Dynamic Linking and Personalization on the Web using Linked Open Data

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ABSTRACT

This paper presents a novel Semantic Web browser, called SemWeB. SemWeB supports Web browsing using Linked Open Data and personalization. This is the first time a Semantic Web browser combines the advances in Adaptive Hypermedia (i.e. personalization) and Linked Open Data. In particular, users are provided with a personalized and semantically rich Web browsing experience. For example, SemWeB supplies goal-based adaptive information retrieval from the LOD, adaptive link recommendation using a novel semantic relatedness measure and adaptive content creation. A user based study was used to assess the value of LOD-based hyperlinks and personally relevant content compared with a standard Web browser (Firefox). Results showed that users were able to browse and view more relevant information, as well as, value significance of LOD-based hyperlinks and personalized content in comparison to a standard Web browser.

Keywords: Adaptive Hypermedia, Linked Open Data, Personalization, Semantic Annotation, Semantic Hyperlinks, Semantic Web, Semantic Web Browser, User Modeling

1. INTRODUCTION

Hyperlinks allow us to navigate the document space of the WWW. However, WWW hyperlinks suffer from limitations such as the embedded and point-to-point nature of the links and their uni-directionality. In addition, these hyperlinks do not provide semantic information about what type of relationships exist between the inter-connected documents. As a result, navigation relies on explicitly defined hyperlinks by the content authors, which may not be sufficient to browse the Web efficiently. Furthermore, as the complexity and heterogeneity of the network grows, the simple node-link model of the WWW does not provide a practical orientation on the unstructured information space. Very often users need further assistance during Web browsing. Web browsing is a complex activity and it is difficult to provide guidance using unstructured data. The Semantic Web is a potential solution to this problem. For instance, the context of a

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Web page can be understood by annotating it with ontology concepts, concept instances or instance relationships. Users can then be guided to relevant Web pages using ontology-based hyperlinks.

Several Semantic Web browsers have been proposed to assist Web browsing with ontology-based hyperlinks and content such as COHSE (Carr et al., 2001), Magpie (Dzbor et al., 2007), PowerMagpie (Gridinoc et al., 2008), Haystack (Quan & Karger, 2004), PiggyBank (Huyhn et al., 2005) and KIM (Kiryakov et al., 2004). Some of these browsers utilize specially created ontologies and metadata (e.g. MagPie, KIM) for the creation of hyperlinks. Most recent approaches, such as PowerMagpie, use the LOD as the source of ontology-based hyperlinks. In our approach, we also exploit LOD since it provides interconnected and vast semantic knowledge about different domains. In order to use LOD, first we pre-process LOD datasets so that resource labels (i.e. lexicons) and URLs can be extracted for semantic annotation.

On the other hand, with the growing data, adaptation of hyperlinks and content to individual needs is becoming more important. Currently, personalization is a popular research topic and commercial interest (e.g. Google, Amazon). However, none of the existing Semantic Web browsers support personalization. It is our conjecture that the semantic information presented would be more useful if it is tailored to the needs of individual users (i.e. the user’s goals, interests and preferences). Therefore, we introduce a personalization framework into our Semantic Web browser, which personalizes LOD-based information and content based on user needs. To achieve this, we incorporate Adaptive Hypermedia (AH) methods and techniques in our system. In particular, AH aims to answer the “lost in hyperspace” syndrome (Conklin, 1987) where the user has normally too many links to choose from and does not know how to proceed/ select the most appropriate ones. AH offers a selection of personalized links or content most appropriate to the user (Brusilovsky, 2001) using a user model. Therefore, in our approach, first we introduce a novel user model ontology to represent the user’s browsing needs such as browsing interests, browsing goals, browsing behavior and expertise. Then, we develop a set of adaptation rules and a generic adaptation framework for the personalization of the content based on the user model. In particular, we introduce a novel semantic relatedness measure for link recommendation.

1.1. Related Work

COHSE (Carr et al., 2001), Magpie (Dzbor et al., 2007), PowerMagpie (Gridinoc et al., 2008), Haystack (Quan and Karger, 2004), PiggyBank (Huyhn et al., 2005) and KIM (Kiryakov et al., 2004) are related Semantic Web browsers that have been proposed to assist Web browsing with ontology-based hyperlinks and content. COHSE, Magpie and Kim use pre-defined ontologies and an ontology-driven lexicon (i.e. labels/titles of instances) to add links to arbitrary Web pages. They then utilize ontology-based hyperlinks to support browsing. Magpie also allows tracking of the user’s browsing history, which can trigger semantic services to present inferred knowledge about semantic content. However, none of these approaches provide any personalization. Haystack and PiggyBank follow a slightly different approach. They use screen scrapers to extract and store metadata from the browsed Web pages. This accumulated semantic data is presented out of context with different visualization interfaces. Haystack provides browse, debug and all information views. PowerMagpie finds occurrences of LOD instances and classes on the Web page using the Watson search engine (Watson, 2008). Then, links to relevant LOD instances are presented. However, the amount of information shown to users can again be too much since users cannot control datasets. Although the approaches presented above use different architectures and ontologies, their aim is to support browsing with ontology-based information. However, none of them support adaptation. It is our conjecture that the semantic information presented would be more useful if it is tailored to the different needs of users (i.e. the user’s goals, interests...
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