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The Conceptual Web – our research vision.

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Abstract

We present a vision of an extension of the emerging semantic web into what we call a *Conceptual Web*, where the semantics is not only machine-understandable, but also available for the user in an appealing form, which creates substantial benefits in terms of overview and clarity. We are using visual modeling in UML and a technique called *conceptual browsing* to present the conceptual web to the user. This construction lives on top of the ordinary semantic web and thus shares the advantages of RDF, such as distributivity and scalability.

1 Introduction

The stated goal of the semantic web is to enable machine understanding of web resources: "One of the major obstacles [...] has been the fact that most information on the Web is designed for human consumption [...] the structure of the data is not evident to a robot browsing the web"[1]. The rationale behind this goal has been that deriving meaning from contemporary HTML or other web resources is nearly impossible due to the lack of a common meta-data framework for describing resources. In fact, most resource descriptions today are in the form of HTML text in a containing document. While such semantic descriptions are meaningful only to the human reader, the semantic web will provide such descriptions in machine readable format.

2 Conceptual (un)clarity on the Web

However, it is not at all evident that such machine readable semantic information will be clear and effective for human interpretation. The hyper-linked structure of the web presents the user with a totally fluid and dynamic relationship between context and content, which makes it hard to get an overview of the conceptual context within which the information is presented. As soon as you click on a hyperlink, you are transferred, helplessly, to a new and often unfamiliar context. This results in the all too well-known "surfing-sickness" on the web, that could be summarized as "Within what context am I viewing this, and how did I get here?" The conclusion we draw is that *extracting usable meaning from web pages is often as difficult for a human reader as it is for a machine.* This strongly suggests that there is a need for a human-understandable semantics for web resources as well.

This form of semantics becomes even more important within the emerging field of e-learning. In a learning context, the conceptual structure of the content is an essential part of the learning material. Losing the contextual information of the content means more than just "surfing-sickness". It means that you will not be able to contextually integrate the concepts that you are trying to learn, which is vitally important in order to achieve an understanding of any specific subject area.

The semantic web initiative, as it looks today, does not provide such a semantics. It provides descriptions of web resources, but no way to present them to the user in a contextually clear way. There are initiatives, such as topic navigation and visual history browsers, that try to address this problem, but they fail miserably in giving the necessary overview of the conceptual context.

3 The Conceptual Web

In order to solve this problem, we are working on ideas to extend the semantic web in order to provide not only semantic information for the machine, but also conceptual information for the human user. This form of extended semantic web, which we call the *Conceptual Web*, is a long-term vision with many parts:

- **RDF and RDF Schema** provide the underlying model and representation. We also use standard RDF vocabularies such as Dublin Core and IMS/IEEE LOM (the RDF binding available in IMS metadata 1.2[2] was constructed by us). The addition of ontology layers such as OIL[3] is of course also a fundamental part of resource description on the web.

[*] `http://cid.nada.kth.se/il`
[1] `http://www.w3.org/DesignIssues/Semantic.html`
[2] `http://www.imsproject.org/metadata`
[3] See `http://www.ontoknowledge.org/oil`

- We will participate in the upcoming **Edutella** effort[4], which aims to produce a distributed meta-data network to serve as an underlying meta-data infrastructure for (primarily educational) applications. Edutella will provide standardized access to distributed meta-data query and search facilities with reasoning capabilities, an important part of a fully-functioning semantic web[5].

- The fundamental building block of the conceptual web is **conceptual modeling**, which provides a human-understandable semantics for both abstract ideas and concrete resources. We use the Unified Modeling Language (UML) for conceptual modeling, which provides a well-proven and standardized vocabulary for this purpose. Unfortunately, the relationship between RDF and UML is still rather unclear[6]. We strongly support the forces that try to refactor UML in order to achieve a more precise meta-model[7], as well as the efforts to merge/combine RDF and UML[8]. We regard these strategic efforts as necessary prerequisites for building the Conceptual Web.

- Using the above technologies, we are designing the Conceptual Web as a ***knowledge manifold***[9]. A knowledge manifold is an educational architecture, developed at CID, that provides an overall strategy for the construction, management and use of well-defined contexts for distributed content.

- One of the fundamental tools of the conceptual web is a new type of knowledge management tool which we call a ***concept browser***[10].This tool allows the user to browse conceptual contexts in the form of concept maps (typically UML diagrams) with rich annotations. Thus the full power of visual modeling is combined with the distributivity and universal annotation property of RDF into a hyper-linked web of conceptually clear material. This combination gives the user a clear overview of the subject area (= context), while at the same time allowing the exploration of its various forms of content. Incorporating web resources as content is done similarly to ISO Topic Maps[11], or the Conceptual Open Hypermedia system[12], in that content is linked to concepts in the conceptual web, with the important added benefit of a clear and browsable visual overview of the context. Combined with our form of visually configurable query/search/filter engines this results in a new and revolutionary web experience.

  Our first incarnation of a concept browser is called **CONZILLA**[13], and has been developed as an open source project at CID over the last three years. It is proving to be a very valuable tool for providing an overview of complex web-based material. Using Conzilla, several instances of knowledge manifolds are presently under construction at CID, e.g. within the fields of mathematics, e-adminstration, IT-standardization and interoperability between different systems for e-commerce[14]. Conzilla also has the potential to become a very useful and visually pleasing presentation tool for any kind of RDF data.

- An added benefit of using the semantic web as a basis for the conceptual web is **application-independence**. Just as the semantic web gives the machine (software agents and applications alike) a sort of "sixth sense" about the meaning of web resources, the conceptual web gives the human user a sixth sense about the conceptual context and the underlying meaning of the current situation, which is independent of the currently used application. We are therefore studying ways to introduce the conceptual web into other environments. Apart from their usage on the ordinary web, we are investigating the fascinating possibility of introducing conceptual structures in **3D environments**. A 3D environment filled with semantics and conceptual structures would present a fundamentally different experience, enabling for the first time a virtual reality full of meaning, and not only packed with dead 3D objects whose meaning is defined by the graphics engine. This semantics could even be accessed from outside such an environment, making the 3D environment fully transparent.

4 Conclusions

The Conceptual Web is a powerful idea which has yet to become a reality. However, several of the important tools and technologies already exist. The remaining obstacles include a fully working semantic web infrastructure with mature vocabularies and tools as well as the availability of conceptual modeling constructs on top of the semantic web, which would be enabled by the UML/ RDF vocabulary.

[4] a collaboration between Stanford Infolab, CID and KBS in Hannover, within the Wallenberg Global Learning Network.
[5] A sort of Semantic Web Bus, see `http://www.technetcast.com/tnc_play_stream.html?stream_id=459`
[6] See `http://www.w3.org/TR/NOTE-rdf-uml/`
[7] See `http://www.cs.york.ac.uk/puml/`
[8] See `http://www-db.stanford.edu/~melnik/rdf/uml/`, `http://jodi.ecs.soton.ac.uk/Articles/v01/i08/Cranefield/`.
[9] See `http://cid.nada.kth.se/pdf/cid_52.pdf` and `http://cid.nada.kth.se/pdf/cid_17.pdf`
[10] Described in `http://cid.nada.kth.se/pdf/cid_52.pdf`
[11] See `http://www.topicmaps.net/`
[12] See `http://inanna.ecs.soton.ac.uk/cohse/`
[13] See `http://www.conzilla.org/`
[14] See `http://www.cenorm.be/isss/Workshop/ec/Projects.htm#ECIMF`