

Chapter 17

Developing Semantic Web Applications

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ABSTRACT

Semantic Web promises to make the content on World Wide Web machine understandable, thus enabling creation of an agent based web where automated programs can accomplish a variety of tasks that involve interpretation of the content and are not possible with existing web technologies. As Semantic Web technologies are being adopted by the industry at a rapid place, there is the need to develop awareness among developer community about components of typical Semantic Web applications and principles driving the design of these components. This chapter gives a brief introduction to the Semantic Web and components common to all Semantic Web applications. The common components include ontology development, content annotation, and information extraction using reasoning. Basic design principles and available alternative choices are highlighted for ontology construction and content annotation. Reasoning component is not discussed because stable reasoners are available such as RACER, FaCT++ and Pallet and any Semantic Web application can make use of them without having to reinvent the wheel. A running example is used to enhance understandability of the concepts described.

INTRODUCTION

Semantic web was proposed by Tim Berners Lee about a decade ago with the objective of making content on World Wide Web machine understandable. According to W3C (World Wide Web Consortium):

The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.

As the semantic web technologies can help to formally describe any content, these tools and techniques have been widely used in a number

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of domains to support description and automatic discovery of the content. Semantic search is one of the key applications of these technologies that can help in knowledge discovery, extraction, and management (Ilyas 2004(a), (b)). Some of other interesting applications of semantic web include e-government (Magoutas 2010), healthcare (Thuay 2012), e-learning (Barros 2011), contextual advertising (Khan 2009), business process reengineering (Damjanović 2010), web service description and discovery (Talib 2006) and disaster management (Ilyas 2010, Ahmed 2012).

The first section of the chapter gives a brief introduction to semantic web technologies by highlighting shortcomings of existing web technologies and how semantic web promises to overcome them. Architecture of a typical semantic web application is presented and key components of a typical semantic web application are described. Ontologies are backbone of all semantic web applications that provide common understanding of a domain of interest. The most common approaches for ontology development include manual ontology construction and semi-automatic development. Both approaches are discussed with basic design principles and methods/technologies used for each choice. Content annotation is the next phase in ontology development that involves creating link between the text and domain description in the form of ontologies. Both manual and semi-automatic content annotation methodologies are discussed. Finally, a typical application is shown to describe how an application can make use of these technologies for better information extraction. The chapter is closed with further readings and conclusions.

BACKGROUND

Almost a decade ago, Sir Tim Berners Lee clarified to the whole world that existing World Wide Web is not an implementation of what he had actually

conceived about this giant source of information and communication. A significant component of this huge network of networks was relationships among resources on this network but somehow they were completely missed and replaced with simple hyperlinks. These hyperlinks connect these resources but they do not possess/express the relationship between these resources. These relationships could play a vital role in expressing the contextual information about these resources and this contextual information could be used in many ways for machine understandability of content. Consider web pages shown in Figure 1 that display information about a faculty member Dr Qazi Mudasar Ilyas who works at King Faisal University and teaches System Analysis and Design. The web page of Dr Ilyas (<http://www.mudassar-ilyas.info>) contains links to the university homepage (<http://www.kfu.edu.sa>) and the course homepage (<http://www.kfu.edu.sa/ccsit/courses/sad.html>) but these links are merely a way to point to these resources without any hint of giving the following description and relationship between the resources:

- Dr Ilyas is an *assistant professor*
- King Faisal University is an *educational institute*
- Dr Ilyas *works at* King Faisal University
- System Analysis and Design is a *course*
- King Faisal University *offers* System Analysis and Design
- Dr Ilyas *teaches* System Analysis and Design

What impact this missing information has and what could be possible if we had this background information available on the Web? Consider information searching, a very common task performed by every user of the Web. We use search engines for this task. If someone is looking for information about academic staff in King Faisal University and gives “academic staff” and “King Faisal Uni-

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