First Year Ph.D. Report: Argumentation on the Social Semantic Web

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Chapter 1

Introduction

Limited time, and limited ability to reconcile contradictory information, constrain human decision making. Acquiring more information does not always directly lead to increased knowledge, in part because information can be contradictory. Further, information can involve constraints and dependencies (such as when or to whom it applies), which may not be readily apparent from the information itself. Finally, information can be intentionally misleading, for instance in corporate or state espionage, or white collar crime.

The Semantic Web offers great potential to improve decision-making by helping to collate and reconcile disparate pieces of information, and by enabling a rule-based trust layer with automatic, machine filtering. Further, the easy-to-use Social Web provides a vast store of continually updated information, as well as emergent data about an individual's trusted network.

Using the Social Semantic Web, we envision that an individual could get automatic support for decision-making based on their existing, trusted network, effectively augmenting their time and expertise by that of their network. This will require advances in several areas, including argumentation. Argumentation, in our view, is a reconciliation process, leading to improved knowledge based on possibly contradictory pieces of information.

Our main contributions this year have been in 5 areas, as detailed in Section 8:

1. Surveying the state of the art in computational argumentation, including publishing a paper with the preeminent computational argumentation conference COMMA [122], providing a chart of the interdisciplinarity of argumentation (Figure 4.1), and outlining a full state-of-the-art on Argumentation for the Social Semantic Web proposed to the Semantic Web - Interoperability, Usability, Applicability [117], currently in-progress and advanced to their open review process.

2. Semantic approaches to coherence in email, addressing argumentation in email, published in the ACM conference ISWSA [97].

3. Understanding the argumentative structure of Wikipedia discussions, including publishing a poster at the Web Science conference [120] and presenting at WikiMania, the international conference of Wikipedia and WikiMedia users [118]. At WikiMania we also served on a research panel, pre-

sented summaries of others' recent research for "The State of Wikimedia Scholarship 2009-2010: WikiSym and Beyond", and chaired the "Research on Wikipedia: HowTo" session.

4. Providing semantic support for Wikipedia discussions, including publishing an ontology and use cases at the SemWiki workshop at ESWC [119], presenting at NUIG's Research Day, and submitting a paper under consideration for the Web Technologies Track of ACM SAC [121].

5. Community involvement, including serving for the international library technology community Code4Lib as organizer of the 2010 conference and as an editor of The Code4Lib Journal, and on two W3C groups, the Scientific Discourse Task of the Health Care Life Sciences Interest Group and the Library Linked Data Incubator Group.

Following this introduction, we first define argumentation on the Social Semantic Web (Section 2), next review the literature on the Social Semantic Web (Section 3) and on argumentation (Section 4). Subsequently we describe selected argumentation software and tools (Section 5) and review existing ontologies for argumentation (Section 6). In Section 7 we detail other approaches to argumentation. We then discuss our own progress (Section 8) and plans for future work (Section 9) before providing our conclusions (Section 10.1) and acknowledgements (Section 10.2).

Chapter 2

Defining Argumentation on the Social Semantic Web

2.1 What is an Argument?

2.1.1 Simple Arguments, Cases, and Argumentative Dialogues

Following [161][1], we use three senses of argument: simple arguments, cases, and argumentative dialogues. We make no strong distinction between 'argument' and 'argumentation'. A *simple argument*[2] is "a pair $< reason, conclusion >$, which makes no reference to any other arguments," [161]. *Cases* are composed of simple arguments strung together, where simple arguments may be embedded as reasons (or sub-arguments); cases can be then modelled by proof trees. *Argumentative dialogues*[3]) allow room for disagreement, and present the viewpoints of multiple parties, including those parties' simple arguments and cases; in artificial intelligence, debates can be modelled by argumentation frameworks [37]. Dung defines an argumentation framework AF as $AF =< AR, attacks >$ where AR is a set of (simple) arguments, and attacks is a binary relation on AR, i.e. $attacks \subset ARxAR$. We will use 'argument' and 'argumentation' to include all these senses. When needed, we will distinguish between simple arguments, cases, and argumentative dialogues. In Section 4.1.1 we discuss the kinds of argumentative dialogues, but first we present our definition of argumentation on the Social Semantic Web.

[1] O'Keefe [90] earlier distinguished two sense of argument: *making* an argument ($argument_1$) and *having* an argument ($argument_2$). An $argument_1$ is something one person makes or presents; an $argument_2$ is something two or more people have or engage in. In everyday language: $Arguing_1$ *that* is different from $arguing_2$ *about*.

[2] Wyner et al. used just 'argument' here.

[3] Wyner et al. called these 'debates', however, as we will soon see, 'debate' is also an overloaded term.

2.2 A First Definition of Argumentation on the Social Semantic Web

Arguments are often elided in everyday conversation, where claims may be advanced without fully outlining the reasons behind them. Thus we break down the simple argument $< reason, conclusion >$ even further, treating the justification and the claim each as first class objects. For the moment we will model both reasons and conclusions as statements, leaving aside any distinguishing characteristics.

On the Social Semantic Web, we expect it to be useful to index *who* made a statement (whether a justification or claim) and *where* they said it. Further, we draw from SIOC [16] where possible. Thus, our model of argumentation for the Social Semantic Web consists of a statement, a useraccount who asserted the claim, and the item and space (e.g. site) where the statement was advanced.

More formally, we define a statement s as $s := (useraccount, phrase, item, space)$ where $useraccount \in Useraccounts$ is a SIOC useraccount belonging to the finite set UserAccounts, $phrase \in Phrases$ belongs to the finite set of phrases, $item \in Items$ is a SIOC item belonging to the finite set Items, and $space \in Spaces$ is a SIOC space belonging to the finite set Spaces.

A simple argument sa then consists two statements: $sa :=< claim, reason > \subset Statements x Statements$.

We can then follow the existing modeling practice of the artificial intelligence community, modelling a case as a tree of simple arguments and modeling a dialogical argument as an argument framework of simple arguments and cases.

Examples of statements include "I think it's a good idea for restrictions on young drivers." and "Banning new drivers from driving at night would be a knee-jerk reaction to a particular statistic."[4]

An example of a simple argument is "Banning new drivers from driving at night would be a knee-jerk reaction to a particular statistic. Cars differ from public transport in that you can go anywhere at any time so why take this advantage away?"

An example of a non-simple argument is: "I think the proposed restrictions on young drivers are completely unrealistic and unfair. When I was 18 and bought my first car I was studying for my A-levels during the day and therefore needed to work in the evenings to earn my own money and pay for the upkeep of my car. I finished work between 11pm and midnight. If these restrictions had been in place I would have had three options: 1-give up my job (I think we can all agree that the current government is aiming to encourage more people to work and take pride in earning their own money, not rely on state handouts or their parents. 2 - Walk home alone in the dark (clearly this is not a sensible option either for obvious reasons) 3 - demand my parents pick me up and drop me off to work each night (this is also unreasonable as many young people cannot rely on their parents for many reasons e.g. if their parents are also working late or cannot drive)."

Later we review argumentation in further detail, but we first turn to the Social Semantic Web, the environment in which this definition will be applied.

[4]These and the following examples are based on reader comments at the BBC's Have Your Say `http://www.bbc.co.uk/blogs/haveyoursay/2010/09/do_you_deserve_a_licence_to_dr.html`.

Chapter 3

Literature Review: The Social Semantic Web

3.1 The Social Web

The Social Web [31] is one name for the current generation of websites, which promote collaboration, discussion, and sharing of personal information. Various names are used to refer to the Social Web, including web2.0[1],[2] and read-write web[3], social media [61], social software[4], social networks [31], and social platforms[5].

The Social Web includes blogs [18, 114], wikis [74], photo and video sharing [83], tagging [83], and microblogging [87, 32, 59], among others. Emerging Social Web genres include lifestreaming, aggregation, and 'internetworking' services [85] and location-based social networking [77, 30].

The Social Web has many antecedents on the pre-Web Internet, as well as in the early Web, including email and listservs [36, 157], Usenet [158], and Bulletin Boards [71]. The Social Web builds on groupware [111] and collaborative software [57], meeting Lessig's 2004 call for 21st century media to be "both read and write" [72].

Social Websites are often object-centred [66], and individual items (e.g. a Twitter post) may have their own URI or family of URIs (e.g. a Flickr image). These URIs function as identifiers, facilitating links both between different social objects on a website and across the wider Web. However, in general, across the Web, different URIs may be used to refer to the same object; this lack of unique identifiers balkanizes the Web.

Various classifications of the groupware, collaborative software, and the Social Web have been offered, such as whether a medium is synchronous or not synchronous, what constraints are given to messages (such as size, audience, etc.), what types of objects are discussed and shared, and whether items are collaboratively edited.

[1] http://oreilly.com/web2/archive/what-is-web-20.html
[2] http://www.paulgraham.com/web20.html
[3] http://www.readwriteweb.com/archives/the_readwrite_w.php
[4] http://www.lifewithalacrity.com/2004/10/tracing_the_evo.html
[5] http://www.socialtimes.com/2008/01/defining-social-platforms/

3.2 Common Semantic Web technologies and terms

The Semantic Web [10] allows connecting data rather than documents by adding structure and formalisms. Resource Description Format (RDF) [49] is the language for data interchange, which can be serialized several ways, including Turtle (Listing 3.1), RDFa (embedded in HTML) (Listing 3.2), and RDF/XML (Listing 3.3). With RDF Schema (RDFS) [50], restrictions such as domain and range, and relationships, such as rdfs:subClassOf, can be declared. OWL, the Web Ontology Language, can be used to express cardinality, equality (owl:sameAs), and other concepts. SPARQL (Listing 3.4) [51] is the standard query language for RDF, which allows querying on the Semantic Web. Linked Data [9] is the idea that HTTP URIs should be used as identifiers, with meaningful human-readable information, as well as links to other related representations and data.

```
@prefix dcterms: <http://purl.org/dc/elements/1.1/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .


<http://jodischneider.com/> dcterms:creator "Jodi Schneider"@en ;
     dcterms:title "Jodi Schneider's homepage"@en .

 [ <http://www.jodischneider.com/#me> a foaf:Person ;
         foaf:mbox <mailto:jschneider@pobox.com> ;
         foaf:name "Jodi Schneider"@en].
```

Listing 3.1: Sample RDF in Turtle

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML+RDFa 1.0//EN"
    "http://www.w3.org/MarkUp/DTD/xhtml-rdfa-1.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
    xmlns:dcterms="http://purl.org/dc/elements/1.1/"
  xmlns:foaf="http://xmlns.com/foaf/0.1/"
    version="XHTML+RDFa 1.0" xml:lang="en">
  <head>
    <title>Jodi Schneider's Home Page</title>
    <base href="http://jodischneider.com/" />
  <meta property="dcterms:title" content="Jodi Schneider's homepage" />
    <meta property="dcterms:creator" content="Jodi Schneider" />
  </head>
  <body about="http://www.jodischneider.com/#me">
  <div typeof="foaf:Person">
     <h1 property="foaf:name">Jodi Schneider</h1>
     <p> Email: <a rel="foaf:mbox" href="mailto:jschneider@pobox.com">
         jschneider@pobox.com</a></p>
  </div>
  </body>
</html>
```

Listing 3.2: The same example, presented in XHTML+RDFa 1.0

The Linked Data principles [9] are:

1. Use URIs as names for things.
2. Use HTTP URIs so that people can look up those names.
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL).

```
<?xml version="1.0" encoding="utf-8"?>
<rdf:RDF
  xmlns:dcterms="http://purl.org/dc/elements/1.1/"
  xmlns:foaf="http://xmlns.com/foaf/0.1/"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <rdf:Description rdf:about="http://jodischneider.com/">
    <dcterms:title xml:lang="en">Jodi Schneider's homepage</dcterms:
        title>
    <dcterms:creator xml:lang="en">Jodi Schneider</dcterms:creator>
  </rdf:Description>
  <foaf:Person>
    <foaf:name xml:lang="en">Jodi Schneider</foaf:name>
    <foaf:mbox rdf:resource="mailto:jschneider@pobox.com"/>
  </foaf:Person>
</rdf:RDF>
```

Listing 3.3: The same example, presented in XML/RDF

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>

SELECT ?email

WHERE
{
?person a foaf:Person
?person foaf:mbox ?email
}
```

Listing 3.4: Using SPARQL to retrieve all email addresses associated with any foaf:Person

4. Include links to other URIs. so that they can discover more things.

In effect, this means to use identifiers which can be dereferenced to provide "useful" information and links. The notion of what is useful is a social, rather than a technological, matter, causing some complications in the enactment of a Web of Linked Data.

3.3 Social Semantic Web

With a growing volume of data online, it has become more difficult to understand, make sense of, and get a comprehensive view of what we know. Furthermore, the ease of publication and communication mean that traditional quality controls and expected genres are changing, making filtering of the vast volume of data necessary.

Unstructured data is inherently limited: for instance it may not be immediately clear whether a date is specified as month/day/year or day/month/year, and keywords can have several meanings: a 'crown' means different things to a royalist, a plant biologist, and a dentist, and Paris, Texas is not Paris, France. However, context can help reduce ambiguity, allowing us to infer meanings and add structure.

The idea of the Social Semantic Web is that we can organize the world's knowledge while using social media, by leveraging Semantic Web technologies to create synergy between human-readable and machine-understandable data.

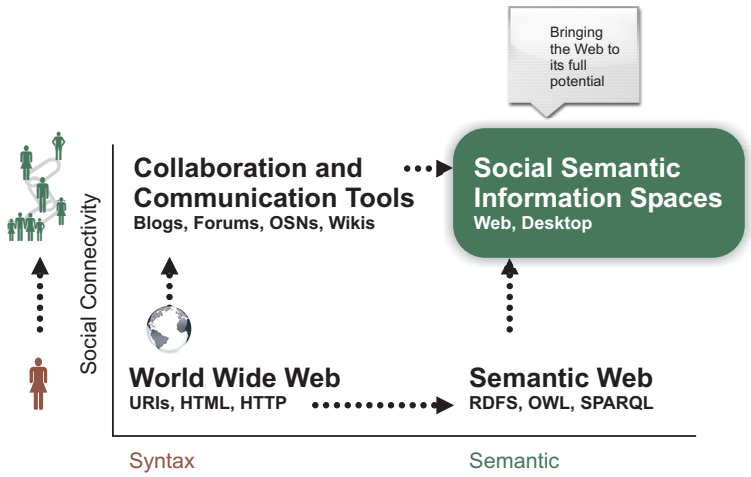


Figure 3.1: Social Semantic Information Spaces, including the Social Semantic Web, can bring the Web to its full potential. Image source: Alexandre Passant.

As shown in Figure 3.1, the Social Semantic Web leverages the syntax of the World Wide Web, the added semantic structure of the Semantic Web, and the social connectivity of the Social Web, to bring the Web to its full potential. Tom Gruber expresses the vision of the Social Semantic Web as a move from the *collected* intelligence of web2.0 to a *collective intelligence* [54]. As Gruber explains, Semantic Web technologies can "enable data sharing and computation across independent, heterogeneous Social Web applications. By combining structured and unstructured data, drawn from many sites across the Internet, Semantic Web technology could provide a substrate for the discovery of new knowledge that is not contained in any one source, and the solution of problems that were not anticipated by the creators of individual web sites" [54]. Such aggregation and filtering would not require significant overhead in the form of additional effort by end-users; instead, lightweight curation would be a side-effect of existing social conversations. Further, the Social Semantic Web might be bootstrapped from existing media [11].

Two examples of bootstrapping approaches are inferring implicit structures and combining ontologies with folksonomies. By inferring implicit structures, with human analysis of site structures or machine-based data mining, we can lift pages from a Social Website into the Social Semantic Web. For instance, Wikipedia templates do not have explicit semantics declared, but they are sufficiently well-understood to be translated into semantically enhanced versions for DBpedia [12]. By combining ontologies with folksonomies, we can have better retrieval while maintaining flexibility in data entry. Combining hierarchies of unstructured data, we could, for instance expand a search for "Ireland" to include parts of Ireland (e.g. "Dublin", "West of Ireland", "County Galway"), or allow proximity searching, i.e. to include Limerick in a search for "places near Shannon airport".

The Social Semantic Web has been further discussed [15] and has recently received book-length [17] and thesis [126] treatments.

Chapter 4

Literature Review: Argumentation

4.1 Communities around Argumentation

Argumentation is a vast field of study, tracing its roots to Aristotle's logic, with modern branches in philosophy, mathematical logic, communication studies, linguistics (including natural language processing and pragma-dialectics), education (including applications to e-learning) and computing (including tool development) and artificial intelligence (including reasoning and multi-agent models). Figure 4.1 shows some of the connections between these areas. A 2010 editorial [47] introducing the new journal *Argument & Computation* describes the emergence of computer argumentation as a interdisciplinary field.

4.1.1 Kinds of Argumentative Dialogue

Argumentative dialogues are, in our view, a dialectic process, based on the conversation between multiple parties (possibly an individual in dialogue with himself). Philosopher Douglas Walton has distinguished eight types of dialogue, as shown in Figure 4.2. These types are Persuasion, Inquiry, Deliberation, Negotiation, Information-Seeking, Quarrel, Debate, and Pedagogical.[1] They are distinguished by the initial situation, the individual goals of the participants, and the overall goal of the dialogue. In our own view, these types of dialogue can be classified based on whether knowledge plays a large, middling, or minor role. Inquiry and Pedagogical and Information-seeking dialogues are almost entirely knowledge-based, while knowledge plays only a minor role in Negotiation (aiming at a harmonious settlement) and Quarrel (beneficial mainly for venting emotions). Knowledge plays some role in the remaining three types: in Debate, airing arguments (rather than settling them) is of primary importance; in Deliberation and Persuasion, opinion and belief have a large role. In the following, we focus primarily on knowledge-based argumentation.

[1] Walton's taxonomy has been revised several times. [150], page 183 considers Debate and Pedagogical as special cases of the other dialogues; [152] adds 'Discovery', motivated by choosing the best hypothesis for testing.

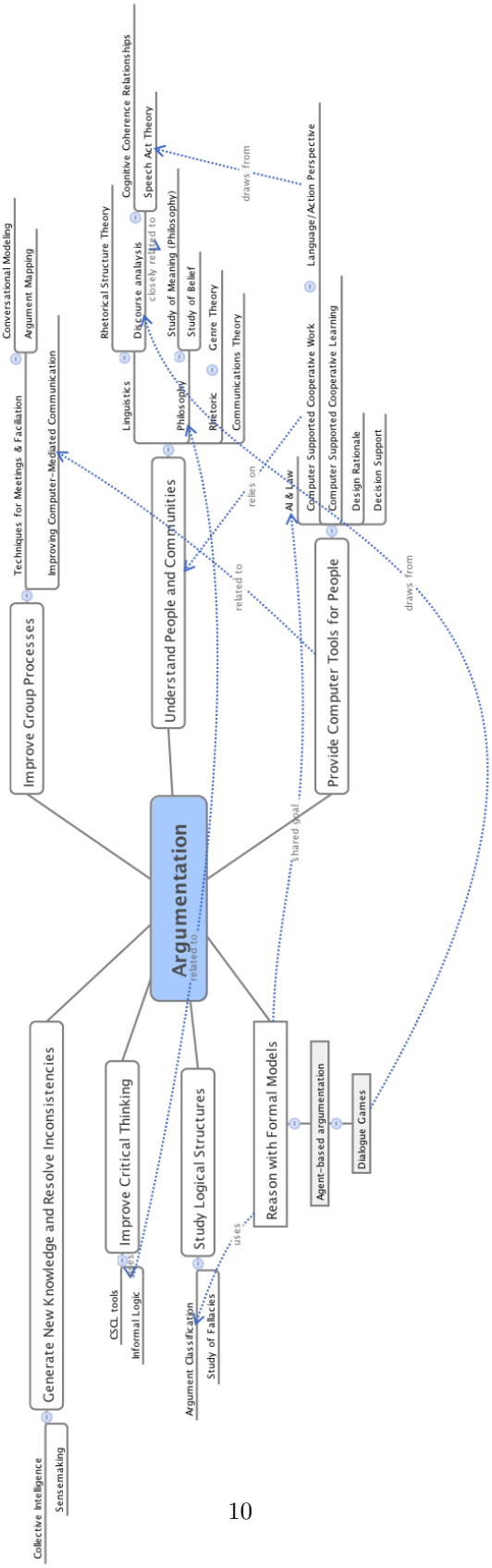


Figure 4.1: Argumentation is a massively interdisciplinary and multidisciplinary field. [Original image].

TYPE OF DIALOGUE	INITIAL SITUATION	INDIVIDUAL GOALS OF PARTICIPIANTS	COLLECTIVE GOAL OF DIALOGUE	BENEFITS
Persuasion	Difference of Opinion	Persuade Other Party	Resolve Difference of Opinion	Understand Positions
Inquiry	Ignorance	Contribute Findings	Prove or Disprove Conjecture	Obtain Knowledge
Deliberation	Contemplation of Future Consequences	Promote Personal Goals	Act on a Thoughtful Basis	Formulate Personal Priorities
Negotiation	Conflict of Interest	Maximize Gains (Self-Interest)	Settlement (Without Undue Inequity)	Harmony
Information-Seeking	One Party Lacks Information	Obtain Information	Transfer of Knowledge	Help in Goal Activity
Quarrel (Eristic)	Personal Conflict	Verbally Hit Out at and Humiliate Opponent	Reveal Deeper Conflict	Vent Emotions
Debate	Adversarial	Persuade Third Party	Air Strongest Arguments for Both Sides	Spread Information
Pedagogical	Ignorance of One Party	Teaching and Learning	Transfer of Knowledge	Reserve Transfer

Figure 4.2: Walton's eight types of dialogue, from [149].

4.2 Structural aspects of argumentation: layers of an argument

Arguments can be modelled in various ways, focusing on different aspects of an argument's structure.

Bentahar et al. [7] distinguish three types of models: monological, dialogical, and rhetorical, as shown in Figure 4.3. Monological models, which view arguments as tentative proof, focus on the internal structure of the chain of inference rule which connect premises to conclusions. Dialogical models, at the macro level, emphasize the interaction between arguments, and especially the notion of 'attacks' of an argument: an argument is viewed as sound if it stands up to all attacks and is 'defeasible'. Rhetorical models study how arguments are used as a means of persuasion; these models focus on the audience's judgement rather than on literal truth or soundness.

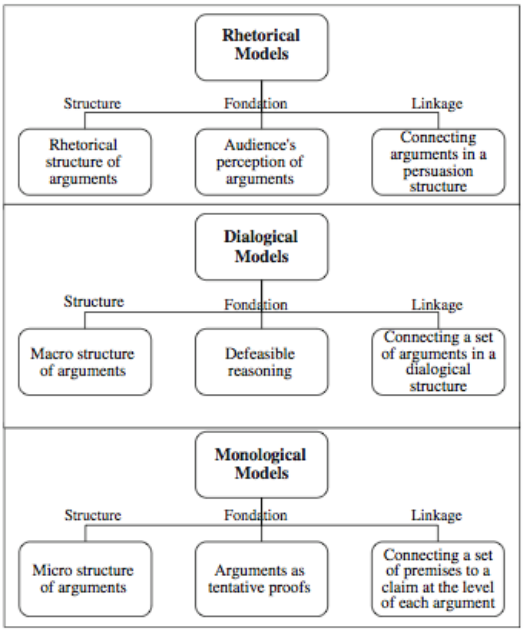


Figure 4.3: Monological, dialogical, and rhetorical models, from [7].

Macintosh et al. [78] describe similar distinctions of the logical layer, dialectical layer, and rhetorical layer, as shown in Figure 4.4. The logical layer concerns a knowledge base where schemas are applied and arguments are constructed; in the dialectical layer dialogues are moderated and arguments are compared and evaluated; in the rhetorical layer arguments are presented and visualized. With e-participation in mind, Macintosh et al. also distinguish the roles of participant (to select moves), an authority (to decide the issues under discussion), and a moderator (to frame and moderate dialogues).

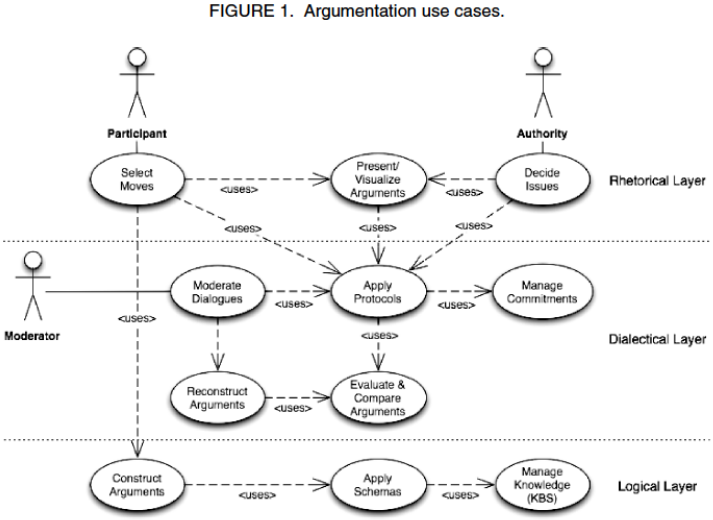


Figure 4.4: Logical layer, dialectical layer, and rhetorical layer, from [78].

4.3 Models of Informal Argumentation

Informal argumentation, with its focus on conversations, is a natural match for the Social Web, so we next describe three of the most influential models of argumentation: Toulmin, IBIS, and Walton.

4.3.1 Toulmin

Informal argumentation originated in philosophy, with Toulmin's 1958 account of informal argumentation [142]. Toulmin sought to find a common underlying basis for arguments in every field of human activity. His model applies, for instance, to law, science, and informal, conversational arguments. In Toulmin's theory, evidence and rules called *Warrants* support *Claims*. *Claims* may also be qualified (i.e. to add constraints or indicate uncertainty); *Rebuttals* may be used to argue against an argument. Toulmin's original argument pattern is shown in Figure 4.5: *Data* is supported by *Warrants* which have *Backings*, showing that a *Claim* holds with *Qualifiers* regarding the situation, unless there is a *Rebuttal*. The same pattern is shown in Figure 4.6, with fewer abbreviations. Figure 4.7 shows Toulmin's now-famous argument, presented according to this structure.

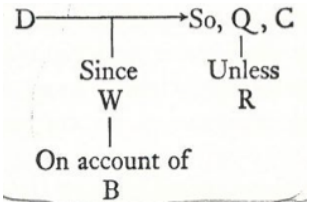


Figure 4.5: Toulmin's argument pattern, from page 104 of [142].

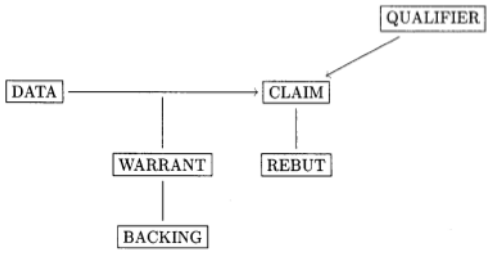


Figure 4.6: An interpretation of Toulmin's argument pattern, from [19].

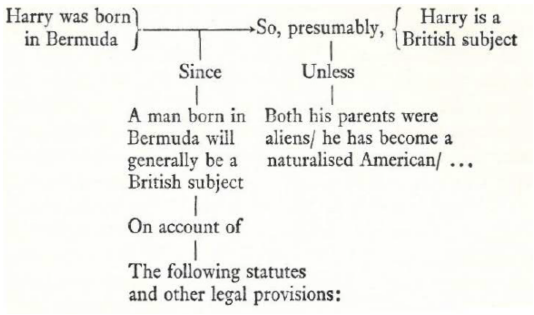


Figure 4.7: Toulmin's example argument from page 105 of [142].

Toulmin is cited frequently and in numerous fields, from rhetoric to education to computer argumentation. While his model is a useful abstraction, scholars have argued about whether people actually think in terms of Toulmin's warrants [88].

4.3.2 IBIS

IBIS, Issue-Based Information System, is a problem-solving structure first published in 1970 [68]. As the name suggests, IBIS centers around controversial *issues* which take the form of questions. Specialists from different fields may use the same words with different assumptions and intentions[2], hampering communication. IBIS is especially intended to support community and political decision-making. In this scenario, the participants in a discussion, the relevant experts and the decision makers may be three separate groups, who need to communicate with each other and who must also get information from existing records and documentation.

IBIS, as originally designed, is a documentation system, meant to organize discussion and allow subsequent understanding of the decision taken; this explains the use of "Information System" in the title. The context of the discussion is a *discourse* about a *topic*. Issues may bring up *questions of fact* and be discussed in *arguments*. Here, "*Arguments* are constructed in defense of or against the different positions until the issue is settled by convincing the opponents

[2] "Many central terms used are proper names for long stories specific of the particular situation, with their meaning depending very sensitively on the context in which they are used." [68]

or decided by a formal decision procedure," [68]. IBIS also recognizes *model problems*, such as cost-benefit models, that deal with whole classes of problems.

Several kinds of relationships between issues: direct successor, generalization, relevant analogy, compatible, consistent, or inconsistent. The method also distinguishes issue content, as factual, deonic ("Shall X become the case?"), explanatory, or instrumental (Shall we take approach X to accomplish Y?).

Originally implemented as a paper-based system, IBIS influenced several ontologies (Section 6.2) and numerous tools (Section 5.1 and Section 5.3.2) as well as procedures such as dialogue mapping [29].

4.3.3 Walton

The Canadian philosopher Walton continues to write extensively on argumentation; informal argumentation is one of his specialties [151]. His eight types of dialogue were described earlier.

According to Rahwan [100], while many taxonomies of argumentation have been proposed [99, 48, 145, 63], Walton's taxonomy [148] provides the point of departure for computational models of argumentation. In his detailed classification from 1995 [148], Walton describes each scheme with a name, a conclusion, a set of premises, and a set of critical questions. Critical questions address the points where this argument scheme may break down, and suggest attacks against the argument. For example, the following six critical questions are associated with the Argument from Expert Opinion [46] [3]

1. How credible is E as an expert source?
2. Is E an expert in the field that A is in?
3. Does E's testimony imply A?
4. Is E reliable?
5. Is A consistent with the testimony of other experts?
6. Is A supported by evidence?

Walton's 2008 book [153], coauthored with computational argumentation researchers, presents 96 general argumentation schemes, presumably updating [148].

Walton also describes four stages of argumentation[4] common between genres or fields of argument: *Opening*, *Confrontation*, *Argumentation*, and *Closing*. In the opening stages, the rules are agreed to (perhaps implicitly). In the confrontation stage, the issue at hand is announced, agreed upon, or clarified. In the main stage (*Argumentation*), each party is expected to make a serious effort to support his point of view, while also allowing the other party to make his case. Finally, the argument closes when the goal is fulfilled or the parties agree to end the debate.

Validity and critical questions are important within the *Argumentation* stage. Walton also describes additional rules of argumentation in such categories as relevance, cooperativeness, and informativeness. Relevance, for example, can be

[3] [46] attributes this to page 49, D. Walton, Appeal to Expert Opinion, Penn State Press, University Park, 1997.

[4] Confrontation and Argumentation are sometimes combined [152].

global, local, subject matter-specific, or probative. An argument may be relevant at one phase, but irrelevant at another point; for example an argument related to selecting the topic of discussion is not relevant once the topic has been agreed upon. Further complexity arises because dialogue types may shift in an actual discussion, and argument schemes may be embedded in one another [152].

For our purposes, "the Walton model" is that a dialogical argument uses one or more dialogue types and one or more argument schemes and has an opening, a middle (argumentation) phase, and a closing.

Chapter 5

Argumentation Software and Tools

Argumentation tools include research prototypes, free software, and commercial products. They are discussed online in discussion groups[1], and for some tools, in-person training, consulting, and facilitation services are available.[2] Argumentation software appears in numerous contexts, including education, law, public policy, and personal organization. For a thorough investigation of argumentation in the context of Computer-Supported Collaborative Learning, see [116], which reviews 50 tools. Recent books also cover argument mapping software and related issues [64, 89], including tracing the "Roots of Computer Supported Argument Visualization" [132].

Aakhus and collaborators [33, 1] classify argumentation software by use: issue networking, funneling, or reputation (Figure 5.1). Shum says that each tool is 'tuned' to a different task: "foraging for material, classifying and linking it, discussing it in meetings and online, and evaluating specific points in more depth" [130].

We now discuss argumentation tools. We first discuss some early tools for design rationale, followed by some early Internet-based tools, then a few important modern tools.

5.1 Early design rationale tools

Design rationale, "the explicit listing of decisions made during a design process and the reasons why those decisions were made," [58] motivated many early argumentation tools; Jarczyk et al. review a number of design rationale tools and discusses the differences in the underlying model [58]. Here we cover just

[1] Such as the Yahoo Argumap Group `http://groups.yahoo.com/group/argumap/`.

[2] The UK-based Compendium Institute `http://compendium.open.ac.uk/institute/index.htm` serves an international community, and has held workshops in France and the United States. Jeff Conklin's US CogNexus Institute `http://www.cognexus.org/` provides consulting, training, and facilitation in issue mapping and dialogue mapping using Compendium. The Australian consultancy Mind Muse`http://mindmuse.com.au/` provides training services for Rationale, aimed at educators and businesses.

Type	Purpose	Orchestration	Systemic Rationality	Examples
Issue-Networking	Form a web of issues and relevant positions on issues	Clash of claims	Self-correction of claims and lines of argument	gIBIS, Compendium
Funneling	Consensus Formation	Flow of argumentation toward an acceptable conclusion	Activity establishes commitment to put proposals into action	GroupSystems, FacilitatePro, SAMM, MeetingWorks
Reputation	Create a knowledge base for action	Pooling and refining expertise	The best available expertise competes to answer questions posed by those who need an answer	Experts Exchange,

Figure 5.1: Issue-networking, funneling, and reputation, from [1].

two of the best-known, gIBIS and QOC.[3]

5.1.1 gIBIS

gIBIS (for 'graphical IBIS') [26] was one of the first computer-based tools for argumentation [27].[4]. There are only a few ways to relate IBIS' issues, positions, and arguments(Figure 5.2), making for simplicity. Figure 5.3 shows a sample IBIS network. IBIS has been reinterpreted in other software; the polarity of agreement and disagreement is central in these.

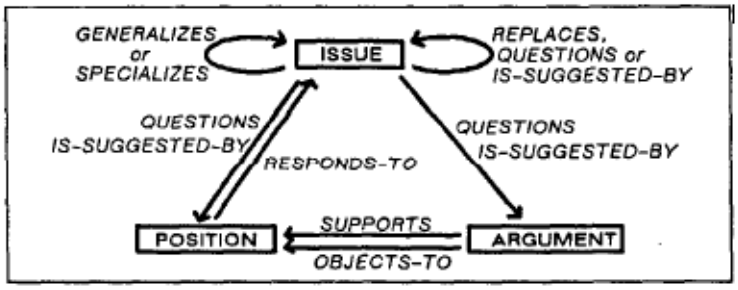


Figure 5.2: Legal rhetorical moves in IBIS, from [26].

[3]Some evidence that these are best-known is given by the title "Hypermedia Support for Argumentation-Based Rationale: 15 Years on from gIBIS and QOC" [134].

[4]IBIS originator Rittel implemented a computerized version of IBIS in 1983 [58].

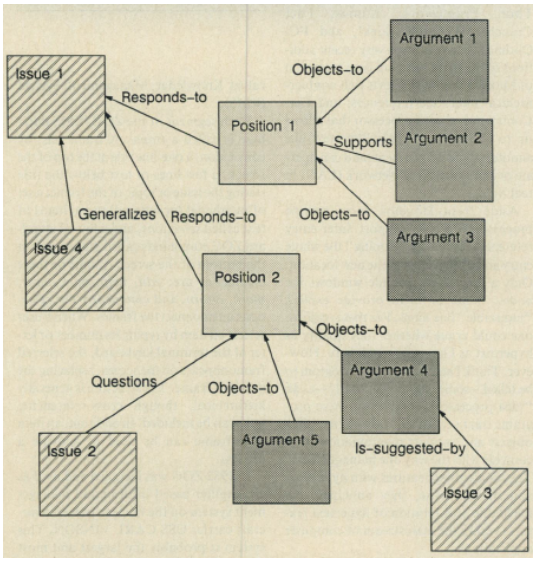


Figure 5.3: Sample structure of an IBIS discussion, from [28].

5.1.2 QOC

QOC, which stands for Questions, Options, Criteria, also developed from problem-solving and design rationale. Generating and analyzing a design space is its focus, and QOC was motivated by design rationale where 'criteria' (rather than issues) are of key importance [80]. The paper describing the system [80] included a detailed analysis of a design-oriented use case. Options are assessed according to the Criteria, as shown in Figure 5.4, perhaps lessening its impact outside the design community. 'Negative assessment' and 'positive assessment' again show the importance of polarity. A seminal article, "Graphical argumentation and design cognition", uses QOC as the primary example [133].

5.2 Early Internet-based Tools

Earlier Internet-based systems such as WIT, Hypernews, and Zest integrated social and argumentation features.

5.2.1 WIT

The WIT discussion system[5] aimed to make the current state of a discussion clear, by having the user indicate "whether he was agreeing, disagreeing or asking for clarification of a point" [8].

Figure 3. **A QOC representation of the design space for the XCL, elaborated from Figure 2 to include Criteria and Assessments. The boxed Options are the decisions made in the design of the XCL environment.**

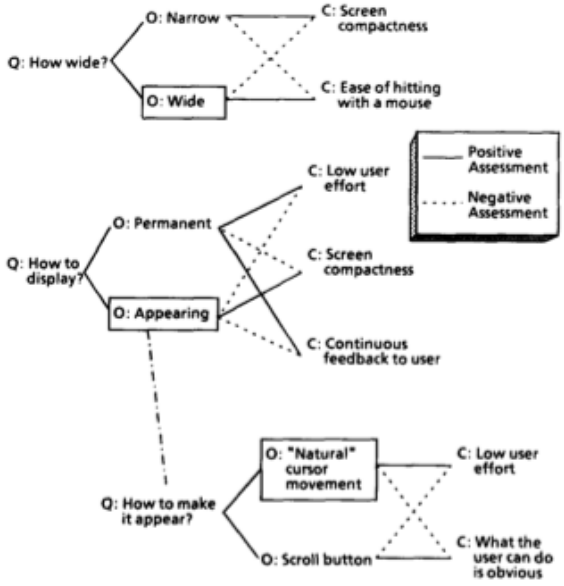


Figure 5.4: QOC, from [80].

5.2.2 Hypernews

Hypernews[6] [13] asks users to indicate what kind of message they are posting[7] as shown in Figure 5.5(a); the message type is then displayed as an icon in the forum's thread view (Figure 5.5(b)).

5.2.3 Zest

Zest [162], a prototype email browser, supported lightweight integration of IBIS-based[8] argument maps, using "criticons" such as [?], [#], [+], and [-] to mark paragraphs as questions, statements, supporting arguments, or opposing arguments; a fifth criticon, [!], indicated resolution of a discussion. Figure 5.6 shows Zest.

5.3 Modern Tools

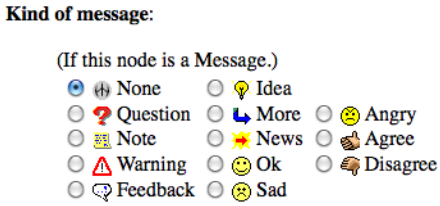
The software here was chosen on the basis of a use case recently written by Simon Buckingham Shum [130], which took into account Compendium, Cohere, Debategraph, Rationale, and Carneades. It is not comprehensive; for example

[5] `http://www.w3.org/WIT/User/Overview.html`

[6] `http://www.hypernews.org/HyperNews/get/hypernews/reading.html`

[7] None, Question, Note, Warning, Feedback, Idea, More, News, Ok, Sad, Angry, Agree, Disagree

[8] Strictly speaking, *polarity-based*.



(a)

19 No "Next message" in response header *by Nils Davis, 1995, Aug 30*
1 I noticed that too *by ben@wiliki.eng.hawaii.edu, 1995, Oct 06*
Next and Previous will be rejoining us soon *by liberte@hypernews.org, 1995, Oct 09*
20 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)

Figure 5.5: (a) Users are asked to specify their message type, using this Hypernews taxonomy; (b) Part of a Hypernews discussion thread.

Zeno [45], Parmenides, and HERMES are recent e-participation tools that are within scope and suggested by [78], and we have listed twenty-four relevant tools [117].

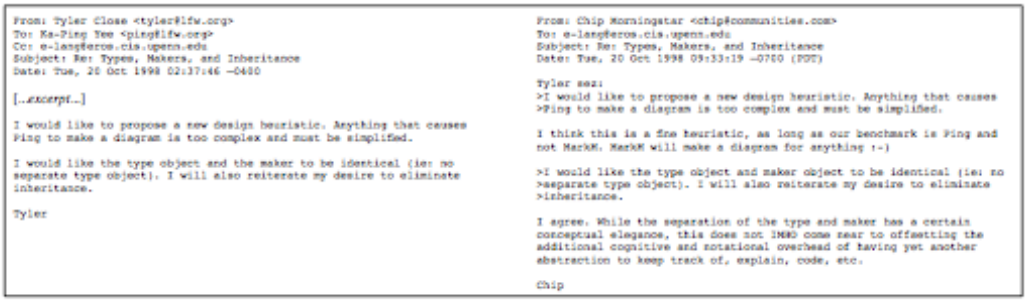
5.3.1 Compendium

Compendium [27] is probably the most famous IBIS-based tool. It uses an extended IBIS model, as shown in Figure 5.7. Compendium uses the AIF format for interchange, which we discuss in Section 6.8, and Compendium's developers are enabling integration with other argumentation tools [75] (starting with import and export to CoPe_it! [62]). Compendium has recently been used for various purposes, including organizational memory of design rationale [125] and e-participation [75].

5.3.2 Cohere

Cohere[9] [129], shown in Figure 5.8, is a knowledge-mapping application. At the Cohere website, users can view and create maps, or import them from Compendium. Maps consist of ideas, which can be taken from the site's public, global pool of ideas, or added to one's own private collection. After installing a Firefox plugin, users can also clip ideas and save websites while browsing (similar to social bookmarking). Cohere offers sorting options and several views, including map, timeline, argument, and argument listing views. Ideas can be private or shared, allowing the possibility of finding arguments and ideas which interact with your own. Groups can also be created. Users can also tweet from

[9] `http://cohere.open.ac.uk/`



From: Tyler Close <tyler@lfw.org>
To: Ka-Ping Yee <ping@lfw.org>
Cc: e-lang@eros.cis.upenn.edu
Subject: Re: Types, Makers, and Inheritance
Date: Tue, 20 Oct 1998 02:37:46 -0400

[...excerpt...]

I would like to propose a new design heuristic. Anything that causes Ping to make a diagram is too complex and must be simplified.

I would like the type object and the maker to be identical (ie: no separate type object). I will also reiterate my desire to eliminate inheritance.

Tyler

From: Chip Morningstar <chip@communities.com>
To: e-lang@eros.cis.upenn.edu
Subject: Re: Types, Makers, and Inheritance
Date: Tue, 20 Oct 1998 09:33:19 -0700 (PDT)

Tyler sez:
>I would like to propose a new design heuristic. Anything that causes >Ping to make a diagram is too complex and must be simplified.

I think this is a fine heuristic, as long as our benchmark is Ping and not MarkM. MarkM will make a diagram for anything :-)

>I would like the type object and maker object to be identical (ie: no >separate type object). I will also reiterate my desire to eliminate >inheritance.

I agree. While the seperation of the type and maker has a certain conceptual elegance, this does not IMHO come near to offsetting the additional cognitive and notational overhead of having yet another abstraction to keep track of, explain, code, etc.

Chip

Figure 1. Two actual e-mail messages from the E language developers' mailing list.

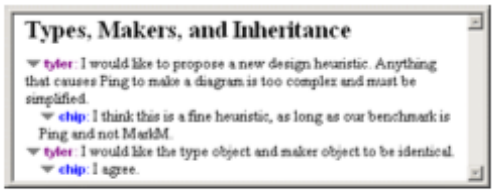
1998-October Archives by Thread

- **Messages sorted by:** [subject] [author] [date]
- **More info on this list...**

[...excerpt...]

- Types, Makers, and Inheritance *Tyler Close*
  - Types, Makers, and Inheritance *Chip Morningstar*

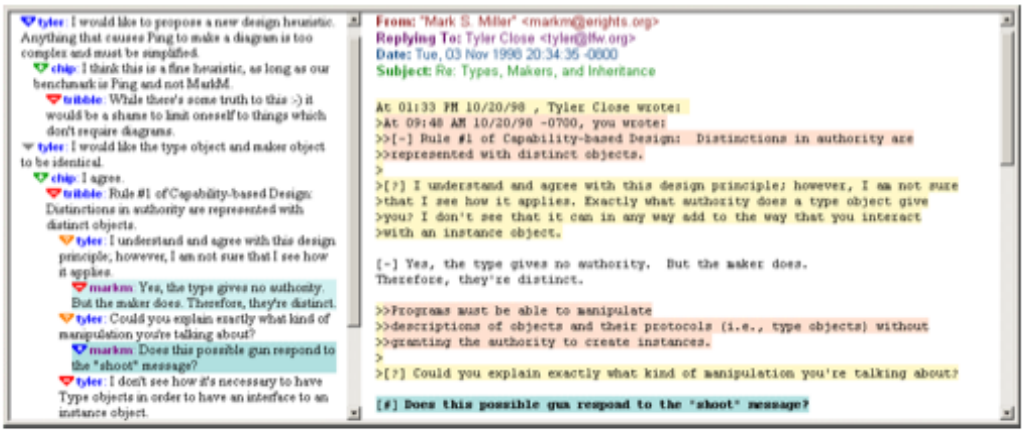
Figure 2. Standard subject-threaded view.



Types, Makers, and Inheritance

tyler: I would like to propose a new design heuristic. Anything that causes Ping to make a diagram is too complex and must be simplified.
  chip: I think this is a fine heuristic, as long as our benchmark is Ping and not MarkM.
tyler: I would like the type object and maker object to be identical.
  chip: I agree.

Figure 3. Zest content-threaded view.



tyler: I would like to propose a new design heuristic. Anything that causes Ping to make a diagram is too complex and must be simplified.
  chip: I think this is a fine heuristic, as long as our benchmark is Ping and not MarkM.
    tribble: While there's some truth to this :-) it would be a shame to limit oneself to things which don't require diagrams.
tyler: I would like the type object and maker object to be identical.
  chip: I agree.
    tribble: Rule #1 of Capability-based Design: Distinctions in authority are represented with distinct objects.
      tyler: I understand and agree with this design principle, however, I am not sure that I see how it applies.
        markm: Yes, the type gives no authority. But the maker does. Therefore, they're distinct.
      tyler: Could you explain exactly what kind of manipulation you're talking about?
        markm: Does this possible gun respond to the "shoot" message?
      tyler: I don't see how it's necessary to have Type objects in order to have an interface to an instance object.

From: "Mark S. Miller" <markm@erights.org>
Replying To: Tyler Close <tyler@lfw.org>
Date: Tue, 03 Nov 1998 20:34:35 -0800
Subject: Re: Types, Makers, and Inheritance

At 01:33 PM 10/20/98 , Tyler Close wrote:
>At 09:48 AM 10/20/98 -0700, you wrote:
>>[-] Rule #1 of Capability-based Design: Distinctions in authority are >>represented with distinct objects.
>
>[?] I understand and agree with this design principle; however, I am not sure >that I see how it applies. Exactly what authority does a type object give >you? I don't see that it can in any way add to the way that you interact >with an instance object.

[-] Yes, the type gives no authority. But the maker does. Therefore, they're distinct.

>>Programs must be able to manipulate
>>descriptions of objects and their protocols (i.e., type objects) without >>granting the authority to create instances.
>
>[?] Could you explain exactly what kind of manipulation you're talking about?

[#] Does this possible gun respond to the "shoot" message?

Figure 4. In this view of the entire thread, the user has selected Mark's reply (shaded, at bottom) to Tyler's question. The content-threaded outline generated by Zest, at left, provides a conversation-like overview of this exchange.

Figure 5.6: Zest, from [162].

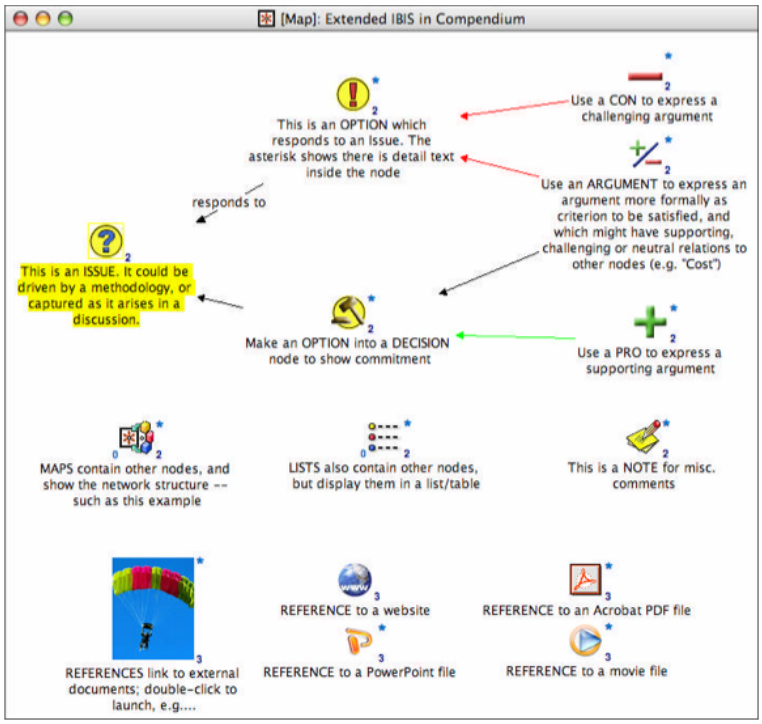


Figure 5.7: IBIS plus additional node types rendered in Compendium, from [89].

a Jetpack extension to Cohere. Cohere is not distributed, since all the data resides on this website; however, the possibility of finding related arguments demonstrates the potential utility of distributed systems. Downloading maps for display in Compendium would be useful; the website's current screen area available for maps is quite small and the website response time is sometimes slow. One limitation is that while items can be updated, their history does not appear to be available, making it difficult to refer to previous versions of a comment, i.e. a relation or the entire map as asserted at a fixed point in time. While bookmarking views was straightforward, direct links to Cohere's identifiers for individual elements are not be immediately evident.

5.3.3 Debategraph

Debategraph[10] [79] 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 WAVE[11]. Debategraph's Debate Explorer view (Figure 5.9(a)) is complex, and the alternate, text-based outline (shown in Figure 5.9(b)) is not easily summarized; these two views can sometimes, but not always, be used in conjunction. Visualizations can be embedded in other websites, and Debategraph encourages users to add links to related webpages within graphs. While Debategraph's user interface is fully developed, its navigation methods may take

[10] `http://debategraph.org/`
[11] `http://www.wave-project.eu/`

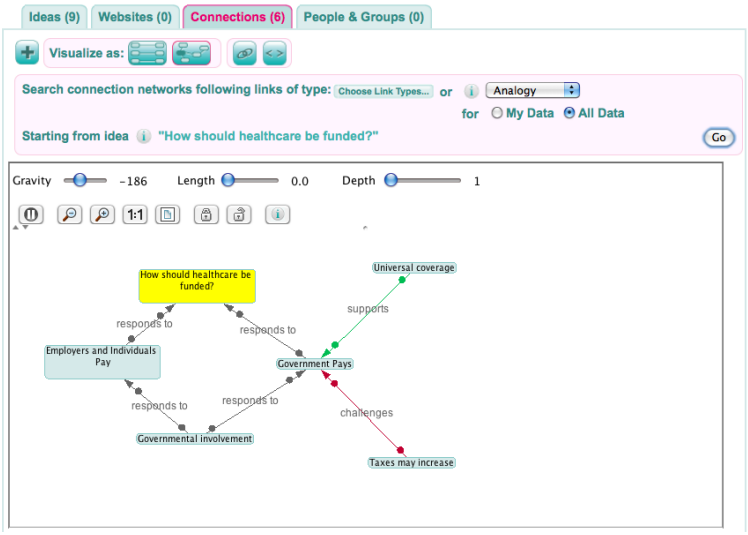


Figure 5.8: A sample argument map viewed in Cohere.

some time to get used to, especially when map is to large to see at once. As the focus changes, so does the graph, and for a novice user it can be confusing to figure out how to get back to a previous view. The learning curve to effective use is its main disadvantage, compared to the other systems we evaluated, but Debategraph could also provide more support for quoting, rather than just replying or citing.

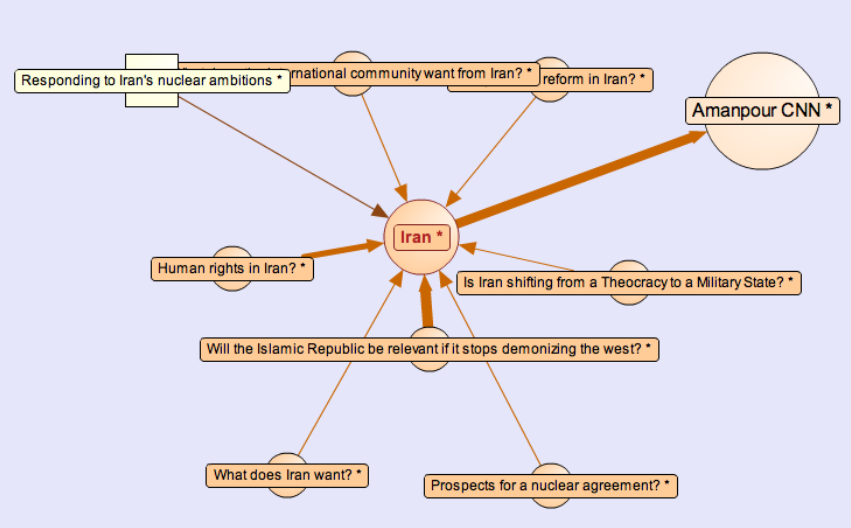
5.3.4 Rationale

Rationale [146] is a commercial package allowing the diagramming and visualization of arguments; while its predecessor, Reason!Able, was designed for the education domain, Rationale is aimed at lawyers. As shown in Figure 5.3.4, Rationale facilitates the creation of 'box-and-arrow' argument maps, where users to link premises to conclusions with boxes and arrows.

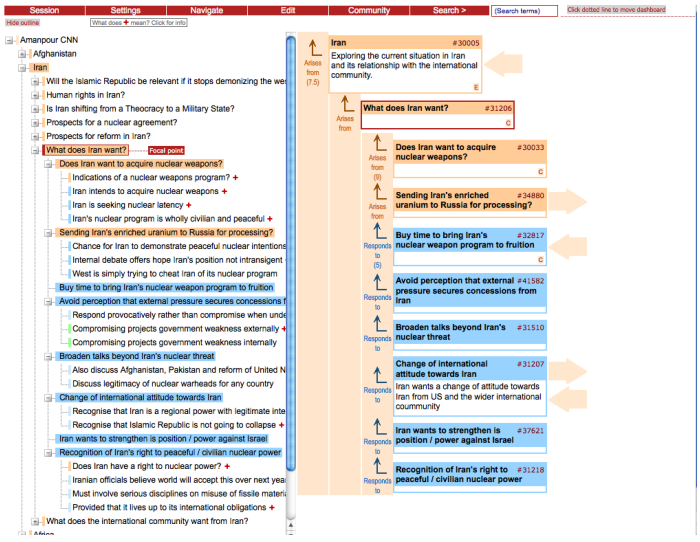
5.3.5 Carnedes

Carnedes[12] [46] is centered on persuasive dialogues where one or more parties seek to convince the other. The Carneades Argumentation Framework [46] provides a formal mathematical model of evaluating arguments, based on Walton's model of argumentation. Carneades uses four proof standards, drawn from logic (dialectical validity) and from legal proof standards (a scintilla of evidence, a preponderence of the evidence, beyond a reasonable doubt).

[12] `http://carneades.berlios.de/`



(a)



(b)

Figure 5.9: Debategraph for CNN's Amanpour TV shown in (a)Debate Explore view; (b) text view.

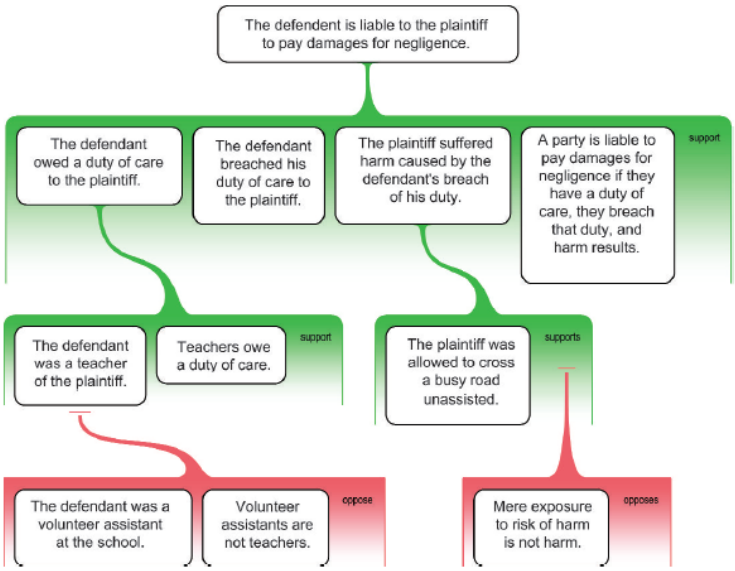


Figure 5.10: A sample argument map viewed in Rationale from [146].

Chapter 6

Ontologies for Argumentation

6.1 CiTO

CiTO [128] is an ontology for citation networks in scholarly publications. Terms like *obtains background from*, *uses data from*, *confirms*, *extends*, *shares authors with* connect a paper to particular citations. Papers can thus be semantically enhanced.[1]

CiTO is probably too complex for ready adoption, however it shows the possibilities of semantic annotation, and perhaps suitable authoring tools could be developed.

6.2 IBIS

Although many tools are described as 'using the IBIS model' or 'IBIS-like', there is significant variation in the underlying structure of these models [58]. In our view, these models use 'IBIS-like' to mean that they concern design rationale, provide graphical representations, and use some form of polarity.

The IBIS model received early critiques from the design rationale community. One difficulty was that only deliberated issues were included; Procedural Hierarchy of Issues (PHI) modifies IBIS to allow inclusion of subissues which are not deliberated [42]. SEPIA, another early system using IBIS-based argumentation, also modified IBIS [123]. Another difficulty, representing the relationships and interdependencies of issues [42], remains difficult to resolve.

For instance, Compendium uses extended IBIS, as shown in Figure 5.7, which adds Options, Notes, and References, as well as abbreviated representations for the rest of an argument map (e.g. Lists and Maps). Gerosa et al. [44] discuss an e-learning message board system adopting a modification of IBIS, where message types are specified; in addition to IBIS-analogues, Question, Argumentation, and Counter-Argumentation, the system adds two types: Seminar (a general topic for the week) and Clarification.

[1] `http://imageweb.zoo.ox.ac.uk/pub/2008/plospaper/latest/`

6.3 ScholOnto

The ScholOnto [135] [6] project, which ran at Open University's Knowledge Media Institute from 2001-2004, focused on modeling claims and arguments in scholarly communication. ClaiMapper, ClaiMaker, and ClaimSpotter were among the tools[2] developed in the project, which was seen as part of sensemaking research. An open source web publishing tool called the Digital Document Discourse Environment[3], or D^3E [131] was also developed in related research. ScholOnto made an RDF Schema available, but database queries with SQL were preferred to querying based on this RDF Schema (SPARQL was first released as a working draft in 2004). The underlying ontology for these projects is shown in Figure 6.3.

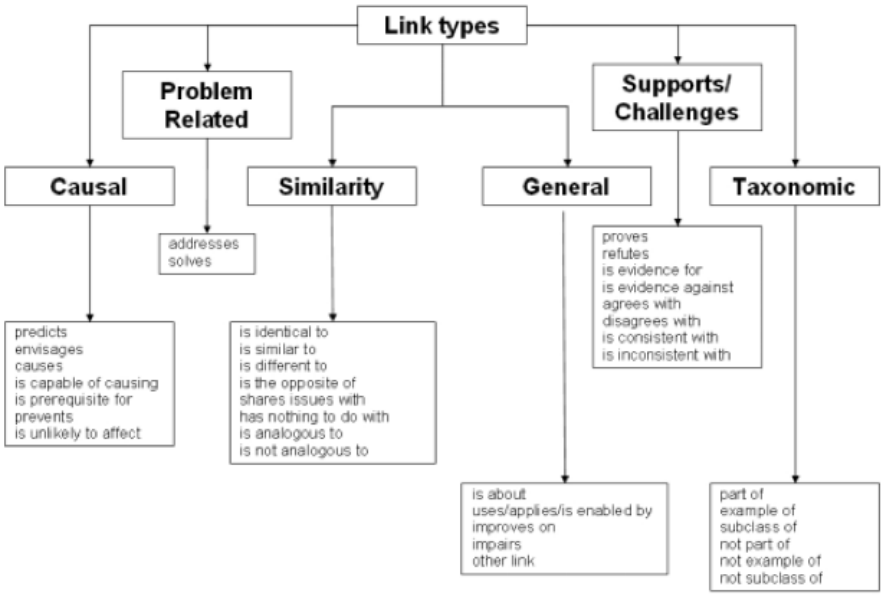


Figure 6.1: Class structure of the Scholarly Discourse Ontology from [135] .

6.4 SWAN-SIOC

SWAN-SIOC [96] harmonizes the argumentation aspects of two pre-existing ontologies SWAN (Semantic Web Applications in Neuromedicine) [24] and SIOC (Semantically-Interlinked Online Communities) [16]. SWAN models scientific communication in neurology while SIOC is an ontology providing interoperability and exchange formats for social software.

SWAN/SIOC uses 12 terms, as shown in Figure 6.4. The most general term is relatedTo, which has 5 direct descendents or subterms. These, in turn, may

[2] `http://projects.kmi.open.ac.uk/scholonto/software.html`
[3] `http://d3e.sourceforge.net/`

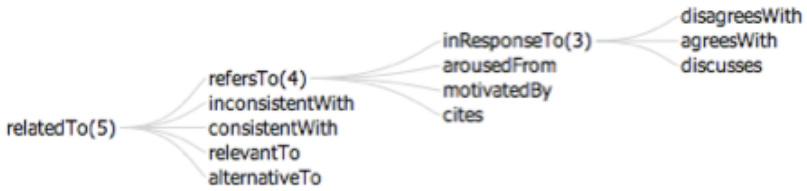


Figure 6.2: An overview of the SWAN-SIOC ontology from [23].

have subterms, until we reach the base terms in the ontology: disagreesWith, agreesWith, and discusses.

SWAN/SIOC provides a simple model for the relationships between items. Like CiTO, it may be too complicated for a user to specify without assistance, however, tools have developed around it, such as PDOnline[4], an online community for scientists, funders, and medical professionals working in Parkinson's disease science, which is funded by the Michael J. Fox Foundation.

Figure 6.3 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. Due to the COinS[5] microformat those citations can be read by existing Semantic Web tools such as Zotero[6].

6.5 Introductory Text Signals

Lawyers are expected to introduce citations with particular terms, introductory text signals[7]. These are encoded into the Bluebook citation system [2] lawyers use and are taught to student lawyers.[8][9] Each term has specified semantics, such as supporting, contradicting, providing examples, background, or pointing out comparisons. These include "see generally" for background, "e.g." for examples, and "compare...with..." for comparisons, as well as several choices of equivalent terms to indicate support for or contradiction of an argument.

6.6 Trigg

Trigg's 1983 dissertation [143] proposed a complex series of link types for citations, as shown in Figure 6.6. Trigg's taxonomy has two categories, normal and commentary links. Trigg envisioned these being used for citations as well as for

[4] http://www.pdonlineresearch.org/
[5] http://ocoins.info/
[6] http://zotero.org
[7] http://www.crossref.org/CrossTech/2009/03/introductory_signals.html
[8] http://www.law.suffolk.edu/library/research/Bluebook/signals.cfm
[9] http://www.law.cornell.edu/citation/6-300.htm

Figure 6.3: Part of an argumentative discussion at PDOnline

intertextual links (e.g. to chapters or text sections). Describing the difference between the two types, Trigg says, "Almost invariably, commentary links serve as side links rather than train of thought links. (Of course readers can later build paths which include commentary nodes, but this will generally not be the case for the original author's intended path.)"

Prefixes describe each taxon's name, for instance among the normal links 'C' stands for citation (Trigg defines several sub-types, and considers intertextual references as citations), 'A' for argument (with the typed subtaxa 'A-deduction', 'A-induction', 'A-analogy', and 'A-intuition'). In the commentary link types, 'E' (Environment), 'P' (Problem Posing), 'Pt' (Points), 'D' (Data), and 'S' (Style) are used, along with further Arguments: 'A-comment', 'A-invalid', 'A-insuff(icient)', 'A-immaterial', 'A-mislead', 'A-alternate', and 'A-strawman'.

Trigg later worked on the Xerox PARC NoteCards hypertext system [55], which used flexible link types, determined by the user.

Normal link types		
Citation C-source C-pioneer C-credit C-leads C-epon Background Future Refutation Support Methodology Data	Generalization/Specification Abstraction/Example Formalization/Application Argument A-deduction A-induction A-analogy A-intuition Solution	Summarization/Detail Alternate-view Rewrite Simplification/Complication Explanation Correction Update Continuation
Commentary link types		
Comment Critics Supportive *Environment* E-comment E-misrepresent E-vacuum E-ignored E-Isupersede E-Irefute E-Isupport E-Irepeat *Problem Posing* P-comment P-trivial P-unimportant P-impossible P-ill-posed P-solved P-ambitious	*Points* Pt-comment Pt-trivial Pt-unimportant Pt-irrelevant Pt-redherring Pt-contradict Pt-dubious Pt-counter Pt-inelegant Pt-simplistic Pt-arbitrary Pt-unmotivated *Arguments* A-comment A-invalid A-insuff A-immaterial A-mislead A-alternate A-strawman	*Data* D-comment D-inadequate D-dubious D-ignored D-irrelevant D-inapplicable D-misinterpreted *Style* S-comment S-boring S-unimaginative S-incoherent S-arrogant S-rambling S-awkward

Figure 6.4: Trigg's link types, from [143].

6.7 W3C Process Ontology

The W3C Process Ontology[10] [43] tracks the relationship between email. The `refersTo` property has two main subproperties, `agree` and `disagree`. `supportingExample` is a subproperty of `agree`, while `modifyPoint` and `counterExample` are subproperties of `disagree`.

[10]This is an ontology *about* the W3C, not one endorsed by the W3C.

6.8 The Argument Interchange Format, The World Wide Argument Web, and Extensions of AIF

The Argument Interchange Format (AIF) [21] is an ontology which represents a (monological) argument. The core ontology consists of two disjoint sets of nodes: *information nodes* (I-nodes) holding the content of the argument and *scheme nodes* (S-nodes) holding the relationships between arguments. Scheme nodes are further divided into three main types, for representing logical inference (RA nodes), preferences or values (PA nodes), and conflicts between I-nodes (CA nodes). The AIF is still under development with AIF2.0 expected to be released shortly [130].

Several published extensions exist. Rahwan adds *form nodes* (F-nodes) [103] in order to more fully represent generic argument schemes (as opposed to the instantiations of those schemes). The AIF+ extension augments monological AIF for use in representing dialogical argumentation [106, 108, 110, 109, 105].

Rahwan has also used AIF to discuss and propagate the notion of the World Wide Argument Web, "a large-scale Web of interconnected arguments posted by individuals to express their opinions in a structured manner" [104], where RDFS and OWL are suggested to be used for AIF. The foundations of the World Wide Argument Web have been further developed [100, 101] and Rahwan's student Zablith presents AIF-RDF, used for a Semantic Web argumentation system called ARGDF which uses an associated storage layer ARGDB [163].

Chapter 7

Other Approaches to Argumentation

Machinery for studying argumentation on the Social Semantic Web may come from a variety of directions. We briefly review the most closely related areas.

7.1 Social Web-related work from the Argumentation Community

A recent paper [56] uses Walton's Critical Questions to help structure Amazon reviews. Older work in the argumentation community has identified viewpoint clusters extracted from a Wikipedia article on the abortion debate [6] (shown in Figure 7.1). De Moor and Efimova provide an argumentative model for the blogosphere [34], using research on how stories move through the blogosphere in a newscycle including Opinion, Vote, Reaction, and Summation posts (shown in Figure 7.2).

Recently, e-participation researchers are moving towards using the Social Web as a venue to provide a voice to citizens [79], perhaps in concert with sophisticated argumentation [78].

7.2 Corpus-based Approaches

Linguistic and social theories from the areas of dialogue analysis, coherence, and pragmatics, may prove relevant. We have not thoroughly surveyed this area: One notable shortcoming is that Eemeren and Grootendorst's extensive body of work on pragma-dialectics [38], a linguistic model designed for argumentation, has not been discussed. Next we discuss several approaches, and point to recent research that has used these theories in an argumentative context, focusing on Cognitive Coherence Relations, Speech Act Theory, the Language/Action Perspective, and Rhetorical Structure Theory.

Some conversations are coherent while others are not. Compare "Tim must love that Belgian beer. The crate in the hall is already half empty." to "Tim must love that Belgian beer. He's six foot tall," [67]. What sense is a reader to make of the second example? The theory of Cognitive Coherence Relations

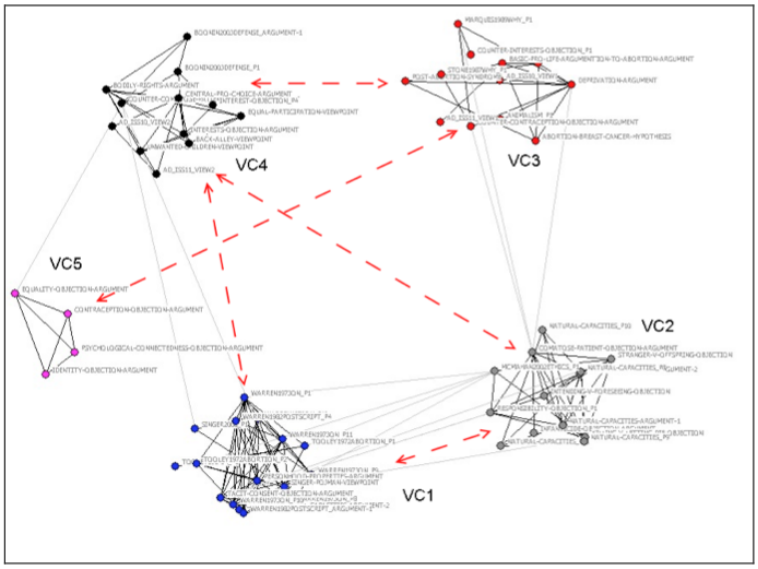


Figure 7.1: In this representation of the viewpoint clusters in an argumentative debate, dashed lines indicate opposition between clusters [6].

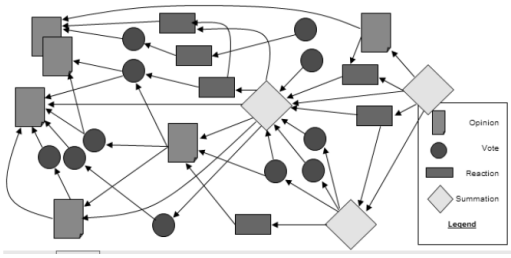


Figure 7.2: As news travels through the blogosphere, there are Opinions, Votes, Reactions, and Summations. From Jenkins, 2003 as presented in [34].

[115] posits that readers use conceptual relations to understand text. The four basic Cognitive Coherence Relations are: 'Basic Operation' (causal or additive), 'Source of Coherence' (semantic or pragmatic), 'Polarity' (positive or negative), 'Order of Segments' (for causal relations only: basic or non-basic, depending on whether or not the antecedent appears before the consequent). Buckingham-Shum's student Mancini uses Cognitive Coherence Relations in describing cinematic hypertext, [81], a visual language for structuring hypertext links to maximize their rhetorical impact, and allow coherent arguments to be understood in new ways. As Mancini observes, scholarly argumentation in hypermedia tends to follow paper formats, in part because linearity, continuity and centrality are needed to make arguments.

Searle's Speech Act Theory [124] describes five categories of speech acts: assertives, directives, commissives, expressives, and declaratives. Speech acts are about the force of a statement: what effect they seek to have on the hearer or the world. Assertives ("The sky is blue') assert that something is true. Directives ('Clean your room') order, permit, or request something. Commissives are vows or pledges ('I swear to tell the truth'). Expressives offer thanks or congratulations ('Great work!'). Declarations ('I now pronounce you man and wife') enact what they say, effectively changing reality.[1] The journal *Argumentation* dedicated a special issue to "Argumentation and Speech Act Theory," edited by Eemeren and Grootendorst [38]. Carroll et al. [20] use the idea of performative warrants, to describe assertions made legitimately by the authority signing a Named Graph. Speech acts are also used to model the flow of online conversation in several recent works. Jeong et al. [60] use semi-supervised machine learning to identify speech acts in email and forum posts. Ritter et al. [112] model Twitter conversations with Speech Act Theory in combination with topic modelling and show a Speech Act transition map with probabilities for each state.

The Language/Action Perspective [160] embeds Speech Act Theory in an task-based framework. It was first used in a groupware system called the Communicator for diagramming workflows associated with messages in a work setting. For instance, after accepting a request to do some action, a person may report completion or cancel; however, at this point, it is redundant and meaningless for that person to accept the same request a second time. Twitchell et al. [144] describe Winograd's work as providing a taxonomy of "conversations for action, conversations for clarification, conversations for possibilities, and conversations for orientation." Using the Language/Action Perspective and drawing from Speech Act Theory, Twitchell et al. [144] model online conversations to classify them and create visual maps, used for information retrieval:

> Using current search engines, the searcher could search for the words Vietnam, war, and critique. However, many critiques of the war might not contain the word critique, and would thus be lost (or receive a low ranking) in such a search. If the searcher was able to issue a query such as Vietnam war (critique) where critique is the purpose of at least one participant in the conversation, she would likely get better results. The search for the semantic meaning of the words Vietnam war using conventional searching techniques would

[1] As with all speech acts, sincerity is a criterion, and social criteria, e.g. ceremony, may also hold.

then be combined with the search for the pragmatic force of the word critique, yielding a search result with higher precision than searching on semantic meaning alone." [144]

Attending to Speech Acts can also help predict deception, which uses 'fewer assertions and more expressives' [144].

Rhetorical Structure Theory (RST) [82], a method for analyzing texts according to their structure and rhetorical role, was developed at the Information Sciences Institute to assist with computer-based text generation. In RST, structures such as 'Concession', 'Evidence', and 'Justify', called 'relations', describe the relationship of two or more spans of text. Generally one span (the most important) is called the nucleus, while the less important spans are known as satellites. In some situations (such as sequences and contrasts), both spans are nuclei of equal weight. RST has been widely used and in 2006 a paper summarizing its applications [138] was published. Recently, Mentis et al. [84] used RST to analyze group decision rationale, comparing new and established groups using relations such as 'Interpretation & Evaluation', 'Evidence', 'Elaboration', 'Concession', and 'Antithesis'.

Additional corpus-processing techniques and approaches could be drawn from opinion mining [94], question answering and explanation [86], contradiction detection [113] and automatically typing links [25]; these might also prove relevant.

7.3 Information Quality and Argument Construction

Argumentation is sometimes used to probe or enforce information quality or help construct arguments. We now describe two information quality systems and one argument construction system.

Videolyzer[2] [35], a system for sensemaking and argumentative discussions about the quality of online videos, 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), to provide an integrated discussion forum for annotating and challenging the claims a video makes. Dispute Finder [40, 41] is a browser extension that alerts users when information they read is disputed, based on a database of disputed claims, first populated by hand-annotation by activists who want to inform or convince others and then extended algorithmically.

Bocconi et al. [14] automatically generate argumentative video sequences from annotated interviews. They also provide documentary filmmakers with a simple annotation structure relying on the relations 'similar', 'opposite', 'generalisation', and 'specialization'. Statements are modeled as having a subject, a modifier, and a predicate, and each possible term is recorded in a thesaurus, along with two related terms and the relationship ('similar', 'opposite', 'generalisation', or 'specialization')between thesaurus terms. For example, modifer might be 'no modifier', 'not', or 'never'.

[2] `http://videolyzer.com/`

7.4 Multiagent Argumentation

Argumentation in multiagent systems is a very active research area which includes the description and classification of argumentation frameworks [107], drawing in part on Dung's seminal paper on the acceptability of arguments [37]. Semantic Web research in argumentation from a multi-agent perspective typically [102, 140] but not always [76] draws on Dung's framework.

Connections between human-oriented argumentation and agent-oriented argumentation are still scant though there is a small body of work bridging these perspectives. Dialogue is a natural bridging point between machine and human agents [3, 106, 108], though not the only research direction [141, 73]. Important dialogical research includes AIF+ (the dialogical extension of AIF mentioned above) and Dialogue Game Description Language (DGDL) [155], described as "a domain specific language for describing dialectical games and provides a grammar for determining whether a game description is syntactically correct" [105].

Chapter 8

Progress to date

Our research this has focused on four areas: surveying the state of the art in computational argumentation [122, 117], exploring semantic approaches to coherence in email [97], understanding Wikipedia discussions [120, 118] and providing semantic support for Wikipedia discussions [119, 121].

8.1 Surveying the State of the Art in Computational Argumentation

Argumentation is the thread running through all our research. We have conducted an investigation into the state of the art of computational argumentation this year, with three outputs: this report, a "A Review of Argumentation for the Social Semantic Web" [117] (in-progress and accepted to the open review stage of the Semantic Web Journal – Interoperability, Usability, Applicability), and a paper [122] at COMMA 2010, the biennial conference on computational argumentation.

This report presents a first review of argumentation for the Social Semantic Web, along with a definition of argumentation in that context. "A Review of Argumentation for the Social Semantic Web" identifies sixty-one of the most relevant scholarly works along with eleven relevant argumentative ontologies and twenty-four relevant tools, to provide a more comprehensive view of how argumentation is currently used on the Social Semantic Web.

The third paper, which was presented at COMMA, began as a survey of requirements for argumentation on the Social Semantic Web; as published, it discusses the need for cross-website navigation by arguments. In particular, we would like to identify, across various wikis, weblogs and other applications, who is arguing (positively or negatively) about a particular product, topic, or position. We envision arguments as objects of social interest in their own right, thinking of object-centered socialization [66]. Semantic Web technologies could play an important role in enacting this vision. Although the World Wide Argument Web (WWAW) [104] nominally exists, it is not in widespread use; we argue that this is in part due to a gap between the sophistication of existing argumentation tools and the simplicity of typical Social Web uses, and a lack

of alignment between common Social Semantic Web ontologies such as FOAF[1] and SIOC [16] and argumentation ontologies such as the Argument Interchange Format (AIF) [22].

To delve further into the current ecosystem, and what users want, we review current tools and we survey users. We describe current argumentation in the Social Web in four environments: on forums, in wiki discussion pages, blog comments, and microblogs, explaining how the affordances of different sites affect the kind and amount of argumentation we find. We provide an overview of four Social Web systems for argumentation: Cohere, Debategraph, Debatepedia, and LivingVote. We also survey users about the features most important to them in commenting environments.

One fundamental question is what amount of complexity users are willing to adopt in order to reap the benefits of argumentation; previous research has emphasized incremental formalization [127] because users do not generally understand the larger structure of an argument from the outset (see e.g. [135], page 29), and even experienced users can have difficulty holding a complex argumentation model in their heads (page 27, ibid). This leads us to believe that only a simple argumentation model will gain use in social media, unless the complexity can be mitigated by good interfaces and familiar metaphors.

We finally review the research of the argumentation community with incremental formalization and usability in mind, casting a critical eye on the promising environments provided by Argument Blogging [154] and by the AIF-RDF ontology and ArgDF system [104, 100]. We contrast this with the simplicity of existing ontologies such as DILIGENT, IBIS OWL, and SWAN/SIOC, and conclude with a discussion of requirements for moving the WWAW closer to users' existing environment, returning to our Social Web examples of forums, wiki pages, blogs, and microblogs.

This work will form the basis of our future research.

8.2 Semantic Approaches to Coherence in Email

Our paper on the email domain begins to address the notion of argument-centred sociality using quotes as a stand-in for argument topics. Quoting is a common practice in listserv discussions, and email discussions may become voluminous, however email archives do not index conversations based on what subpart of the discussion is being replied to. "A semantic framework for modelling quotes in email conversations" [97] addresses this problem with an SIOC extension, providing a OWL2-RL model of listserv archives with three classes (`Block`, `Quote`, `Response`) and six properties (`has_block`, `has_quote`, `has_response` and their inverses). Additional information, such as the `sioc:creator_of Blocks` and `Quotes`, can be inferred using property chain axioms, relying on SIOC modelling of the email messages themselves. Based on our new model, quotes are extracted and represented in RDF; applications include community detection and finding replies which indicate +1 (agreement) to an ISSUE. Our role in this research was in investigating and presenting related work, particularly on argumentative models of email.

[1] `http://www.foaf-project.org/`

8.3 Understanding the Argumentative Structure of Wikipedia Discussions

Study of argumentative discussions in Wikipedia has been a major focus of this year's work, resulting in several publications [119, 120, 118] and one paper under review [121]. This work included a large-scale content analysis of the discussion pages, called Talk pages, associated with 100 articles; a lightweight extension to SIOC, called wikitalk[2], used to identify the types of messages; RDFa markup of sample Wikipedia Talk pages (which need to be massaged into XHTML to enable this process); JavaScript plugins to highlight relevant message types; example applications and uses, including a SPARQL query for current awareness of Talk page conversations; user interviews of administrators and Talk page users; and a formative evaluation. We provide background about Talk pages and discuss the content analysis in this section and the remainder of this work in Section 8.4.

Figure 8.1: Talk page for the "Semantic Web" article on Wikipedia

8.3.1 How Talk pages are used

Talk pages (Figure 8.1) are variously seen as overhead [137] spaces associated with increased conflict or as an essential locus of coordination: Wikinson found a strong correlation between Talk page comments and article quality [159]. While long Talk pages correlate with contentious editing, they may also offer social benefits reducing the likelihood of conflict [65]. Talk page characteristics depend on the number of contributors [4] and editors contribute to Talk pages at different rates, in part based on their social roles [156].

[2] `http://rdfs.org/sioc/wikitalk`

8.3.2 Content analysis of Talk pages

Despite a large body of research using Talk pages[3], content analysis of Talk pages has been limited in size and scope. Talk pages are large and complex, where six Talk pages can yield over 100 printed pages [5], and individual Talk pages may yield 50 printed pages. Sample sizes of existing studies range from 6 to 20 Talk pages, and generally focus on hand-selected samples [147, 39, 5, 136]. To understand the composition of Talk pages, we analyzed 100 Talk pages in five categories (most visited, controversial, featured, random, and most highly edited), [120] carefully reading each page by hand, and classifying the contents into 15 non-mutually exclusive classifications, as shown in Figure 8.2.

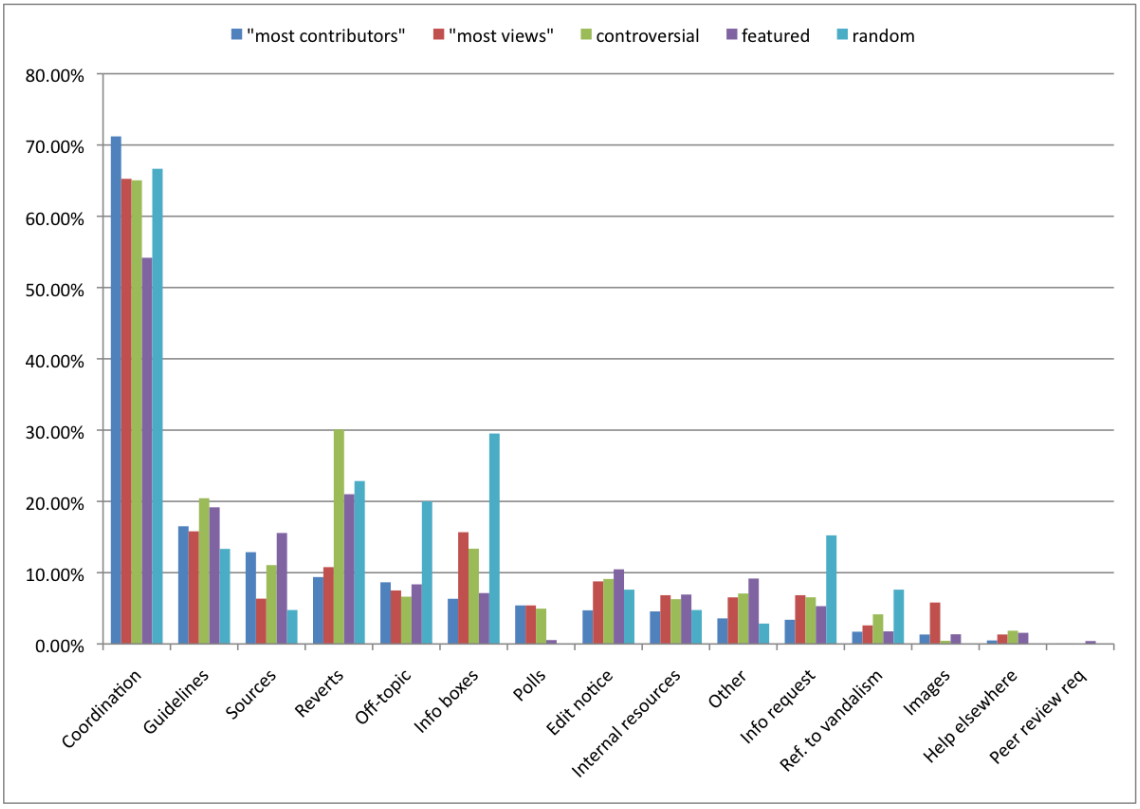


Figure 8.2: Frequency of Talk pages contributions by type for five categories of Talk pages.

These classifications drew first from Viégas' 11 classification[4] [147], enriched with 4 new classifications: "References to external sources", "References to page reverts or other controversies", "References to a user's own article edits", and "Requests for help with another article" [120]. Table 8.1 shows the 11 original

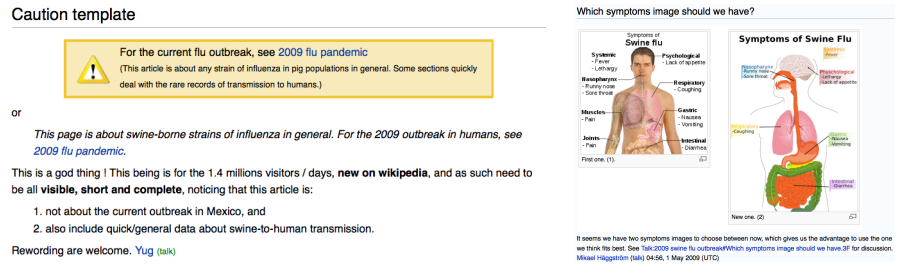
[3] `http://www.citeulike.org/group/13905/`

[4] "Requests/suggestions for editing coordination", "Requests for information", "References to vandalism", "References to wiki guidelines and policies", "References to internal wiki resources"," Off-topic remarks", "Polls", "Requests for peer review", "Information boxes", "Images", "Other"

classifications and Table 8.2 shows our 4 added classifications, each with its definition and an example drawn from a Wikipedia Talk page.

The article category[5] influences the kind of discussion that takes place there. Coordination requests occur heavily on all five categories of Talk pages, and are especially frequent on the articles with the most contributors. Articles with the most views tend to have Talk pages with more info boxes, and may have FAQs and numerous archives; discussions of sources are somewhat less frequent in this category. Controversial pages are indicated by their high percentage of revert discussions, which may be long and entrenched. Discussions of policies and guidelines, while common on controversial pages, occur nearly as frequently on Featured Articles' Talk pages. Intriguingly, while many Featured Articles show signs of extensive coordination and collaboration[6] in their Talk pages, others have seen no discussion whatsoever[7], indicating that there may be different processes for article improvement, and suggesting that explicit coordination may not always be needed. Random pages often consist solely of info boxes, and many contain request for information, off-topic comments, and discussions about reverted or disputed content.

The presence or absence of two main features–infoboxes and discussion threads–indicates how much and what kind of attention a Talk page has received. Talk pages are an artefact of community interest, and become more developed through controversy, through the collaboration of multiple active editors, or in reaction to a large reader population.



(a) (b)

Figure 8.3: Comments from the Swine influenza Talk page containing: (a) a proposed infobox and, (b) images.

8.4 Providing Semantic Support for Wikipedia Discussions

While extensions such as LiquidThreads[8] provide structural improvements for MediaWiki Talk pages, additional *semantic* improvements could further improve Talk page conversations, for instance by automatically transcluding discussions to additional locations or automatically listing the article as having suggestions

[5] most visited, controversial, featured, random, or most highly edited
[6] e.g. Reactive Attachment Disorder
[7] e.g. Koli Point Action
[8] `http://www.mediawiki.org/wiki/Extension:LiquidThreads`

Classification	Definition	Example
Requests/suggestions for editing coordination	Ideas, comments, or suggestions involving editing the article.	Currently some of the refs are YYYY-MM-DD format and some are Month DD, YYYY. Which format do we want to standardize to?
Requests for information	Questions asked by someone who doesn't intend to edit the page.	Where is Ligurian spoken in the Var ?
References to vandalism	Mentions of vandalism.	I've semi-protected the article for another week, the signal-to-noise ratio of the IP edits seemed too low.
References to wiki guidelines and policies	References to guidelines and/or policies of this wiki.	The section I removed had no sources / references - if you have sources they're no good being kept a secret ;) WP:VERIFY, WP:CITE. Thanks/
References to internal wiki resources	References to internal wiki resources such as diffs, Talk page discussions, old version of a page.	Would it be a good thing to re-add the links that were taken off in August? Somebody made them into a template that was subsequently deleted. The edit to recover the old links is here: [6]
Off-topic remarks	Remarks not relating to editing the article.	PLATO IS THE BEST MAN ALIVE! LONG LIVE PLATO
Polls	Formal proposals followed by statements such as Support and Oppose, with justifications.	A month should be deleted from the "Deaths in [CURRENT YEAR]" page ONE WEEK after the month ends...
Requests for peer review	Requests for peer review.	Users hoping to elevate articles to featured status may solicit a peer review.[147]
Information boxes	Special boxes with information, usually found at the top of a Talk page.	See Fig. 8.3(a), which proposes and discusses a new info box for the Swine influenza article.
Images	Images posted on the Talk page.	See Fig. 8.3(b)
Other	The sole exclusive category, describes items that don't fit elsewhere.	"This review is transcluded from Talk:Wiki/GA1. The edit link for this section can be used to add comments to the review."

Table 8.1: Our own examples of Viégas' 11 types [147] of Talk pages comments.

Classification	Definition	Example
References to sources outside the wiki	References to sources, including print and deep web resources, outside this wiki.	Exclusive! Mighty Stef records football protest song"Hot Press. Not sure where to put it but I'll leave it here as somebody might find it useful...
References to reverts, removed material, or controversial edits	Discussions of reverts, removing material, or controversial edits.	I noticed some people edit the page into what it will be in 10 minutes but someone is reverting it...just let it be.
Reference to edits the discussant made	Applied when an editor discusses his/her own article edits on the Talk page.	Added the About.com review since the review was part of the reception section.
Requests for help with another article, portal, etc.	Solicitations for assistance elsewhere, or recruiting editorial help in the Talk page for another article.	This is just to invite attention to the page Facebook statistics just created; of all interested editors. I have just placed a mergeto tag in it. Thanks.

Table 8.2: Our 4 additional comment types for Talk pages.

for particular kinds of improvement. Talk page improvements are important due to the rapid growth of Talk pages, which have grown more quickly than articles, on English Wikipedia in recent years, whether measured by number of new pages [147] or by percentage of edits [136]; in general, article talk seems to scale linearly with the size of a wiki [65].

8.4.1 Motivation

Of Wikipedia's various discussion venues [98], Talk pages, which sit behind each article, are the most accessible to readers. Several projects have addressed Talk pages, seeking to make them easier to use. LiquidThreads makes Talk pages more similar to discussion boards, by making it easy to add topics, preventing users from editing others' comments, automatically signing comments, and notifying users about responses to their comments. Reflect[9] provides a space for summarizing comments, to make long, complex discussions easier to skim, and to provide feedback to commenters on what part of their message has been understood.

However, Talk pages have further limitations not addressed by these existing projects. One difficulty is that articles get varying amounts of attention and editing, and comments on Talk pages may languish for weeks or months[10], unresponded by others. Newcomers' comments are particularly liable to languish, especially when they lack some procedural or structural knowledge. For instance, readers may ask a topical question or ask whether the article should be deleted; however, questions about a topic should be asked at the ReferenceDesk,

[9] `http://www.cs.washington.edu/homes/travis/reflect/`

[10] `http://en.wikipedia.org/w/index.php?title=Talk:Demand_Five&action=history`

and article deletion can be proposed with a special template.

Rather than expecting users to know these facts, we would like to propagate their questions and comments to the appropriate place. Experienced users would benefit from an easier way to follow discussions of interest, even if they are not participating in them.

Further, experienced users may want to find areas that need attention; readers' and new users' feedback can be helpful in identifying these areas. The current approach relies on templates to find articles with pending tasks, such as 'verify', 'wikify', 'update', as well as requests for articles and images to be added.

Existing mechanisms for keeping up-to-date with a Talk page are limited; the RecentChanges[11] can be used, or a user can create his/her own RecentChanges by 'watching' pages. However, not all pages are 'watched', particularly new articles which may be created at any time, pages have a varying number of watchers, and watchers may not be constantly following the pages.

Centralized discussions spaces serve some of this purpose. In some language editions, such as Arabic Wikipedia, centralized discussion spaces such as the Village Pump are used regularly, to ensure a quorum on discussions. In English Wikipedia, WikiProjects[12] host topical discussions about areas of interest (such as 'WikiProject Computing', 'WikiProject Quebec', 'Guild of Copy Editors'). These projects may also provide alerts about important stages in the article lifecycle, for instance listing articles in the project that are proposed for deletion or nominated as good or featured articles.

However, not all discussions need centralization, which can fragment the topical discussions in an area. For instance, to 'watch' all the articles in WikiProject Computing, a user would need to add over 24,000 articles to his/her watchlist, continually adding new articles to the watchlist as they are created.

So what is needed is a way to increase the attention given to particular comments on Talk pages. We can provide this with our approach to modeling Wikipedia Talk pages, which we next describe.

8.4.2 Modeling Wikipedia Talk pages

Talk pages offer a number of opportunities for structured data. We reuse well-known ontologies, such as FOAF and SIOC, to model a wiki's users, discussion topics (considered as SIOC threads), and the structure of discussion items. Further, we model the content of discussion items, using a dedicated ontology extending SIOC [119], which we created to provide a lightweight structure for categorizing each discussion item in a wiki page. This has evolved out of Talk page-related research, and our content analysis described above. Figure 8.4 shows the model applied to the Wikipedia Talk page. We also reuse the `sioct:WikiArticle` class from the SIOC Types module and the `sioc:has_discussion` property introduced in some of previous DERI work on modeling wiki structure using semantics [91].

To add semantic structure in wiki pages, we first created a taxonomy based on the 15 categories of our abovementioned content analysis. We culled five categories: two which we could not expect users to add as annotations[13] and three

[11] RecentChanges is a list of the most recently updated pages.

[12] `http://en.wikipedia.org/wiki/Wikipedia:WikiProject_Council/Directory`

[13] "off-topic remarks" and the catchall category "other"

which duplicated existing semi-structured information[14]. We then modeled the remaining ten categories as the most relevant ones for retrieval [119]; these are now the SIOC wikitalk module.

Our model, available at `http://rdfs.org/sioc/wikitalk`, then consists of:

- A class `WikiDiscussionItem`.
- Two classes, subclasses of the aforementioned one, named `ReferenceItem` and `RequestItem`, for references and requests, respectively, that have various subclasses as follows:
  - For the `ReferenceItem` class:
    - `ReferenceToEdit`;
    - `ReferenceToGuidelinesOrPolicies`;
    - `ReferenceToInternalResources`;
    - `ReferenceToRevertsOrControversialOrRemovedMaterial`;
    - `ReferenceToSources`;
    - `ReferenceToVandalism`.
  - For the `RequestItem` class:
    - `RequestEditingCoordination`;
    - `RequestHelpElsewhere`;
    - `RequestInfo`;
    - `RequestPeer-review`.

Figure 8.4: Wikipedia Talk page with labels from SIOC, including SIOC wikitalk.

[14] "infoboxes", "polls", "images"

```
@prefix content: <http://purl.org/rss/1.0/modules/content/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix sioc: <http://rdfs.org/sioc/ns#> .
@prefix siocwt: <http://rdfs.org/sioc/wikitalk#> .

<#post_1> a siocwt:RequestEditingCoordination ;
     content:encoded """Could somebody please put examples of 'semantic
          web' immediately after the opening sentence? Otherwise it just
           sounds a bit waffly and, more importantly, the intelligent
          lay reader is lost. Thanks.
<a href="/wiki/Special:Contributions/86.42.96.251" title="Special:
     Contributions/86.42.96.251">86.42.96.251</a> (<a href="/wiki/
     User_talk:86.42.96.251" title="User talk:86.42.96.251">talk</a>)
     10:38, 30 March 2009 (UTC)
"""^^rdf:XMLLiteral ;
     sioc:has_container <#Opening_sentence> .

<#Opening_sentence> a sioc:Thread ;
     sioc:has_container </w/index.php?title=Talk:Semantic_Web> .
```

Listing 8.1: Example RDF markup for a Talk page thread and comment, in Turtle serialisation.

We first created an enhanced XHTML+RDFa version of each Talk page, inserting comment types (based on our own analysis) from the taxonomy into the markup of a local copy of the page. Listing 8.1 shows sample RDF markup, presented in Turtle for easy of readability; in fact, we added RDFa to an XHTML version of the MediaWiki page. We wrote JavaScript bookmarklets to highlight Talk page comments based on their taxonomy class. Relying on the RDFa markup and best practices[15], these bookmarklets parse pages to extract the RDFa, then highlight comments on that Talk page, if they belong to the specified taxonomy class. For instance, Figure 8.5 shows the results of the `ReferenceToEdit` bookmarklet, which highlights edits from the `ReferenceToEdit` class.

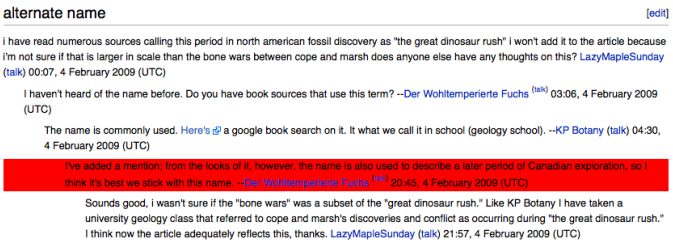


Figure 8.5: Highlighting "ReferenceToEdit" in the Bone Wars Talk page.

A formative evaluation validated the approach, and provided suggestions for future enhancement. We have also presented usage ideas, described in a scenario below.

8.4.3 Evaluation and User Interviews

The goal of our evaluation was twofold:

[15] `http://www.w3.org/2001/sw/BestPractices/HTML/rdfa-bookmarklet/`

1. to compare two systems for finding and identifying Talk page comments: a manual, control process and an assisted process using our RDFa markup and bookmarklet

2. to determine whether the assisted system would provide a motivation for users to add annotations.

Evaluation Setting

We used four Wikipedia Talk pages, with RDFa markup added as described above, from the SIOC wikitalk module, along with two JavaScript bookmarklets, for highlighting the `ReferenceToEdit` or the `ReferenceToRevertsOrControversialOrRemovedMaterial` classes.

The participants of the user study were 11 volunteers from our Semantic Web lab. Participants reported reading Wikipedia regularly, either weekly (4) or daily (7). Six also edited Wikipedia, either monthly (3) or a few times a year (3). Four of the editors and two of the non-editors had seen Talk pages before, and only two had previously edited a Talk page.

Participants were asked to find two types of comments on each of the four Talk pages, using bookmarklets for two pages and a control system for the other two pages. Pages were presented in the same order to each participant, but the order of bookmarklet use varied: Five participants used the bookmarklets for the first and third pages, while six participants used the bookmarklets for the second and fourth pages. We stopped users after five minutes on each task. Annotations were not visible to users except when using the bookmarklets, and "identify" meant that the user had to find the comments, but did not need to annotate them themselves.

We briefly explained the tasks both orally and in writing but gave no description of the bookmarklets, only indicating where to click to activate them. Before completing the tasks, participants were asked to answer a one question, multiple choice questionnaire: "When posting a comment on a Wikipedia Talk page, how likely would you be to indicate the comment type?" This question was asked again in the post-task questionnaire.

Afterwards, we asked the participants to answer a multiple choice questionnaire with three sections. We asked about their technical background (experience with other wikis, use of Wikipedia and Wikipedia Talk pages) and their satisfaction with each of the two systems: we asked (using Likert scales) whether finding comments was fast, reliable, had good results, and was easy in each system. In four free-text questions, we asked what the participant liked and didn't like in each system. A final free-text question solicited other overall comments and suggestions, and users made further oral comments, unprompted, while completing the questionnaire. Next we report on the evaluation results.

8.4.4 Evaluation Results

Talk pages are confusing

Talk pages and their current configuration proved confusing, in part due to the unusual structure. Several users asked "where are the comments?" when first encountering the Talk page, and most had never seen a Talk page before. For these participants, it took more than 4-5 minutes to understand the Talk

page itself which was "disorganised" making it "difficult to take part in the discussion." As one participant, commented, "At first glance, it's very hard to understand the structure of the page and to find out where and how the comments are displayed."

Several participants expected a forum interface and were confused that there was "no apparent order/hierarchy of threads". Others pointed out that there's no indication of whether a thread is "open" or "closed", and suggested that "resolved" be added for threads with completed actions. One participant appreciated how the bookmarklet helped identify the boundaries between highlighted posts; even more visual chunking would be helpful, and one participant suggested that colorizing or highlighting posts by commenter would help them follow the flow of a conversation.

Participant reactions to the bookmarklet

Figure 8.6 shows the results of our questionnaire about participants' experience of the bookmarklet and control systems (we received 10 usable results; one participant declined to complete the questionnaire).

Participants were happy with the speed and ease of use of the bookmarklet system, and said that with highlighting, comments were easier to find and navigate through. Overall, it "speeds up the reading of the Talk page, and makes it more understandable". While users found that the plugin drew their attention to relevant conversations, they also spent significant time checking the results of the plugin. It was helpful, one user noted, that there were "no false positives", although several users commented on clarifications of the categories, or suggested alternative determinations that could have been made. Despite concerns about accuracy, users preferred using the plugin, and several groaned when asked to switch from the plugin to the control system.

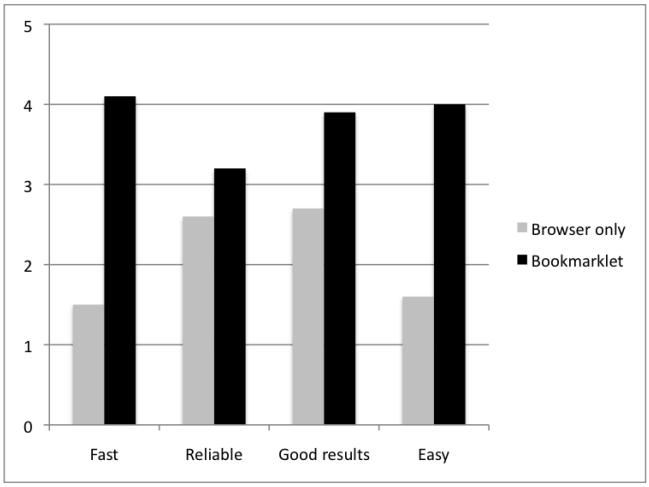


Figure 8.6: Average ratings of the control system (light) and bookmarklet (dark)

Initially it took about 50 seconds for a user to understand the bookmarklet and what it did. This might have involved reading the visible parts of the page (especially for users who started with the bookmarklet rather than the control

system, who may never have seen a Talk page before), clicking the bookmarklet multiple times, or understanding the interface of the computer being used.

Participants suggested several improvements that could be made in future development of the bookmarklet interface. Several participants asked for highlighting only of the most important information, noting that "There's no indication of what is really (even subjectively) important." Highlighting the most significant words was a common request. Another request was for references to be typed so that, for instance, URLs providing supporting evidence could be distinguished from those providing contextual information. Another request was to hide irrelevant comments, or to load just the relevant ones in a new page. Other participants would have preferred a faceted navigation approach (i.e. selecting which types of comments to show).

Some participants would have classified some comments differently, pointing to a need for further refinement of the taxonomy classifications and their labels. Most interesting was the suggestion that resolution, discussion, and proposed changes are among the important events which could be labelled.

Annotation

Users' likelihood of adding comment types increased after using the plugin, and several wrote about user annotation in the feedback section. On average, while using the plugin, participants changed from 'somewhat likely' to midway between 'somewhat likely' and 'very likely'; after using the plugin, Wikipedia editors were, on average 'very likely' to add annotations. Several participants suggested additional categories that could be useful for annotation, and one wrote that "When posting a comment on a Talk page the user should have the possibility to choose the type of the comment".

Based on these results, we think that some Wikipedia editors would find it satisfying to annotate comments, although not all edits or editors might take part. To be successful, annotations would need to closely agree with editors' mental models, unannotated comments would need to not decrease the overall usefulness of the system, and a limited, tractable set of annotations would be needed (perhaps 3-5 choices).

8.4.5 User interviews

We conducted four semi-structured user interviews with two Wikipedia administrators and two editors, to further understand how they use Talk pages.

Administrators talked about frequently monitoring the conversations in which they were participating. They felt a strong sense of community with their co-editors, whom they may have interacted with in other community spaces, sometimes offline. Some administrator edits to Talk pages were not discussions but associated with page moves, and they were more likely to add community-related information such as infoboxes.

Editors, however, reported mainly reading Talk pages, especially when they wanted to understand what was controversial about an article, or what scintillating facts didn't make it into the article itself. They commented infrequently, if at all; Talk pages gave them a perspective on the community and how it operated, for instance they sometimes discovered new policies or terminology in the process of reading Talk pages.

A frequently requested feature is to bring the Talk page closer to the article, by indicating which sections or topics have related discussions. This might also support readers' desire to understand the controversies and previously disputed information of an article. Timescales are an important factor in Talk page design; while deeply involved users monitor pages on a daily or weekly basis, readers and casual editors are more likely to encounter existing pages with dormant discussions or substantial archives.

Existing mechanisms for keeping up-to-date with a Talk page are limited; the RecentChanges[16] can be used, or a user can create his/her own RecentChanges by 'watching' pages. However, not all pages are 'watched', particularly new articles which may be created at any time; further pages have a varying number of watchers, and watchers may not be constantly following the pages.

Centralized discussions spaces serve some of this purpose. In some language editions, such as Arabic Wikipedia, centralized discussion spaces such as the Village Pump are used regularly, to ensure a quorum on discussions. In English Wikipedia, WikiProjects[17] host topical discussions about areas of interest (such as 'WikiProject Computing', 'WikiProject Quebec', 'Guild of Copy Editors'). These projects may also provide alerts about important stages in the article lifecycle, for instance listing articles in the project that are proposed for deletion or nominated as good or featured articles.

However, not all discussions need centralization, which can fragment the topical discussions in an area. For instance, to 'watch' all the articles in WikiProject Computing, a user would need to add over 24,000 articles to his/her watchlist, continually adding new articles to the watchlist as they are created. This can be accomplished with our taxonomy and RDFa markup of annotations, along with SPARQL queries.

8.4.6 Sample Use Case and SPARQL Query

RDFa markup of annotations allows us to retrieve, for instance, all `RequestInfo` posts in WikiProject Computing, using a SPARQL[18] query, as shown in Listing 8.2. Consequently, we can draw attention to postings in a separate listing, for instance on the project page, or transclude these comments to the Reference Desk; since postings stay in their original location, unannotated comments still may be viewed and replied to in their original location, meaning that it's not necessary for every comment to be annotated for the system to be useful.

8.5 Community Involvement

This year we have participated in several international efforts not represented in research output above. These are the Code4Lib community, the W3C Health Care Life Sciences (HCLS) Interest Group's Scientific Discourse task, and the W3C Library Linked Data (LLD) Incubator Group. Code4Lib[19]is an international group in library technology, with an annual conference, a quarterly journal, and various communication channels; we served on the 2010 conference

[16]RecentChanges is a list of the most recently updated pages.
[17]`http://en.wikipedia.org/wiki/Wikipedia:WikiProject_Council/Directory`
[18]http://www.w3.org/TR/rdf-sparql-query/
[19]`http://code4lib.org`

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX sioc: <http://rdfs.org/sioc/ns#>
PREFIX siocwt: <http://rdfs.org/sioc/wikitalk#>
SELECT ?comment ?page

WHERE
{
?page sioc:has_container <http://en.wikipedia.org/wiki/Special:
    WhatLinksHere/Template:WikiProject_Computing> .
?comment  sioc:has_container page ;
          rdf:type sioc:Post ;
          rdf:type siocwt:RequestInfo .
}
```

Listing 8.2: Using SPARQL to retrieve all RequestInfo posts in WikiProject Computing

organizing committee and ended a three-year term on the founding editorial committee of the Code4Lib Journal[20] in March 2010. HCLS' Rhetorical Structures [21] is a subtask of HCLS' Scientific Discourse[22] task and seeks to provide a formal structure describing scientific papers, addressing the granularity of paper sections, and on the claims, positions, and arguments within these papers. LLD[23] is a one-year effort to assess the status of Linked Data in the library domain and closely-related communities, with the intention of recommending what further standards and guidelines should be developed, and what organization should be set up in order to develop them.

[20] http://journal.code4lib.org/
[21] http://esw.w3.org/HCLSIG/SWANSIOC/Actions/RhetoricalStructure
[22] http://esw.w3.org/HCLSIG/SWANSIOC
[23] http://www.w3.org/2005/Incubator/lld/charter

Chapter 9

Research Questions & Future Work

9.1 Research Questions

We discuss two main research questions regarding Argumentation on the Social Semantic Web: explicit vs. emergent argumentation and environments for argument detection and refinement.

9.1.1 Explicit vs. emergent argumentation

A number of web2.0 tools are designed to support explicit argumentation, including Debatepedia[1], LivingVote[2], and Debategraph[3]. Some systems, such as MIT's Climate Collaboratorium[4], aim to become an integrated environment for discussing and debating: the Collaboratorium focuses on global warming and integrates domain-relevant models. Similarly, Cohere[5] aims at a unified annotation/argumentation environment [129].

On the other hand, *emergent* argumentation is not well-studied. We want for individuals to be able to use their own preferred tools – in a social environment – while understanding what else is being discussed. Collaboration and sense-making overlap with parts of this research, as do the creation of decentralized social networks. However, despite some papers on social networks and argumentation (particularly web2.0 and argumentation [129], [52], [70], [53])), the emergence of a distributed conversation seems to have had little impact to date on argumentation tools and theories, though there is some current work on federating particular tools[6], in part based on the notion of a World Wide Argument Web (WWAW) [104].

Federation usually increases the usefulness of filtering, based either on particular criteria (i.e. arguments one hasn't heard before, or arguments that counter

[1] `http://wiki.idebate.org/`
[2] `http://www.livingvote.org/`
[3] `http://debategraph.org/`
[4] `http://www.climatecollaboratorium.org/`
[5] `http://cohere.open.ac.uk/`
[6] Jack Park's in-progress Ph.D. work [95] is in part on federating Compendium, Debategraph, Cohere, and Deliberatorium.

one's own) or based on the credibility of the source. This leads to some related questions regarding success criteria of the WWAW and its vulnerabilities to bad actors: What actions and motivations are necessary for the success of the WWAW? What impact can bad actors have? For example, systems such as the Dispute Finder [40, 41] rely on annotation of arguments by activists who want to inform or convince others; bad actors could mark credible statements as not credible (causing users to suspect the usefulness of the system) or fail to mark not credible statements (limiting its usefulness). For instance, systems such as the Deliberatorium which incorporate collaborative editing, must take safeguards against misuse. A video introduction[7] to the Deliberatorium explains that others' arguments may be edited to strengthen them, and concedes that the system is vulnerable to bad actors; a moderation system (by which proposals are not publicly viewable until moderated) is used to limit their impact.

A further challenge is that argumentation on the Web supports a variety of different activities. Systems for negotiation support and decision support may already have adequate boundaries, without finding an obvious benefit from federation. Further, some methodologies for argumentation, for instance dialogue mapping, or human mediation, rely on the presence and participation of a neutral third party. What are the limitations of the WWAW for argumentative discourse? Are all types of argumentative discourse suitable for the WWAW approach, or do some types of discourse, such as negotiation absolutely require dedicated support?

Furthermore, how can we tell when two sources are talking about the same topic, if they do not use unique identifiers or do not directly respond *to* each other? Especially, how can we tell when a hypothesis has been refuted, especially in unsettled and ongoing debates?

9.1.2 Environments for Argument Detection and Refinement

On the Social Web, humans have little incentive to classify their statements and arguments. Therefore, we believe that arguments must be machine-identified. What approaches can be brought to bear on argument identification? How can arguments be identified, and what approaches and algorithms should be used? Can methods for automatic argumentation detection be [139, 93, 92] modified for the Social Web?

Even once arguments are identified automatically, the identification may need to be refined or corrected by humans. How can we provide an argument ecosystem allowing humans and machines to collaborate on argument identification and argumentation?

Incremental Formalization, Implicit Argumentation, & Task-specificity

Authors may wish to explicitly mark their argumentation, however this can be a tedious process. In the past, incremental formalization and leveraging of existing (e.g. visual and rhetorical) structures have been useful for supporting similar processes. What sort of environment will promote these?

Fragmentation comes in part because there are many task-based tools and environments. In 'Formality considered harmful' [127], Shipman & Marshall

[7] `http://www.youtube.com/watch?v=k2w2WBCn7ug`

provide insight into why there are so many different task-specific tools: users "find it very difficult to formalize knowledge as they are generating or producing it." Task-based systems help to some extent, because tasks, individual choice, and group norms affect the way we communicate. Even though software has been based on good models which faithfully descriptive models of informal communications, people cannot readily abstract away from the content, and they "are hesitant about formalization because of a fear of prematurely committing to a specific perspective on their tasks". Overall, formalism provides an overhead which can be difficult for users.

As the title of that paper ('Formality considered harmful') suggests, they also address various problems about making arguments explicit: "First, people aren't always able to chunk intertwined ideas; we have observed, for example, positions with arguments embedded in them. Second, people seldom agree on how information can be classified and related in this general scheme; what one person thinks is an argument may be an issue to someone else.

Shipman & Marshall present three approaches that they say mitigate these problems around formalization: use domain-oriented knowledge-acquisition tools, allow end-user modifiability, use question-answering interfaces.

A further problem with formalization is that the deeper we dig into a topic, the more related terms there are which may require formal expression. "A knowledge item might be required but not yet have been conceptualized or formalized. An existing knowledge item might be hard to understand or consist of wrong facts; redundancies with other knowledge items might have been identified, or a subpart of one knowledge item might considered to deal with a topic of special interest, deserving to be promoted to a knowledge item of its own." [69]

Furthermore, depending on the task, argumentation may be inherent, but the kind of argumentation varies with respect to subjectivity. As [69] explains, blog posts generally contain opinions which are personal interpretations of reality; on the other hand the opinions expressed by a bug tracking system may be seen as having objective reality (despite irreproducible issues), since they can be tested.

9.2 Future Work

Based on our initial review of argumentation on the Social Semantic Web, we are investigating mappings between AIF and common Social Web ontologies such as FOAF and SIOC. Following our COMMA paper, we are evaluating and ranking requirements for argumentation on the Social Semantic Web. Our more comprehensive review will draw from this report and from our COMMA paper, filling in with further details about particular tools and methodologies.

We are also refining the definition of argumentation as well as refining use cases for argumentation on the Social Semantic Web, in part to delineate argumentation on the Social Semantic Web from related areas such as opinion mining, question answering, sentiment analysis, information credibility, decision support, and negotiation support.

Further, we are investigating techniques for automatic argumentation detection, to apply to Wikipedia discussions or other Social Web discussion venues.

Chapter 10

Conclusion & Acknowledgements

10.1 Conclusion

We have defined argumentation for the Social Semantic Web, reviewed the state of the art of the Social Semantic Web and computational argumentation, both separately and together, and described the progress we have thus far made in this field. We have also outlined related areas with theory or machinery that may be of use for advancing the state of the art of argumentation in the Social Semantic Web.

We have identified two main driving research questions, regarding the decentralization of argumentation and the identification of arguments. Further, we have discussed areas of future work, including requirements, use cases, and a refined definition for argumentation, mappings between Social Semantic Web and argumentation ontologies, and areas where automatic argumentation detection could be applied.

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