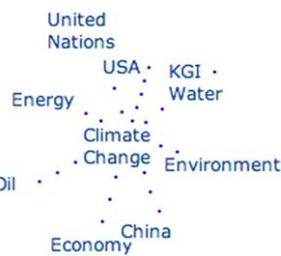


Fig. 28. The global warming 'tag sphere' from Argumentations. (Color figure online)

A.8. Argumet

Argumet [166] is a desktop tool⁸³ coupled with an open source federation system for sharing argument maps. A public server, Argumet.org⁸⁴, allows authors to make maps public or restrict viewing and/or editing to a specified group. Connecting to other servers is also possible; this focus on federation, makes Argumet unique.

Argumet also has other unique features. Argumet is a multi-lingual environment which records the language of the map. Maps published at Argumet.org, must be released under the CC-BY license. An extensive online manual provides instruction, and they promote embedding debates. Users also have significant control over the presentation of arguments, such as colors and de-

⁸³<http://www.argumet.org/editor/>

⁸⁴<http://www.argumet.org/debates/>

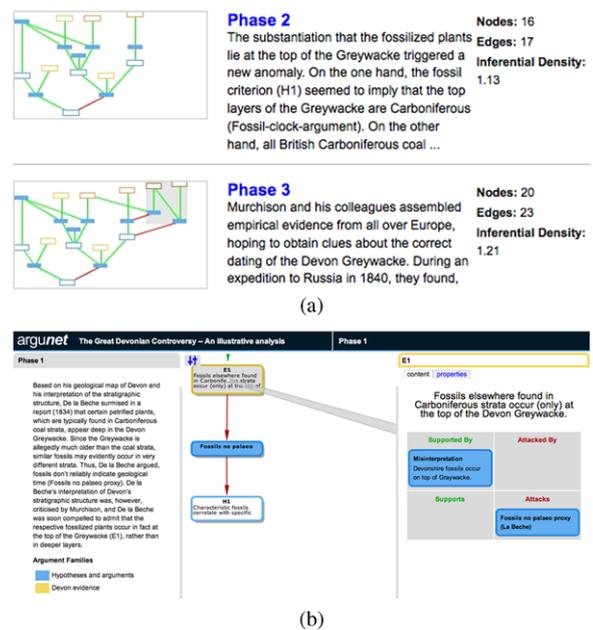


Fig. 29. Argumet can show an (a) overview of several related argument maps; and (b) in each individual map, nodes can be opened up to show arguments they support, attack, are supported by, and are attacked by. (Color figure online)

scriptions of different argument families. Related maps can be published in series, as shown in Fig. 29(a). In the argument map representation, each node can be opened up to reveal a matrix listing which other arguments support, attack, are supported by, and are at-

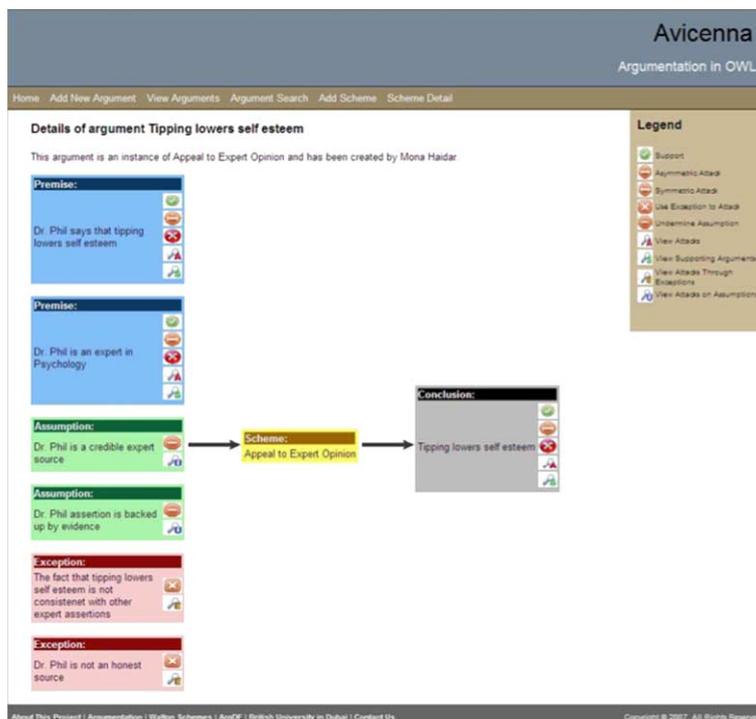


Fig. 30. Avicenna uses Walton's critical questions and argument schemes [145]. (Color figure online)

tacked by the given node (Fig. 29(b) on page 199). Argunet appears to support incremental formalization since arguments can be quickly sketched or reconstructed as premises and conclusions.

A.9. Avicenna

Rahwan and Banihashemi's OWL-based argumentation system Avicenna (Fig. 30) was demonstrated at COMMA 2008 [144] and recent descriptions and screenshots appear in [145]. Extending the work of ArgDF, Avicenna is a Web-based system using Jena [33], ARQ⁸⁵, and Pellet [173]. Since OWL supports inference over transitive properties, Avicenna can support argument chaining, such as retrieving all arguments that directly or indirectly support a given conclusion. Avicenna is also used to infer the classification hierarchy of argument schemes: for example, an appeal to expert opinion is a specialization of an argument from position to know.

A.10. bCisive online

bCisive Online⁸⁶ is an online argument mapping and spatial hypertext environment for real-time col-

laboration and team problem-solving (Fig. 31(a) on page 201). Aimed at the business market and individual decision-makers, bCisive Online is a commercial product from AusThink, the makers of the Rationale desktop tool; the free option allows up to three users to collaborate, or users can upgrade with a monthly subscription fee. bCisive Online is unique in that it is intended for real-time use with audio conferencing. One person edits the map at a time, adding nodes and connections between nodes (Fig. 31(b) on page 201) while others can point with their cursor or request editing control. Maps can be embedded in blogs (which allows viewers to pan, zoom, hide and show parts of the map) or exported as PowerPoint. Snapshots can be saved as history items, to allow restoring to or reviewing a previous map.

A.11. Belvedere

Belvedere⁸⁷ is open source software for problem-based collaborative learning. It provides multiple views, such as tables, graphs, and argument maps, of the same topic (Fig. 32 on the next page). It has been extensively investigated in studies of computer-supported collaborative learning [179].

⁸⁵<http://jena.sourceforge.net/ARQ/>

⁸⁶<http://www.bcisiveonline.com/>

⁸⁷<http://belvedere.sourceforge.net/>

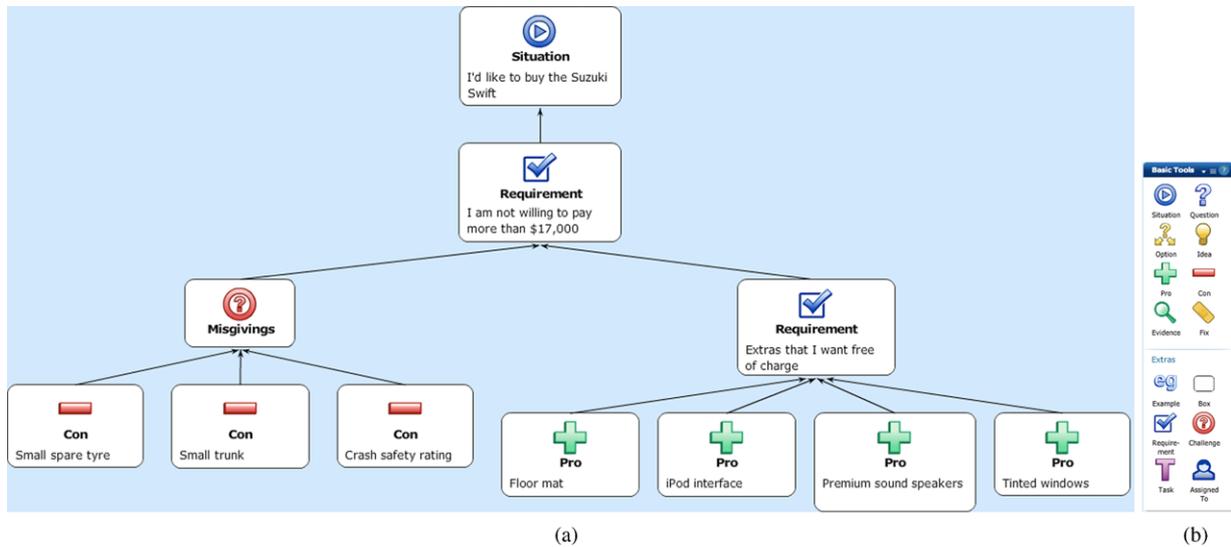


Fig. 31. (a) Collaborative maps for bCisive Online can be used for decision-making and requirements analysis. (b) bCisive Online’s node types show the kinds of discussions that it facilitates. (Color figure online)

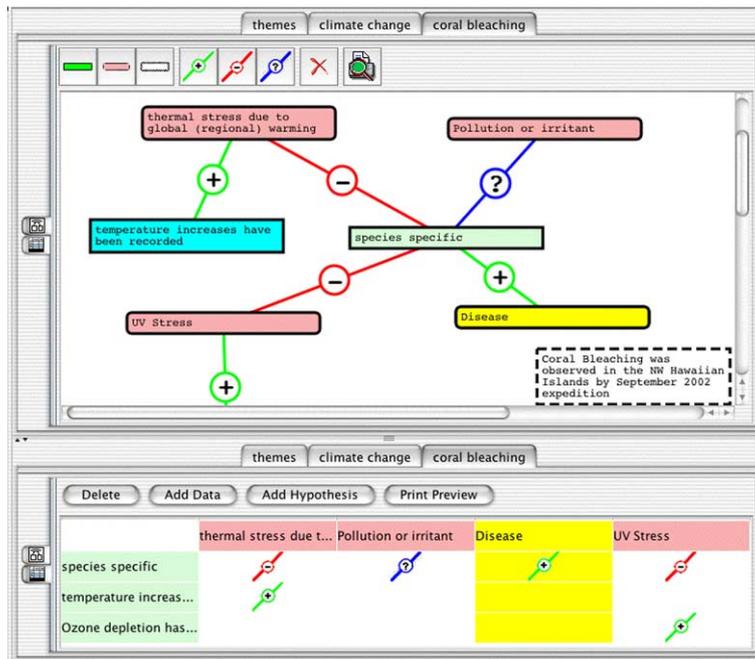


Fig. 32. Belvedere has both argument maps and tables to help organize evidence in collaborative learning. (Color figure online)

A.12. Cabanac’s annotation system

Cabanac used a Java-based system⁸⁸ to research social validation of the arguments in comments [30]. Users did not contribute new content to an ongoing public debate, but analyzed the argumentative status of

document comments. Uniquely, sliders were used to indicate the extent to which items were refuted, neutral, or confirmed (Fig. 33 on the following page). In effect, users were asked to synthesize the discussion. Aggregated information was not viewed by the users, but held by the experimenter. However, in principle, this approach could be used to promote collaborative sensemaking not just of annotations but also of debate.

⁸⁸<http://www.irit.fr/~Guillaume.Cabanac/expe/>

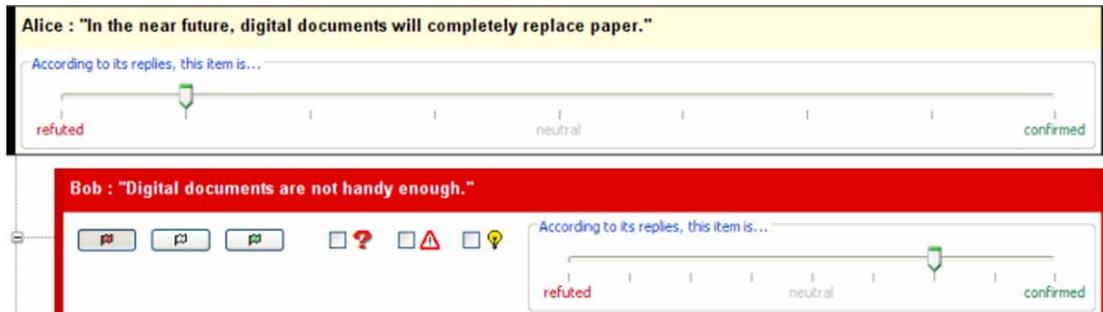
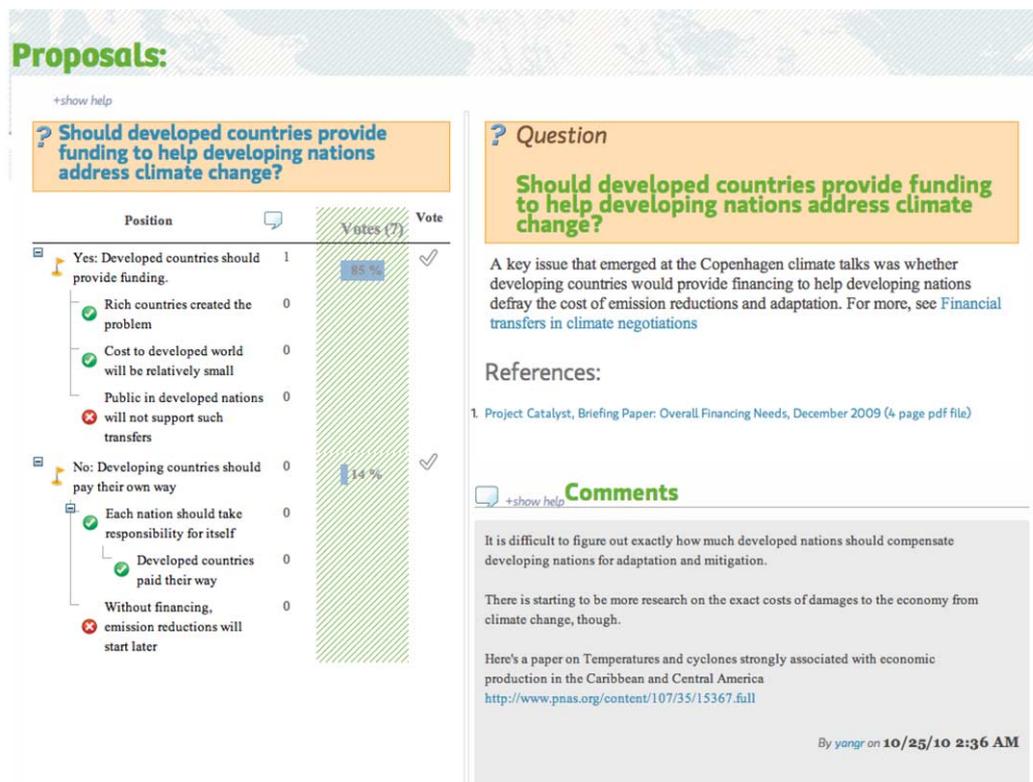
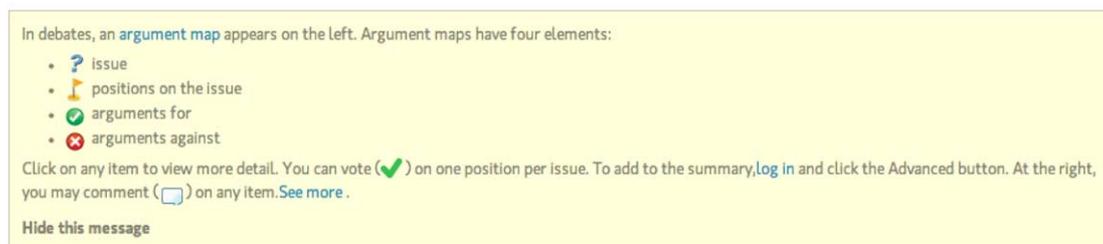


Fig. 33. Cabanac had users flag items (refuted, neutral, confirmed) and indicate their types (question, modification, example). (Color figure online)



(a)



(b)

Fig. 34. At Climate CoLab, (a) the positions tab shows an argument map which users can edit or comment on. (b) argument maps are introduced with contextual help. (Color figure online)

A.13. Climate CoLab

The Climate CoLab⁸⁹ is a deliberation platform under development at MIT, building on former projects such as the Deliberatorium and the ClimateCollaboratorium [80,97,98]. The community runs an annual contest to gather proposals for mitigating global warming from the general public; once proposals are filtered by experts, everyone is invited to discuss the finalists.

Users deliberate in the Positions tab, which facilitates constructing an argument map, voting, and commenting on each of five key topics. Moderators are expected to review comments and add new ideas to the argument map; users can also add Pros, Cons, and Issues directly to an argument map. The Climate CoLab is unique for integrating argument maps into a larger debate, and for its moderator support, which allows users to benefit from argument maps without necessarily needing to understand how to edit them.

A.14. Cohere

Cohere is open source software for sensemaking which integrates annotation and argumentation for the general public [26,110]. At the Cohere website⁹⁰, users can view and create maps, or import them from the Compendium desktop software. Maps consist of ideas, which users can add directly on the site (Fig. 35), draw from Cohere's global pool of public ideas, or clip via a Firefox plugin while browsing.

Cohere is unique for its integration with the Compendium desktop software, its incorporation of social bookmarking, and the ability to mark information as private, public, or shared with a group. Cohere also offers an API⁹¹.

A.15. Competing Hypotheses

Competing Hypotheses⁹² is open source analysis software based on the CIA methodology "Analysis of Competing Hypotheses" (ACH). The software supports breaking down information into hypotheses, evidence, and analysis, which are entered into a matrix as shown in Fig. 36(a) on page 204. The matrix can help visually indicate the most likely and least likely scenarios.⁹³ Multiple analyses can be combined to provide a



Fig. 35. Adding an idea to Cohere. (Color figure online)

group view (Fig. 36(b) on page 204), or compared pairwise. Competing Hypotheses has persistent chat (essentially a comment thread) for the entire project as well as message boards for each hypothesis, evidence item, and evidence-hypothesis pair. We excluded earlier ACH implementations such as PARC ACH⁹⁴. Unlike these systems, Competing Hypotheses has a testing server⁹⁵ which allows online collaboration. It is unique for its visualization structure and its use of both individual and group information.

A.16. ConsiderIt

ConsiderIt⁹⁶ [102] is a new open source deliberation platform under development at the University of Washington. It powers the Living Voters' Guide⁹⁷, a deliberation and voter-information platform for Washington State voters.

What is unique is the possibility to drill down to understand other voters' perspectives. In addition to seeing pros and cons on an issue from all voters, regardless of their stance, (Fig. 37(a) on page 204), the Living Voters' Guide can show the key points for a particular group of voters (Fig. 37(b) on page 204), such as those undecided on the issue or strongly supporting

⁸⁹<http://climatecolab.org/>

⁹⁰<http://cohere.open.ac.uk/>

⁹¹<http://cohere.open.ac.uk/help/code-doc/>

⁹²<http://competinghypotheses.org/>

⁹³More sophisticated ACH-based software uses matrices as input to Bayesian probabilistic reasoning.

⁹⁴<http://www2.parc.com/istl/projects/ach/ach.html>

⁹⁵http://groups.google.com/group/ach-users/browse_thread/thread/d87a5ec4df8be6c0

⁹⁶<http://www.livingvotersguide.org/considerit>

⁹⁷<http://www.livingvotersguide.org/>

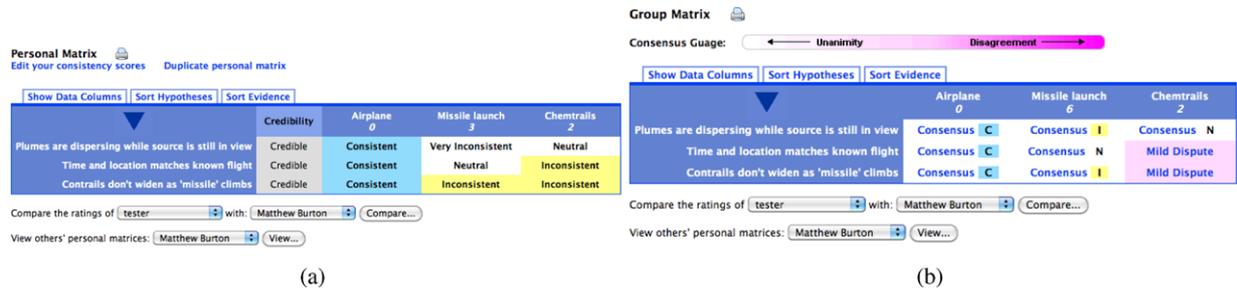


Fig. 36. In Competing Hypotheses, (a) each individual's analysis is represented in a consistency matrix; (b) multiple analyses can be combined to create a group matrix. In the group view, darker shades of purple indicate more disagreement. (Color figure online)

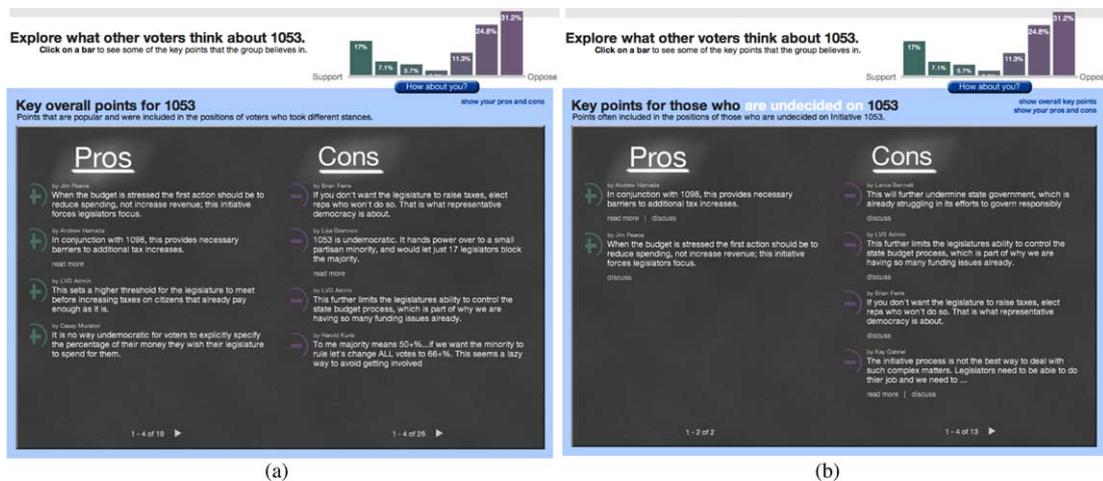


Fig. 37. The Living Voters' Guide compiles pro and con lists on each issue. They give (a) an overview of what all voters think about the issue; as well as (b) the key points for undecided voters. (Color figure online)

it. This can help users understand what makes an issue controversial. Users indicate how they feel about an issue before and after reading an argument (deliberative polling), which could also be used to find the most convincing arguments.

A.17. ConvinceMe

ConvinceMe⁹⁸ is a competitive debating environment which uses a point scheme and user rankings to motivate contributions to several types of debates. In the *King of the Hill* game, the most popular choice (and the debater who suggested it) wins. *Battles* are one-on-one debates between two users, who add arguments and evidence in hopes of getting readers' votes; the debate ends when one side gets a pre-agreed number of votes. *Open debates* (Fig. 38) are ongoing and accept pro or con arguments from any registered user, as well

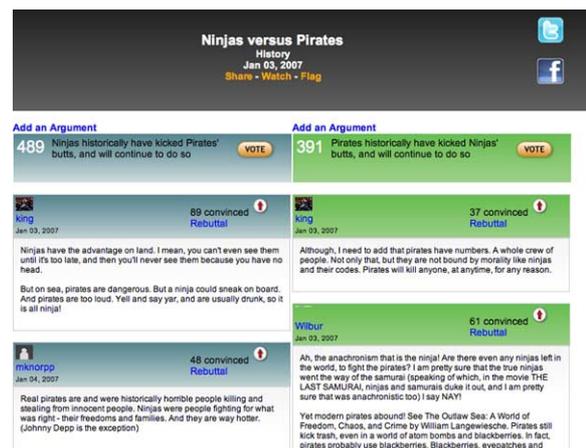


Fig. 38. In ConvinceMe's *Open Debates*, users can vote for an argument that convinced them. (Color figure online)

as rebuttals to existing arguments; users convinced by an argument vote for it. These various types of debate games make ConvinceMe unique.

⁹⁸<http://www.convinceme.net/>

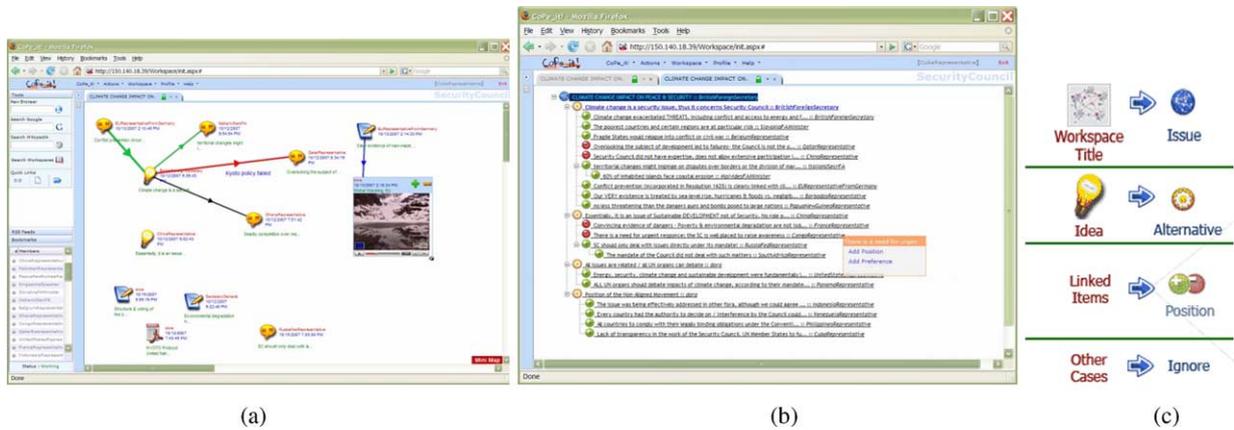


Fig. 39. CoPe_it! has (a) an informal spatial hypertext view; and (b) a formalized view, created by (c) automatically transforming items. (Color figure online)

A.18. CoPe_it!

CoPe_it!⁹⁹ [187] is a spatial hypertext environment for collaboration, aimed at the learning and e-government domains. Users can form groups to share maps, but communicate only through email on the site. Maps can be imported from Compendium, and entire discussions from external webforums in phpNuke format can be imported using a URL.

One unique aspect of in CoPe_it! is its approach to incremental formalization. CoPe_it! transforms the user-created informal spatial hypertext view (Fig. 39(a)) into an issue chart Fig. 39(b) according to rules shown in Fig. 39(c). Users can also customize the transformation rules.

A.19. CreateDebate

CreateDebate¹⁰⁰ is a social debate community, aimed at the general public as well as primary and secondary school classes¹⁰¹. The highest-rated arguments are shown at the top, based on user votes (and ignoring the down votes), which are also used to determine a point score for the user. They offer bookmarks and promote JavaScript buttons to webmasters¹⁰². Some unique features are that the debate moderator can add a ‘Topic Research’ section with RSS feeds from other sites, and that, in addition to pro/con debates, CreateDebate has Perspective debates, which generally have more than two sides, are scored based

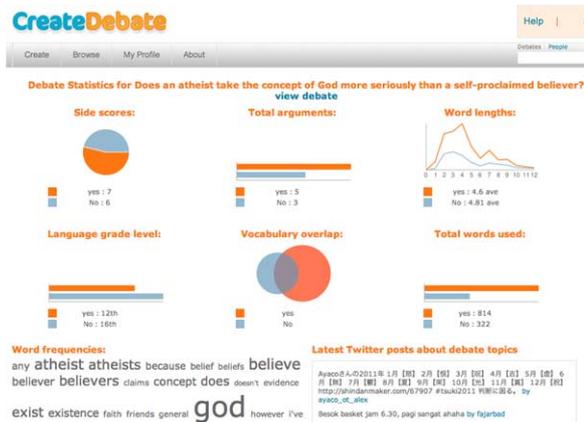


Fig. 40. At CreateDebate, users add and comment on pro and con arguments. (Color figure online)

on user-applied tags. A wordcloud and various statistics (Fig. 40), including the language grade level, average word lengths, and vocabulary overlap are calculated for each debate.

A.20. Debate.org

Debate.org¹⁰³ is a social networking site for debate lovers. Debates take place between two members and have four cycles: the challenge period, debating period, voting period, and post voting period. The debating period consists of 1–5 time-limited rounds in which debaters post arguments. While comments can be added at any time, votes are only accepted during the voting period. Voting involves choosing one of the debators (or ‘tied’) for each of the fol-

⁹⁹<http://copeit.cti.gr/>

¹⁰⁰<http://www.createdebate.com/>

¹⁰¹<http://www.createdebate.com/about/sites/school>

¹⁰²<http://www.createdebate.com/share/buttons>

¹⁰³<http://debate.org/>

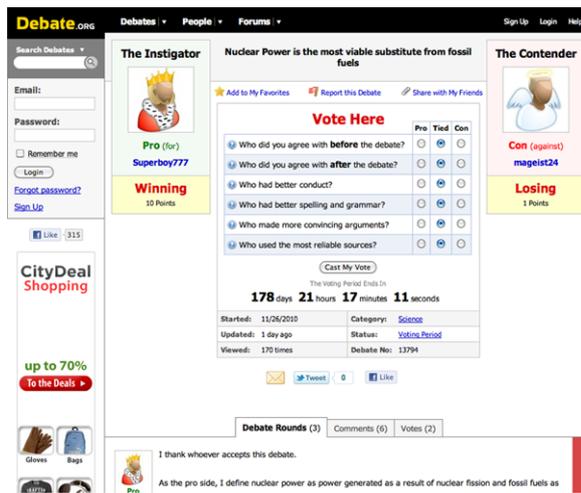


Fig. 41. Debate.org is a social networking site promoting debate. (Color figure online)

lowing six questions: (1) Agreed with before the debate: (worth 0 points) (2) Agreed with after the debate: (worth 0 points) (3) Who had better conduct: (worth 1 point) (4) Had better spelling and grammar: (worth 1 point) (5) Made more convincing arguments: (worth 3 points) (6) Used the most reliable sources: (worth 2 points). Points are awarded, with the most importance given to using reliable sources and making convincing arguments.

Another unique feature is Debate.org's focus on user profiles, where various user details are displayed including information such as income, location, ideology, gender, president, religion, and who they are interested in and looking for. These can be used to search for people with particular profile attributes, and aggregate user demographics¹⁰⁴ are also available. Debate.org also determines the percentage to which other members agree with you on "the big issues" (cultural, religious, and political hot topics). Individual members are also ranked by their percentile, based on the outcomes of previous debates.

A.21. Debategraph

Debategraph¹⁰⁵ [115] is a wiki debate visualization tool which has been adopted for use at the Kyoto climate change summit and is being tested by EU projects such as WAVE¹⁰⁶. Debategraph offers several visual-

izations, including the Debate Explorer view shown in Fig. 42(a) on page 207 and a text-based outline shown in Fig. 42(b) on page 207. Visualizations can be embedded in other websites, and Debategraph encourages users to add links to related webpages within graphs.

A.22. Debatepedia

Debatepedia¹⁰⁷ bills itself as the "the Wikipedia of pros and cons". Sponsored by the International Debate Education Association, Debatepedia is a collaborative community effort to summarize arguments. Each argument page provides an overview, then a list of issues, with pros and cons supported by news articles and similar sources. It provides an intuitive editing environment, where users can edit just the relevant section, such as the pro or con for a topic. Debatepedia is unique for providing an easily-editable wiki of pros and cons.

A.23. Debatewise

On Debatewise¹⁰⁸, everyone can collaborate in creating the strongest case both for and against a given issue. As part of a partnership with the International Debate Education Association (iDebate), they provide links to Debatepedia and iDebate's reference site Debatabase¹⁰⁹. Karma, teams, and lists of recent participants and new editors help motivate participation.

There are several unique features. The site makes it easy to get involved by providing suggestions of 5-minute, 20-minute and 1-hour tasks and showing "7 things you should have an opinion on" in rotating images on the homepage. Edit histories are available for each pro and con point. Debates are structured as adjudicated debates between two teams; other users can make comments, vote, and subscribe to debates.

A.24. DiscourseDB

DiscourseDB¹¹⁰ is used to collaboratively collect policy-related commentary. Opinion pieces (Fig. 44(a) on page 208) are collected from notable sources, newspapers and websites with at least 50,000 circula-

¹⁰⁴<http://www.debate.org/about/demographics/>

¹⁰⁵<http://debategraph.org/>

¹⁰⁶<http://www.wave-project.eu/>

¹⁰⁷<http://debatepedia.idebate.org/>

¹⁰⁸<http://debatewise.org/>

¹⁰⁹<http://www.idebate.org/debatabase/intro.php>

¹¹⁰<http://discoursedb.org/>

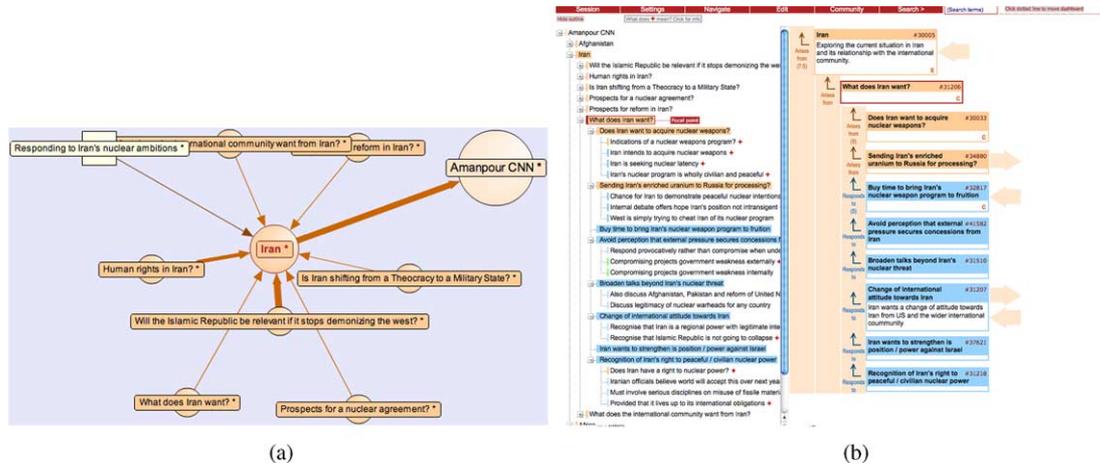


Fig. 42. Debategraph for CNN's Amanpour TV shown in (a) Debate Explore view; (b) text view. (Color figure online)

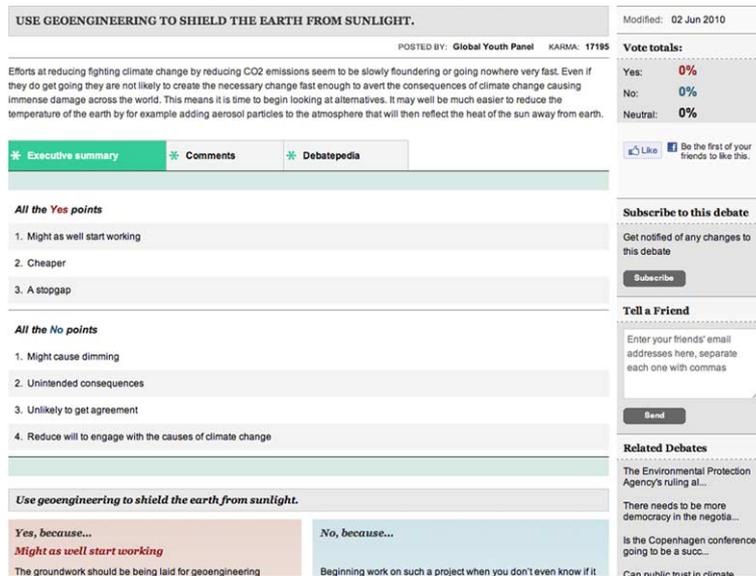


Fig. 43. Debatewise offers an executive summary, followed by a detailed pro/con debate. (Color figure online)

tion/unique visitors per month. Users categorize these opinion pieces, selecting a quote, indicating the topic and position, along with whether the author's argument is for, against, or mixed on the position.

DiscourseDB uses Semantic MediaWiki [104] with the SemanticForms¹¹¹ extension. This makes it possible to list all commentary written by particular person, published in a particular venue, and so forth.

Further, since items indicate the position they take on a topic, DiscourseDB can list all commentary for

or against a given position as shown in Fig. 44(b) on page 208. When a topic has multiple positions (e.g. Darfur¹¹²), DiscourseDB is especially helpful in summarizing the discussion.

A.25. Dispute Finder

Dispute Finder¹¹³ [60,61] is a browser extension that alerts users when information they read is disputed, based on a database of disputed claims. This

¹¹¹http://www.mediawiki.org/wiki/Extension:Semantic_Forms

¹¹²http://discoursedb.org/wiki/Darfur_conflict

¹¹³<http://ennals.org/rob/disputefinder.html>

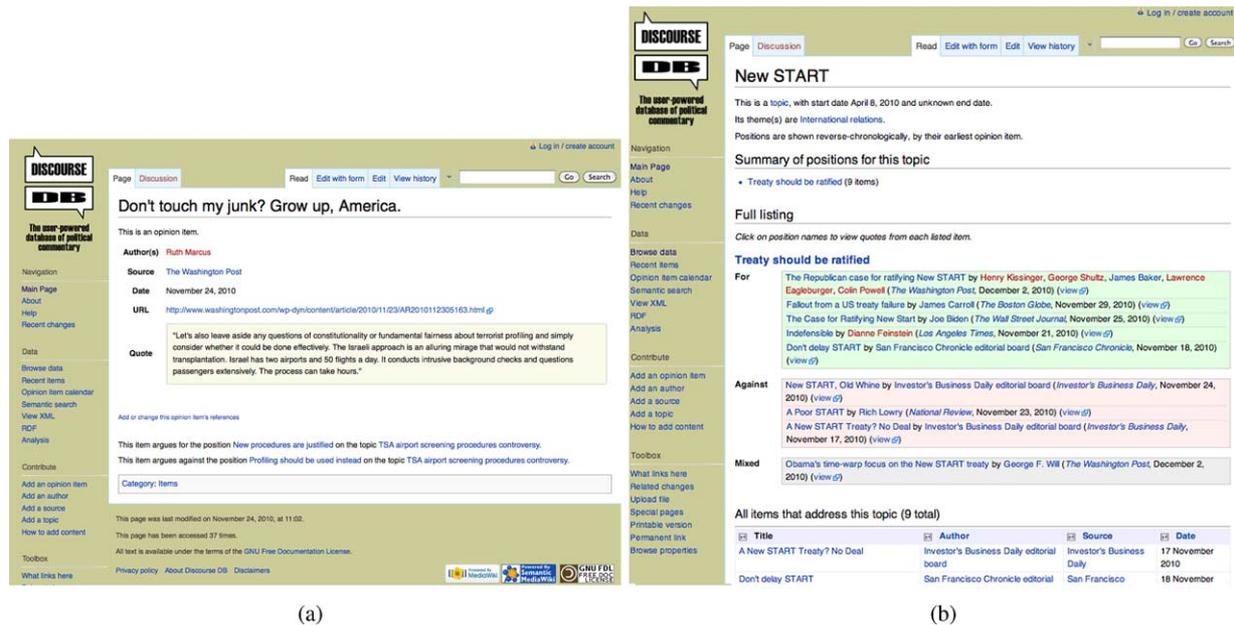


Fig. 44. In DiscourseDB, (a) users catalog opinion pieces; (b) this generates an overview of the positions for, against, and mixed on a topic. (Color figure online)

Kind of message:

(If this node is a Message.)

- None Idea
 Question More Angry
 Note News Agree
 Warning Ok Disagree
 Feedback Sad

(a)

- 19 🗨️ [No "Next message" in response header](#) by Nils Davis, 1995, Aug 30
- 1 🗨️ [I noticed that too](#) by ben@wilki.eng.hawaii.edu, 1995, Oct 06
- 20 🗨️ [Next and Previous will be rejoining us soon](#) by liberte@hypernews.org, 1995, Oct 09
- 1 🗨️ [It would be nice to have "TOP" option](#), 1995, Nov 17
- 1 🗨️ [Lost without a "Top" option](#) by jaf@tyrell.net, 1996, Jun 15
- 1 🗨️ [Implemented a HOME/Top option](#) by haroon@wwwnoet.attmail.com, 1996, Jul 10
- ...
- 2 🗨️ [A better implementation for Top/Home](#) by haroon@wwwnoet.attmail.com, 1996, Jul 10
- ...
- 21 🗨️ [Reversing Threads?](#) by Randy Cosby, 1995, Dec 30
- 1 🗨️ [Other solutions possible too](#) by liberte@hypernews.org, 1995, Dec 30
- 1 🗨️ [Another alternative....](#) by jap@tc.cornell.edu, 1996, Jan 02

(b)

Fig. 45. (a) Users are asked to specify their message type, using this Hypernews taxonomy; (b) Part of a Hypernews discussion thread. (Color figure online)

database was created by asking activists (who are interested in informing or convincing others) to indicate disputed claims manually, and then extended algorithmically. While the Dispute Finder plugin remains available¹¹⁴, it notes that the project has ended; unfortunately, the plugin no longer highlights phrases such as the “abortion reduces crime” phrase used in paper examples.

A.26. Hypernews

Hypernews¹¹⁵ [18] is a general purpose Web forum, inspired by Usenet news. Its use of message types dis-

tinguishes HyperNews from other forums. Users are asked to indicate what kind of message they are posting (None, Question, Note, Warning, Feedback, Idea, More, News, Ok, Sad, Angry, Agree, Disagree) as shown in Fig. 45(a); the message type is then displayed as an icon in the forum’s thread view (Fig. 45(b)).

A.27. LivingVote

At LivingVote¹¹⁶, the general public can discuss pro and con arguments of issues, creating argument maps, as shown in Fig. 46 on the next page. A tree view provides a coherent view of the argument, which can be drilled down, where arguments and their counter-

¹¹⁴<http://addons.mozilla.org/en-US/firefox/addon/11712/>

¹¹⁵<http://www.hypernews.org/HyperNews/get/hypernews/reading.html>

¹¹⁶<http://www.LivingVote.org/>

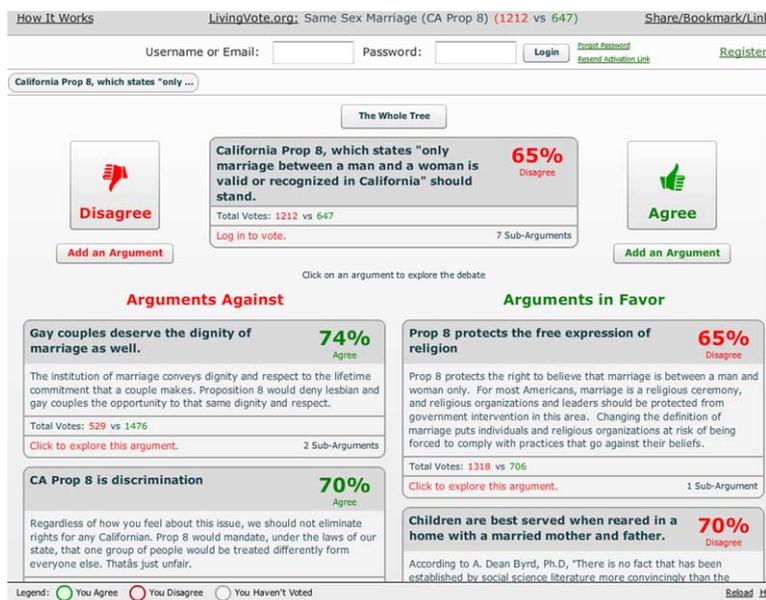


Fig. 46. At LivingVote, the weight given to a user's votes increases as they read and vote on more arguments. (Color figure online)

arguments are presented side-by-side. Users can add arguments, and voting colors the nodes according to whether you agree (green), disagree (red), or haven't voted (white).

LivingVote is unique in the way that it handles and uses votes. To vote, users must answer questions designed to test whether they've read the arguments. LivingVote also prunes unhelpful arguments and aims to provide a "complete, persistent, constantly changing and up-to-date record" of everyone's opinions and the most convincing arguments.

A.28. Opinion Space

Opinion Space is software developed by UC Berkeley's Center for New Media "designed to collect and visualize user opinions" on a variety of topics [63]. The U.S. Department of State is using Opinion Space¹¹⁷ to aggregate opinions about foreign policy and create a "virtual town hall" as shown in Fig. 47.

Opinion Space is unique in its use of deliberative polling and visualization. With deliberative polling, participants are polled both before and after deliberation, to better understand how public opinion can change based on increased understanding of the issues. Users move sliders to express their opinions on five issues. The system then maps the user's opinion, using



Fig. 47. Opinion Space maps comments in a constellation view. (Color figure online)

principal component analysis, to show the user where they stand. Each point in the visualization represents a perspective; larger points represent more popular perspectives. Users can also view and rate others' comments (Fig. 48 on the following page). Ratings can be used to choose the most informative comments for display.

A.29. Online Visualisation of Arguments (OVA)

Online Visualisation of Arguments¹¹⁸ (OVA) is an online argument analysis and mapping environment

¹¹⁷<http://www.state.gov/opinionspace/>

¹¹⁸<http://ova.computing.dundee.ac.uk>



Fig. 48. Opinion Space uses sliders to collect and display users' opinions on five issues. (Color figure online)

[175] which exports AIF. In OVA, web pages can be displayed adjacent to an argument mapping canvas, helping analysts create a graphical representation of the arguments in online forums or news stories. The resulting argument maps can show the relationships between premises (supporting or attacking) as well as the participants responsible for each point of view. In addition to AIF, users can export JPEG and SVG images of the argument.

OVA is part of a pipeline of argumentation tools [174] which starts to bridge the gap between human-oriented argumentation tools and calculation-based agent argumentation. Mixed initiative discussions are enabled by the argument maps created by OVA or any other AIF-based tool. Thus, instead of representing one's point of view countless times in a forum or FAQ, it would be possible to delegate these conversations to a machine agent using an underlying argument map, as prototypes like MAgtALO¹¹⁹ [155,202] and the Google Wave discussion bot Arvina [175] show.

A.30. *Parmenides*

*Parmenides*¹²⁰ [35–37] is a structured survey tool for gathering public opinion on a proposal. Based on argument schemes and critical questions from argumentation theory, *Parmenides* can pinpoint the source of the disagreement, by having participants respond to a series of questions. In a *Parmenides* debate, participants are first asked to agree or disagree with a position on a question such as “Should lap-

tops be banned in lecture theatres?” (Fig. 49(a) on page 211). Those who disagree are stepped through several screens (such as Fig. 49(b) on page 211) of yes/no questions to determine the source of the disagreement. Limited free text boxes allow users to add further information. At the end of the survey, users are offered the choice of submitting an alternative proposal, and are shown the answers they chose. Administrators can then analyze the group's responses, which are displayed in graphical argumentation frameworks [52]. A greater understanding of the most popular reasons for disagreement could support further discussion and debate about the key issues.

A.31. *PDOnline*

SWAN/SIOC is itself used in *PDOnline*¹²¹, an online community for scientists, funders, and medical professionals working in Parkinson's disease science, which is funded by the Michael J. Fox Foundation [50].

Figure 50 shows a *PDOnline* discussion about a recently-published paper and indicates how the topic fits into the “PD Guide” taxonomy of research and communication topics. The discussion links both forward to responses and related contributions and back to a thread on Papers of the Week (itself contained within a Research Question board). Members' full names, credentials, and institutional affiliations are listed, with links to user profiles and institutions. Members' profiles link to their publications, and throughout the site explicit references to the literature are given. It is unique in that it uses scientific argumentation.

A.32. *REASON*

REASON – Rapid Evidence Aggregation Supporting Optimal Negotiation [89,90] – is a Java applet for group deliberation, used to arrive at a consensus decision. Drawing from decision theory, group-decision support systems, and argumentation, *REASON* is intended to improve information pooling. An argument map is used to organize group evidence shared during the decision-making process; further, in an adaptive version of *REASON*, aggregate weights expressing the group's view of each alternative are displayed. Uniquely, arguments start as threaded discussions in

¹¹⁹http://www.arg.dundee.ac.uk/?page_id=61

¹²⁰<http://cgi.csc.liv.ac.uk/~parmenides/>

¹²¹<http://www.pdonlineresearch.org/>

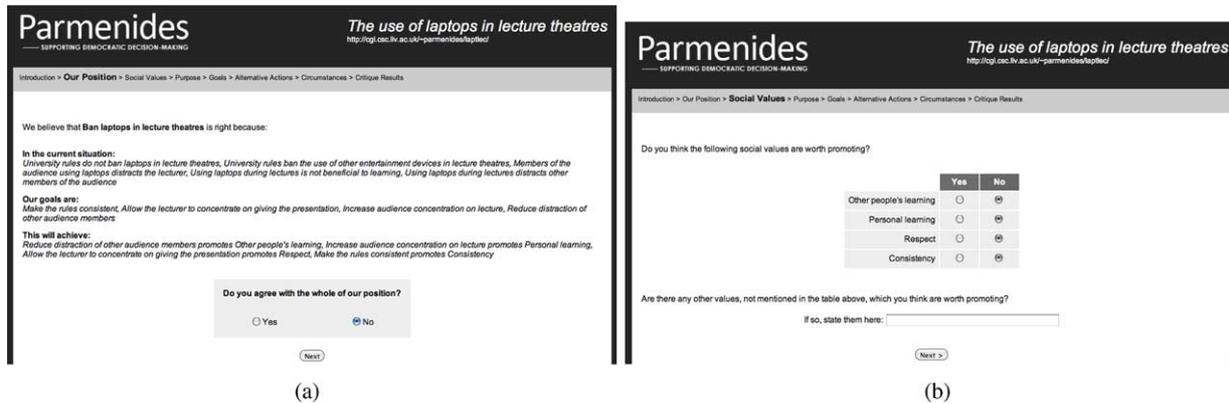


Fig. 49. (a) In Parmenides, participants are asked to agree or disagree with a starting position. (b) Next Parmenides steps participants through a series of yes/no questions to pinpoint the source of their disagreement. (Color figure online)



Fig. 50. Part of an argumentative discussion at PDOnline. (Color figure online)

REASON, and are colored based on whether they agree (blue) or disagree (yellow) with their parent in the thread.

A.33. Riled Up!

Riled Up!¹²² (Fig. 51(a) on page 212) is a debate-centered site which motivates participation with a point-based authority system. Aimed at people who

enjoy debate, Riled Up!'s tagline is "Like Raising Cain? So Do We." Users can add debates, arguments, and comments, and vote for others' arguments, as well as add friends and enemies.

Riled Up! is unique in its comment system – users can respond with positive (green), neutral (grey), or negative (red) comments, as shown in Fig. 51(b) on page 212. In addition to a standard layout, a contributor view gives an overview of the arguments but not the comments.

A.34. SEAS

SRI International's SEAS¹²³ [113,114] is a template-based structured argumentation tool originally designed for collaborative intelligence analysis. It has since been tested in other domains such as by IRS tax auditors and in a simulated public health emergency. SEAS's most unique feature is its emphasis on templating; users can author templates which provide transferrable notions of how to make an argument, and specify authorized coeditors. Figure 52 shows one question from such a template. These templates, which are in essence domain-specific argument schemes, allow non-experts to make sound reasoning. SEAS automatically answers some questions based on earlier responses. The developers report that a threat-assessment template originally developed by U.S. intelligence analysts was successfully applied by non-experts in their laboratory. SEAS visualization features are also considerable: to visualize multiple dimensions, SEAS uses starburst, constellation,

¹²²<http://riledup.com/>

¹²³<http://www.ai.sri.com/~seas/>



Fig. 51. RiledUp (a) debates allow structured discussion on a topic; and (b) readers can respond with positive (green), neutral (grey), or negative (red) comments. (Color figure online)

and table views. SRI International runs a SEAS server with paid accounts and SEAS server software is available.

A.35. Trellis software

The argument analysis system Trellis¹²⁴ [42,43, 70] was built on Semantic Web technologies, including the Semantic Annotation Vocabulary Section 7.7, page 178. Trellis, inspired by intelligence analysis, began as a credibility and analysis system to help structure decisions, for example to construct a family geneology based on contradictory information [70].

Originally, Trellis was designed to help capture argumentation, grounded in documents, whose reliability the user rated, and from which the user extracted statements; although users did not work directly with the underlying ontology, arguments could be exported into XML, RDF, DAML, and OWL. In addition to the original version, now called Rich Trellis, two other modes, Tree and Table Trellis, described in [43], are now supported, for incremental formalization.

In Rich Trellis, statements are given likelihood-qualifiers such 'surprise' (indicating the analyst's subjective reaction); reliability-qualifiers such as 'completely reliable'; and credibility-qualifiers such as 'possibly true'. Statements may also be as-

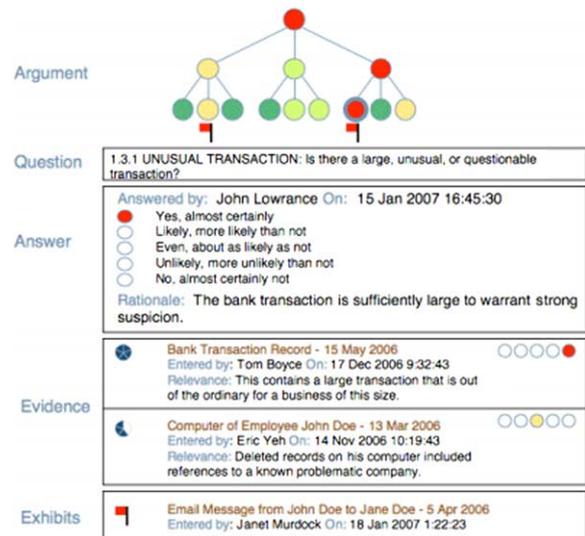


Fig. 52. SEAS uses a series of questions to structure the argument [113]. (Color figure online)

sociated with a document providing evidence. The source for each document, including creator, publisher, date, and format, is recorded. Originally, in Rich Trellis, users added rich relationships such as is elaborated by, is supported by, is summarized by, and stands though contradicted by, which the system stored in XML, RDF, and DAML+OIL.

In contrast to the detailed argumentation of Rich Trellis, Tree Trellis uses only `pro` and `con`, and collaborative discussion is supported, while Table Trellis

¹²⁴<http://www.isi.edu/fikcap/trellis/>

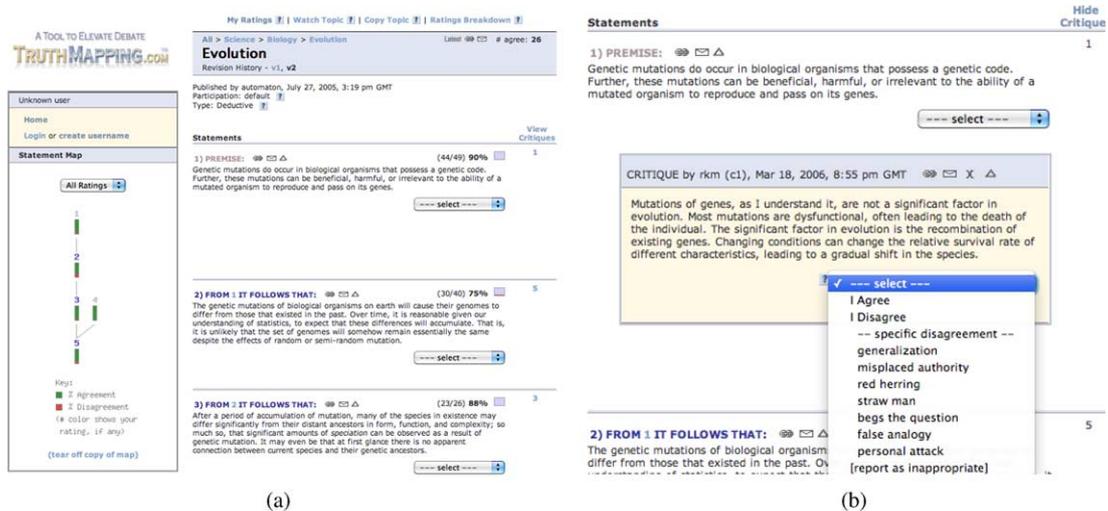


Fig. 53. Truthmapping (a) allows users to construct an argument by laying out premises and conclusions. Each node is colored based on the percentage of agreement (green) and disagreement (red). (b) Each premise and conclusion can be critiqued in comments, and critiques can be responded to with rebuttals. (Color figure online)

allows feature and value pairs to be arranged in a matrix, allowing the user to compare and evaluate alternatives according to their own criteria.

A.36. TruthMapping

TruthMapping¹²⁵ is an online deliberation tool which seeks to structure the conversation to focus around the “aha!” moment, avoiding digressions and soapboxes, and making hidden assumptions explicit. TruthMap facilitates structured conversations which use argument maps, critiques and rebuttals (Fig. 53(a)). Users can vote on and rate topics, and watch particular conversations. Only one user, the original arguer, modifies the map; feedback comes in critiques attached to each premise and conclusion (Fig. 53(b)), which can be rebutted. One unique aspect of TruthMapping is that users can continually modify each contribution, but can only post one critique on each node. This is designed to make it easier to contribute a persistent comment to the discussion, which can not be drowned out by a single opponent. The system indicates when comments are out of sync, and a wiki-style history is available. Another unique aspect is the use of votes to color the map: as shown in Fig. 53(a), each node is colored based on the percentage of votes agreeing (green) and disagreeing (red).

¹²⁵<http://www.truthmapping.com/>

A.37. Videolyzer

Videolyzer¹²⁶ [51] allows the general public to have sensemaking and argumentative discussions about the quality of online videos. It builds on gamelike-creation of video transcripts and on machine tagging of areas of interest in either the transcript (claim verbs, people, money, and comparison) or the video itself (faces) (Fig. 54(a) on page 214), to provide an integrated discussion forum for annotating and challenging the claims a video makes (Fig. 54(b) on page 214). Videolyzer is unique in its focus on integrating argumentative discussion into a video platform.

B. Matrix comparison of tools

We now present comparison charts of the tools reviewed. Figure 55 shows an overall comparison, in which tools are compared according to various features, which we outline shortly. For the downloadable tools, Fig. 56 on page 218 provides the license, programming language(s) and data storage. In both tables, we use “?” to indicate that we could not locate a piece of information.

First, we record the intended purpose of the tool. Next we provide the representation style and func-

¹²⁶<http://videolyzer.com/>

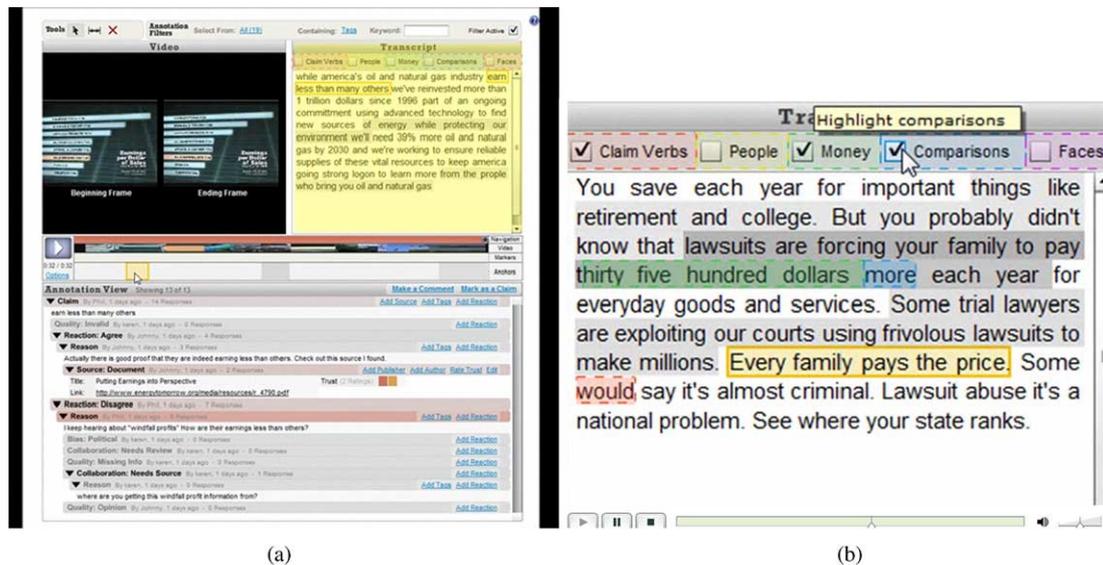


Fig. 54. Videolyzer (a) allows users to comment on the points made in a video; and (b) algorithmically determines segments of possible interest to help focus the discussion: in the transcript these are claim verbs and comparisons as well as mentions of people and money, and in the video these are peoples' faces. (Color figure online)

tional type. As introduced in Section 9.3, page 181, representation style is drawn from linear, threaded, graph, container, and matrix (including combinations of these styles); functional type is drawn from issue networking, funnelling, and reputation. Then we indicate what sort of advanced visualization is offered; ‘—’ indicates that no examples were found (i.e. that the question does not apply). The perspective row records whether an individual user has a personal perspective distinct from the group view. Next we consider whether a tool has a distributed architecture (allowing multiple copies to synch with one another).

Then we distinguish downloadable and hosted systems (noting that some tools are in both categories or use a combined method). To understand their current integration with the Social Web, we record whether they use a site-specific login, or allow external credentials (such as OpenID, Twitter, or Facebook).

We further indicate whether they have any integration with third party services; a single row does not do justice to the wide range of integration we found. For tools with social networking capabilities, we provide an example of the interaction users can have with each other, or the information they can find out about each other. Stable URLs indicates our success in finding reusable bookmarks: in fact these URLs can be at multiple granularities, such as the entire argument

map, issue, or conversation; each individual comment or critique; etc.

We also indicate, in the tags row, whether users can provide tags for content. We also indicate which tools have a bookmarklet for use while browsing, and which promote embedding on external sites. The remaining rows describe features related to the site's interaction style, starting with whether it is possible to attach media in discussions and the input type (such as point and click visual controls or form-based editing). We also indicate which have consistency checking (i.e. avoiding obvious contradictions) and credibility metrics (usually, but not always, voting) as well as export capabilities. Tools which export AIF can take advantage of an existing infrastructure.

Overall, we can make certain observations regarding these tools: generally they focus either on encouraging discussion or having a basis in rigorous argumentation models. Significant amounts of innovation has occurred in the research community, but many ideas have not been propagated to the Social Web at large. There are certain common mechanisms among many systems – basic features such as upvoting, segregating pro and cons, etc. Social Web systems do not have even levels of adoption: some tools are very well-adopted while others are not.

	ArgDF	ArgueHow	Argument Blogging	Argumentum	Argumentations.com	AGORA: Participate-Deliberate
Purpose	Create argumentation schemes on the Web	Distill the best points to support position and brace	Enable argumentative responses on the Web	Prove you're right	Gather and use news stories	Visualize debates
Representation style	Text	Linear	Argument Map	Threaded	Threaded	Argument Map
Functional type	Issue networking	Reputation	Issue networking	Reputation	Issue networking	Issue networking
Advanced visualization	(from AIF)	-	-	-	Tag spheres	-
Perspective	Single	Single	Single	Single	Single	Single
Distributed architecture	N	N	Y	N	N	N
Downloadable or hosted	Hosted, downloadable	Hosted	Combination	Hosted	Hosted	Combination
Registration	Site-specific	Site-specific	No login	Google, Facebook, Twitter	Site-specific	-
3rd party services integration	-	"Addthis" plugin for sharing	Blogs and publishing platforms	Argumentum Facebook App	-	-
Social networking capability	-	User's comment history	-	Compare users	User's comment history	-
Stable URLs	?	Y	?	Y	Y	-
Tags	N	N	N	N	Y	N
Bookmarklet	N	N	Y	Y	N	N
Promote embedding	N	N	N	Y	N	N
Attach media	N	N	Y	N	N	N
Input methods	Form-based	Form-based	HTML	Form-based, depends on type	Form-based, depends on type	Visual controls
Consistency checking	Use AIF tools	N	N	N	N	N
Credibility metrics	N	Y	N	Y	Y	N
Export formats	AIF	None	?	None	None	None

(a)

	Argunet	Avicenna	bCisiveOnline	Belvedere	Cabanac's Annotation System	Climate Colab
Purpose	Sketch and share argument maps	Express arguments in OWL to enable classification	Real-time collaboration for decision-making	Support secondary school students learn critical inquiry skills	Sensemaking of arguments in annotations	Collective intelligence on climate change
Representation style	Argument Map	Argument Map	Argument Map	Argument Map*	Threaded	Threaded
Functional type	Issue networking	Issue networking	Issue networking, funelling	Issue networking	Funelling	Reputation
Advanced visualization	Map associated items	-	-	Concept map, matrix	-	-
Perspective	Personal	Single	Single	Single	Personal	Single
Distributed architecture	Y	N	N	N	N	N
Downloadable or hosted	Hosted, downloadable	Hosted	Hosted	Downloadable	Hosted	Hosted
Registration	-	Site-specific	Site-specific	-	Site-specific	Facebook
3rd party services integration	"Addthis" plugin for sharing	-	Skype	-	-	Facebook like
Social networking capability	Attribution but no user profiles	-	Lists Skype usernames	-	-	Discussion, profiles
Stable URLs	Y	?	Y	?	N	Y
Tags	Y	N	N	N	N	N
Bookmarklet	N	N	N	N	N	N
Promote embedding	Y	N	Y	N	N	N
Attach media	N	N	Y	Y	N	Not in argument map discussions
Input methods	Visual controls	Visual controls	Visual controls	Visual controls	Visual controls	Form-based, some HTML and Wiki
Consistency checking	N	Use AIF tools	N	N	Y	N
Credibility metrics	N	N	N	N	Y	Y
Export formats	Locally stored	AIF	PowerPoint	?	?	None

(b)

Fig. 55. Overall Comparison of Tools.

	Cohere	Competing Hypotheses	Consider It	ConviveMe	CoPE_IT	CreateDebate
Purpose	Connect and share ideas	Analysis and cross-checking	Understand the pros/cons behind your opponents' opinions	Have fun debating	e-Learning, Collaboration	K-12 education, Debating
Representation style	Argument Map	Matrix	Container	Container	Argument Map, Threaded	Container
Functional type	Issue networking	Funelling	Issue networking	Reputation	Funelling	Reputation
Advanced visualization	Map, timeline	Sort by the most likely hypotheses	Show points according to who holds them	-	Automatically formalize the view	Summary graphs and statistics
Perspective	Personal	Personal	Single	Single	Personal	Single
Distributed architecture	N	Y	N	N	N	N
Downloadable or hosted	Hosted, downloadable	Hosted, downloadable	Hosted, downloadable	Hosted	Hosted, downloadable	Hosted
Registration	Site-specific	Site-specific	Facebook	Facebook	OpenID	Site-specific
3rd party services integration	RSS, Send messages to Twitter	Find us on Twitter	Find us on Facebook, Twitter	RSS, Send messages to Facebook, Twitter	Import phpNuke webforums, Compendium maps	API, pull in external RSS feeds, Facebook fanpage
Social networking capability	Groups, profiles	Persistent chat, message board	Attribution, but no user profiles	Forum discussions, user profiles	Groups	List friends, and enemies
Stable URLs	Y	Y	Y	Y	N	Y
Tags	Y	N	N	Y	Y	Y
Bookmarklet	Y	N	N	N	N	Y
Promote embedding	Y	N	N	Y	N	Y
Attach media	URLs only	N	N	N	Y	URLs, embedded videos only
Input methods	Form-based	Form-based	Visual controls	Form-based	Form-based, WYSIWYG	Form-based, WYSIWYG
Consistency checking	N	Y	N	N	N	N
Credibility metrics	N	N	N	Y	N	Y
Export formats	None	None	None	None	None	None

(c)

	Debate.org	Debategraph	Debatepedia	Debatewise	DiscourseDB	Dispute Finder
Purpose	Meet people through debate	Help groups collaborate on complex issues	Clarify public debate, engage citizens	Help make informed decisions	Collect opinions of commentators and journalists	Discover what's widely disputed when browsing the Web
Representation style	Linear	Argument Map, Threaded	Container	Container	Container	-
Functional type	Reputation	Issue networking	Issue networking	Reputation	Reputation	Reputation
Advanced visualization	-	Automatically change the view	-	-	-	Highlight disputed sentences
Perspective	Single	Single	Single	Single	Single	Personal
Distributed architecture	N	N	N	N	N	N
Downloadable or hosted	Hosted	Hosted	Hosted	Hosted	Hosted	Combination
Registration	Site-specific	Site-specific	Site-specific	OpenID	Site-specific	No login
3rd party services integration	Facebook like, Post to Twitter, Send email	RSS, email	RSS, post on Facebook, Twitter, Delicious, Digg	"Addthis" plugin for sharing, Facebook like	-	Facebook
Social networking capability	Extensive user profiles	User profiles	User's contribution history	-	User's contribution history	Profiles
Stable URLs	Y	Y	Y	Y	Y	N
Tags	-	N	N	N	N	N
Bookmarklet	N	N	N	N	N	N
Promote embedding	N	Y	N	N	N	N
Attach media	N	URLs, embedded videos only	Y	N	Y	N
Input methods	Text with HTML	Form-based	Wiki formatting	Form-based, Wiki-style	Wiki formatting	Roll-over text in user mode, Form-based for activist
Consistency checking	N	N	N	N	N	N
Credibility metrics	Y	N	N	Y	N	Y
Export formats	None	None	None	None	RDF	None

(d)

Fig. 55. (Continued).

	HyperNews	LivingVoice	Opinion Space	Online Visualization of Arguments	Parmenides	PDOnline
Purpose	Argumentative Web forum with an email gateway	"An up-to-date record of what we believe and why we believe it"	Exchange perspectives	Analyze and diagram arguments	Get feedback on proposals for e-participation	Speed scientific communication
Representation style	Threaded	Argument Map	-	Argument Map	Argument Map	Threaded
Functional type	Issue networking, discussion	Issue networking	Reputation	Issue networking	Funelling	Reputation
Advanced visualization	-	-	Uses principal component analysis	(from AIF)	Analysis toolset uses Value-based	-
Perspective	Single	Single	Personal	Personal	Personal	Single
Distributed architecture	Y	N	N	N	N	N
Downloadable or hosted	Hosted, downloadable	Hosted	Hosted	Hosted	Hosted	Hosted
Registration	Site-specific	Site-specific	Site-specific	No login	No login	Site-specific
3rd party services integration	-	AddtoAny plugin	-	-	-	Link to Facebook page, Twitter
Social networking capability	Discussion-based	Vote on others' opinions	Rate comments	-	-	Profiles, comments
Stable URLs	Y	Y	N	Y	Y	Y
Tags	N	N	N	N	N	N
Bookmarklet	N	N	N	Y	N	N
Promote embedding	N	N	N	N	N	N
Attach media	N	N	N	N	N	Y
Input methods	Form-based	Form-based	Form-based	Visual controls	Form-based	Form-based
Consistency checking	N	N	N	Use AIF tools	Y, in admin view	N
Credibility metrics	N	Y	Y	N	N	Y
Export formats	?	None	None	ArgDB, AIF	?	None

(e)

	REASON	Riled Up!	SEAS	Trellis	TruthMapping	Videolyzer
Purpose	Support information pooling	Debate & discuss; show that you're an authority on a topic	Intelligence analysis	Analysis	Overcome "loudest voice" and "last word"	Collaboratively evaluate online videos
Representation style	Argument Map, Threaded	Container	Multiple	Linear	Argument Map, Threaded	Threaded
Functional type	Funelling	Reputation	Funelling	Funelling	Funelling	Issue networking
Advanced visualization	-	-	Starburst, Constellation	-	Shows % agreement and disagreement	-
Perspective	Personal	Single	Personal	Single	Single	Single
Distributed architecture	Y	N	Y	N	N	N
Downloadable or hosted	Hosted	Hosted	Hosted, downloadable	Downloadable	Hosted	Hosted
Registration	Site-specific	Site-specific	Site-specific	Site-specific	Site-specific	Site-specific
3rd party services integration	-	Digg, Delicious, Reddit, Yahoo!, Google, Stumble	-	-	-	-
Social networking capability	Discussion	Profiles, comments	-	-	Discussion	Discussion
Stable URLs	N	Y	?	?	Y	Y
Tags	N	Y	N	N	N	Y
Bookmarklet	N	N	N	N	N	N
Promote embedding	N	N	N	N	N	N
Attach media	N	N	N	URLs only	N	URLs only
Input methods	Visual controls	Form-based	Form-based	Form-based	Form-based	Form-based
Consistency checking	N	N	?	N	N	N
Credibility metrics	N	Y	Y	Y	Y	Y
Export formats	None	None	Argument Markup Language, HTML, Word	None	None	None

(f)

Fig. 55. (Continued).

	License	Language	Data storage
ArgDF	?	PHP	Sesame
Argument Blogging	?	Python, Django, Javascript, JQuery	AIFDB
Argunet	Open source	Java	Db40
Avicenna	Author copyright	Java with Jena, ARQ, Pellet	SQL Server DB
bCisiveOnline	Commercial	Python, Django	?
Cohere	LGPL	PHP	MySQL
Competing Hypotheses	GPL v3	PHP5	MySQL
ConsiderIt	AGPL v3	Ruby on Rails	?
CoPe_IT	Various	C#, .NET	MS SQL Server 2005
Dispute Finder	Apache	Python, Ruby, Scala, Java	MS SQL Server
HyperNews	MIT	Perl	Document directory
SEAS	Commercial, Free to US Gov.	?	?
Trellis	GPL	Perl	?

Fig. 56. Downloadable tools: License, language, and data storage.

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A review of argumentation for the Social Semantic Web

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Abstract. Argumentation represents the study of views and opinions that humans express with the goal of reaching a conclusion through logical reasoning. Since the 1950's, several models have been proposed to capture the essence of informal argumentation in different settings. With the emergence of the Web, and then the Semantic Web, this modeling shifted towards ontologies, while from the development perspective, we witnessed an important increase in Web 2.0 human-centered collaborative deliberation tools. Through a review of more than 150 scholarly papers, this article provides a comprehensive and comparative overview of approaches to modeling argumentation for the Social Semantic Web. We start from theoretical foundational models and investigate how they have influenced Social Web tools. We also look into Semantic Web argumentation models. Finally we end with Social Web tools for argumentation, including online applications combining Web 2.0 and Semantic Web technologies, following the path to a global World Wide Argument Web.

Keywords: Argumentation, Semantic Web, Social Web, ontologies

1. Introduction

In recent years, the problem of representing large-scale argumentation on the Web has attracted the attention of scholars from fields such as artificial intelligence [146], communication theory [2], business management [97] and e-government [116]. At the same time, argumentation researchers began establishing the foundations for a World Wide Argument Web (WWAW) as “a large-scale Web of interconnected arguments posted by individuals to express their opinions in a structured manner” [147].

Arguments on the Web can be used in decision-making contexts. Decision-making often requires discussion not just of agreement and disagreement, but also the principles, reasons, and explanations driving

the choices between particular options. Furthermore, arguments expressed online for one audience may be of interest to other (sometimes far-flung) audiences. It can be difficult to re-find the crucial turning points of an argumentative discussion, even one in which we have participated. Yet on the Web, we cannot subscribe to arguments or issues, nor are there tools that support searching for arguments. Nor can we summarize the rationale behind a group's decision, even when the discussion took place entirely in public venues such as mailing lists, blogs, IRC channels, and Web forums.

By providing common languages and principles to model and query information on the Web (such as RDF [99], RDFS [150], OWL [133], SPARQL [177], Linked Data principles [15], etc.), the Semantic Web [17] is an appropriate means to represent arguments and argumentation uniformly on the Web, and to enable, for instance, browsing distributed argumentation

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