Frithjof Dau
Marie-Laure Mugnier
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Conceptual Structures: Common Semantics for Sharing Knowledge

13th International Conference on Conceptual Structures, ICCS 2005
Kassel, Germany, July 2005
Proceedings

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Proceedings

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Preface

The 13th International Conference on Conceptual Structures (ICCS 2005) was held in Kassel, Germany, during July 17–22, 2005. Information about the conference can be found at `http://www.kde.cs.uni-kassel.de/conf/iccs05`.

The title of this year's conference, "Common Semantics for Sharing Knowledge", was chosen to emphasize on the one hand the overall aim of any knowledge representation formalism, to support the sharing of knowledge, and on the other hand the importance of a common semantics to avoid distortion of the meaning. We understand that both aspects are of equal importance for a successful future of the research area of conceptual structures. We are thus happy that the papers presented at ICCS 2005 addressed both applications and theoretical foundations.

"Sharing knowledge" can also be understood in a separate sense. Thanks to the German Research Foundation, DFG, we were able to invite nine internationally renowned researchers from adjacent research areas. We had stimulating presentations and lively discussions, with bidirectional knowledge sharing. Eventually the ground can be laid for establishing common semantics between the respective theories.

This year, 66 papers were submitted, from which 22 were selected to be included in this volume. In addition, the first nine papers present the invited talks. We wish to express our appreciation to all the authors of submitted papers, to the members of the Editorial Board and the Program Committee, and to the external reviewers for making ICCS 2005 a valuable contribution to the knowledge processing research field.

July 2005

Frithjof Dau
Marie-Laure Mugnier
Gerd Stumme

Organization

The International Conference on Conceptual Structures (ICCS) is the annual conference and principal research forum in the theory and practice of conceptual structures. Previous ICCS conferences were held at the Université Laval (Quebec City, 1993), at the University of Maryland (1994), at the University of California (Santa Cruz, 1995), in Sydney (1996), at the University of Washington (Seattle, 1997), at the University of Montpellier (1998), at Virginia Tech (Blacksburg, 1999), at Darmstadt University of Technology (2000), at Stanford University (2001), in Borovets, Bulgaria (2002), at Dresden University of Technology (2003), and at the University of Alabama (Huntsville, 2004).

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Knowledge Engineering and Tools

Knowledge Acquisition and Ontologies

Patterns for the Pragmatic Web

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Abstract. The Semantic Web is a significant improvement of the original World Wide Web. It models shared meanings with ontologies, and uses these to provide many different kinds of web services. However, shared meaning is not enough. If the Semantic Web is to have an impact in the real world, with its multiple, changing, and imperfect sources of meaning, adequately modeling context is essential. Context of use is the focus of the Pragmatic Web and is all-important to deal with issues like information overload and relevance of information. Still, great confusion remains about how to model context and which role it should play in the Pragmatic Web. We propose an approach to put ontologies in context by using pragmatic patterns in meaning negotiation processes, among other meaning evolution processes. It then becomes possible to better deal with partial, contradicting, and evolving ontologies. Such an approach can help address some of the complexities experienced in many current ontology engineering efforts.

1. Introduction

The World Wide Web has profoundly changed the way people collaborate. Whereas e-mail has lowered the threshold for interpersonal communication by providing a medium for fast, cheap, ubiquitous and global communication, the Web has become the metaphor and technology for doing the same with respect to linking and sharing knowledge resources. Even for the computing community, used to fast technological progress, the speed with which the Web has evolved from initial prototype to a foundation of daily life has been dazzling. It was only in 1991 that the following was announced by a then unknown employee from CERN:

> "The WorldWideWeb application is now available as an alpha release in source and binary form from info.cern.ch. WorldWideWeb is a hypertext browser/editor which allows one to read information from local files and remote servers. It allows hypertext links to be made and traversed, and also remote indexes to be interrogated for lists of useful documents. Local files may be edited, and links made from areas of text to other files, remote files, remote indexes, remote index searches, internet news groups and articles ... This project is experimental and of course comes without any warranty whatsoever. However, *it could start a revolution in information access* [my italics]"[1].

The rest, as they say, is history.

[1] Tim Berners-Lee, *comp.sys.next.announce* newsgroup, Aug.19, 1991.

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The rise of the World Wide Web has led to many benefits to society. Documents, news, and results to queries can be obtained 24 hours a day from all over the world. The Web has given a huge boost to research, education, commerce and even politics. An interesting example of how deeply the Web has become embedded in the fabric of our globalizing society is the significant role web sites play in political reforms in less-than-democratic countries [17]. Still, not all is good. One serious consequence of the explosion of Web-accessible information resources is information overload. It is not uncommon to get hundreds, thousands, or even millions of hits when looking for a certain piece of information. Increasingly, the problem shifts from making information accessible, to delivering *relevant* information to the user.

The Semantic Web plays an important role in making the Web more relevant. Berners-Lee, et al. [1] present a cogent view of how the Semantic Web will structure meaningful content and add logic to the Web. In this web, data and rules for reasoning about data are systematically described, after which they can be shared and used by distributed agents. Granted, many of the basic theoretical ideas were already conceived by the AI community in the 1970s and 80s. The added value of the Semantic Web, however, is that this theory is finally being put into large scale-practice. The main components implementing this Web vision include techniques such as XML, for adding arbitrary structures to documents; RDF, to express meaning by simple statements about things having properties with values; and ontologies, to formally describe concepts and their relations. A typical ontology, in the sense of being an explicit specification of a conceptualization [10], consists of a taxonomy with a set of inference rules. Ontologies can be used to improve the accuracy of, for instance, Web search and service discovery processes. Ultimately, such an approach should lead to the evolution of human knowledge by scaling up collaboration from individual efforts to large, joint endeavors. Multiple ontologies then come into play. By selecting the right ontology for the right task, knowledge exchange, at least in theory, could become more effective and efficient.

In practice, however, the Semantic Web comes with its own set of problems. Voices are increasingly being heard that there is a need not only for explicitly taking into account the semantics, but also the pragmatics of the Web, e.g. [25,26,13,7,29,22]. Still, ideas and proposals are preliminary and sketchy and need further elaboration and integration. With this paper, we hope to contribute to the further maturation of thought on this important subject. We have two main objectives: finding out (1) what are fundamental conceptual elements of the Pragmatic Web and (2) how to use these elements in making meaning represented in semantic resources more relevant. In Sect. 2, we outline some contours of the Pragmatic Web that are becoming visible at the moment. This analysis results in a conceptual model of the Web in Sect. 3, outlining how the Semantic and the Pragmatic Web are interrelated. In Sect. 4, we focus on pragmatic patterns as a way to operationalize the pragmatics of the Web. In Sect. 5, we present a scenario of how a Pragmatic Web could look in practice. We end the paper with a discussion and conclusion.

2. Contours of the Pragmatic Web

The Semantic Web, with all its (potential) benefits, still poses a number of difficult challenges, both with respect to the ontologies which contain the shared meanings and the services in which these are used.

Unlike data models, ontologies contain relatively generic knowledge that can be reused by different kinds of applications. Ontologies should therefore not be too tightly linked to a specific purpose or user group [30]. To select the right (parts of) ontologies, the communicative situation needs to be taken into account. To this purpose, a "mindshaking procedure" needs to be developed, in which a formal language for information exchange is determined (syntax), and a synchronisation of the meaning of concepts (semantics) takes place on the basis of a particular context, such as purpose, time, date, or profile [29]. An example of a (typically) manual version of such a procedure is described in [9]. There, a conceptual model supervisor regularly creates reports of existing classes. If concepts seem to be in conflict, and the conflicts are important enough, the model supervisor starts and controls a discussion among stakeholders, who can be either modelers or representatives from the involved departments. If the conflict remains unresolved, both concepts remain in the model marked with their own namespaces.

Ontologies are not an end in themselves. One of the major functions of the Semantic Web is to provide access to web services. These are often described and invoked through central registries. However, for describing, discovering, and composing web services, a semantic approach is not enough. Services cannot be described independently of how they are used, because communities of practice use services in novel, unexpected ways. Social mechanisms are therefore needed for evaluating and discovering trustworthy providers and consumers of services, taking into account contexts and interactions in the composition of service applications [25-26].

Clearly it is not sufficient to model semantics to resolve such issues related to the use of ontologies. Contextual elements like the community of use, its objectives and communicative interactions are important starting points for conceptualizing the pragmatic layer. These elements are combined in a conceptualist perspective. In such a view, meanings are elements of the internal cognitive structures of language users, while in communication, the conceptual structures of different views become attuned to each other [13]. We can therefore make a distinction among shared semantic resources, such as ontologies; individual pragmatic resources, i.e. the internal conceptual models of users applying the semantic resources to their own purposes; and common pragmatic resources, in which joint *relevant* meanings have been established through communication. In communication between users aiming at achieving joint objectives, concepts that are part of individual and common pragmatic resources are selected, defined, aligned, and used. Finding out how such a meaning negotiation process works is essential to understanding the pragmatics of the Web, and to developing (partially) automated support processes for meaning negotiation.

Developing sound and complete pragmatic perspectives, models, and methods can shed light on the confusing debates raging in the ontology and Semantic Web research communities. One fundamental question, for example, is whether the way to

go is to develop large, detailed, standard ontologies such as Cyc[2] or myriad independent, domain-specific, micro-ontologies, one for each application. The answer is not either/or, but a mix of both approaches. A major reason why such a hybrid point of view cannot be easily adopted and defended, is that the real issues underlying these debates are not semantic, but pragmatic. The focus of many of these debates has thus been the wrong one, without the ontological engineering community making any significant progress on resolving the underlying issues.

Before further examining the Pragmatic Web, we first take a closer look at some of the finer details of pragmatics.

2.1 A Primer of Pragmatics

A traditional source of problems, often found in traditional conceptual modelling approaches, is to try and produce THE description of a joint reality. If members of a particular community disagree, the modellers, in the best case, keep negotiating explicit meanings until everybody agrees. If no agreement can be reached (or is not even sought) modellers often impose a meaning by choosing an ontology definition or system specification themselves.

A pragmatic approach, on the other hand, should allow for contradictions, different importance weights of information and subtle cultural differences [9]. Such differences, however, create problems of their own if not handled properly. Collaboration often fails, not because participants do not want to collaborate, but because pragmatic errors lead to the breakdown of the social and contextual components of a discourse [14]. To become successful, a pragmatic approach thus needs to acknowledge and adequately handle ambiguity and consequences of (differences in) semantics.

Facts only get their 'ultimate meaning' in their human context of use, and are always ambiguous. Such *ambiguities* are about shades of differences in meaning. The extent to and way in which ambiguities need to be resolved, depend on the context, including the points of view of the communicating agents, i.e. utterer and interlocutor, their common understanding of each other, and their (partially) shared goals [18].

But how to decide which ambiguities need to be resolved? A semantic approach, even when accepting different sources of meaning (i.e., ontologies), does not explicitly acknowledge the *consequences* of semantic choices. A pragmatic approach, on the other hand, assumes there are always conditions of difference, dependence, and novelty, and recognizes the need for an overall process for transforming existing knowledge to deal with negative consequences for community members [3]. We would argue that, in addition, the community should also examine the *positive* consequences, such as opportunities for action.

In a pragmatic approach, control over representation should shift from the information producer to the information consumer [22]. More precisely, we think control over how to *use* meaning representations should shift to the user, from which controlling representations follows.

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[2] http://www.cyc.com/

The need to accept a necessary amount of ambiguity by communities of users assessing the consequences of semantic choices in a particular pragmatic context, implies that there needs to be some user-controlled *selection* process of semantic representations. In such a process, members of the community, using the knowledge for a particular purpose, are actively involved, and aim to reach agreement only on *relevant* knowledge issues. Pragmatically established changes in the implicit meaning of representations should in the end also lead to changes the *representation* of those meanings in ontologies. For instance, if users always ask for concepts that are not, or only insufficiently, described in an ontology, it may be worthwhile to add this concept to the ontology. Meaning selection and representation processes, however, do not occur in isolation, but are driven by a meaning *negotiation* process in a specific community of users. In such a process, stakeholders arrive at the requisite (as determined by their shared goals) amount of agreement on shared concepts.

3. A Conceptual Model of the Web

Summarizing the previous discussion, we consider 'The Web' to consist of a Syntactic, a Semantic, and a Pragmatic web (Fig.1).

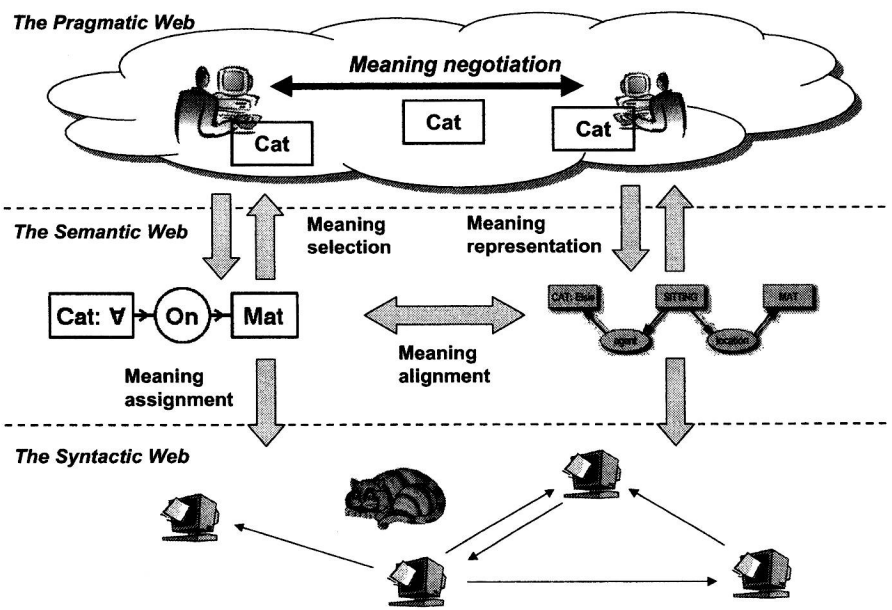

Fig. 1. A Conceptual Model of 'The Web'

The *Syntactic Web* consists of interrelated syntactic information resources, such as documents and web pages linked by HTML references. These resources describe many different domains.