Chapter 14
An Associative and Adaptive Network Model For Information Retrieval In The Semantic Web

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ABSTRACT

While it is agreed that semantic enrichment of resources would lead to better search results, at present the low coverage of resources on the web with semantic information presents a major hurdle in realizing the vision of search on the Semantic Web. To address this problem, this chapter investigates how to improve retrieval performance in settings where resources are sparsely annotated with semantic information. Techniques from soft computing are employed to find relevant material that was not originally annotated with the concepts used in a query. The authors present an associative retrieval model for the Semantic Web and evaluate if and to which extent the use of associative retrieval techniques increases retrieval performance. In addition, the authors present recent work on adapting the network structure based on relevance feedback by the user to further improve retrieval effectiveness. The evaluation of new retrieval paradigms - such as retrieval based on technology for the Semantic Web - presents an additional challenge since no off-the-shelf test corpora exist. Hence, this chapter gives a detailed description of the approach taken to evaluate the information retrieval service the authors have built.

INTRODUCTION

It is largely agreed that the semantic enrichment of resources provides for more information that can be used for search (see e.g. (Heflin & Hendler, 2000) or (Spärck Jones, 2004)). In turn, this can lead to greatly improved effectiveness of retrieval systems, not only for resources on the web but also for personal desktops. However, critics (McCool, 2005) as well as advocates (Sabou, d'Aquin, & Motta, 2006) of the Semantic Web agree that only a small fraction of resources on the current web are enriched with semantic information. The sparse annotation of resources with semantic information presents a major obstacle in realizing search applications for the Semantic Web that operate on semantically enriched resources. To overcome this problem, we propose the use of techniques from soft computing in order to find relevant resources, even if no semantic information is provided for those resources.

The main idea of our approach is to perform associative search using spreading activation in a two layer network structure (graphically illustrated in Figure 1) which consists of (1) a layer of concepts, used to semantically annotate a pool of resources, and (2) a layer of resources (documents). The combination of spreading activation in both layers, traditionally performed either to find similar concepts or to find similar text, allows a search to be extended to a wider network of concepts and resources, which can lead to the retrieval of relevant resources with no annotation.

In this chapter we describe our approach towards information retrieval in the Semantic Web and present a retrieval service. The rest of this chapter is organized as follows: in section *Terminology and Related Work* we introduce the main concepts of Associative Information Retrieval, Associative Networks and Spreading Activation that underlie our approach to retrieval and examine related work. In section *An Associative Information Retrieval Model for the Semantic Web*, we describe the retrieval model, which was developed based on techniques from soft computing. In section *Application of the Retrieval Model within APOSDLE* we present the setting in which a retrieval service based on our retrieval model was realized. In section *Parametrization of the Retrieval Model* we describe which measures where used to parameterize the retrieval model. In section *Evaluation* we focus on the evaluation of the retrieval service. In section *Parameter Learning using Relevance Feedback* we present work on adapting the network structure based on relevance feedback by the user. We end the chapter with Conclusions and Future Work.

This invited book chapter contains work already published in (Scheir et al. 2008). In section *Parameter Learning using Relevance Feedback* we present recent – not yet published - research. Certainly this new aspects need to be better integrated in future versions of the retrieval model.

TERMINOLOGY AND RELATED WORK

The work presented in this chapter provides a retrieval model for the Semantic Web and an implementation of an associative retrieval service based on this model. In this section we briefly introduce the important terms underlying our work: Associative Information Retrieval, Associative Networks and Spreading Activation. Furthermore we briefly discuss other approaches to information retrieval in the Semantic Web and systems. In particular we review the efforts that have used the same or similar soft computing techniques.

Terminology

Associative (Information) Retrieval: Crestani (1997) understands associative retrieval as a form of information retrieval, which tries to find relevant information by retrieving information that is by some means associated with information that is already known to be relevant. Information items

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