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Preface

Introduction

The Semantic Web vision of the World Wide Web Consortium (W3C) is comprised of four primary components: (1) expressing meaning, (2) knowledge representation, (3) ontology, and (4) agents. Expression of meaning is fundamental to the construction of the new "intelligent" Web. The current Web lacks mechanisms for expressing meaning and is therefore static. Knowledge representation provides the mechanism that allows meaning to be expressed in structured format allowing inference mechanism to be applied to arrive at useful conclusions. To make knowledge representation both meaningful and practical, the "meaning" behind the "data" has to be "shared." This can be accomplished using ontologies. Ontology refers to a shared vocabulary of some concept. The premise is that if the vocabulary is shared regarding a concept then the meaning behind the concept becomes apparent among those sharing the vocabulary. Once the ontology has been agreed upon by a community and if the ontology can then be captured in machine-readable form using resource description framework (RDF), RDF schema (RDFS), or Web ontology language (OWL) then software agents can be used to "reason" with the knowledge represented and captured using that ontology. There may be many such ontologies in use but by using a global standard such as OWL from the W3C, it is possible to create many ontologies which are interoperable—therefore amenable—to machine reasoning by software agents.

In this knowledge-based economy, businesses succeed or fail based on how well they are able to share knowledge and information to effectively respond to the changing demands in the marketplace. Semantic Web technology brings to the business world a set of tools that will help in the development of meaningful shared vocabulary or ontologies leading to standardization of terms and concepts related to the descriptions of products, processes, and coordination mechanisms both within and across enterprises. This will lead to the development of effective knowledge management systems that are tightly integrated to the business processes that they are designed
to support. The primary purpose of this book is to highlight business, managerial, technological, and implementation issues surrounding the application of Semantic Web technologies to business process automation eventually leading to the new integrated knowledge-based virtual organizations.

Each and every single business process is enacted by human and/or software agents within a certain set of knowledge domains such as customer knowledge domain, supplier knowledge domain, financial knowledge domain, logistics knowledge domains, and so forth. Semantic technology enables us to capture and codify these knowledge domains in a practical and effective manner, thereby allowing the application of reasoning to be incorporated within these automated business processes thus paving the way towards the integrated knowledge-based virtual organizations.

Significant and in-depth research is needed to understand both the managerial and technological dimensions of how business enterprises may benefit from this promising technology—the Semantic Web. Additionally, business managers, IT professionals, students, and academics need to understand the potential of this technology and its application to the benefit of the consumers. This book is intended to fill this gap.

The audience of this book is MBA students, IT professionals, business executives, consultants, and seniors in undergraduate business degree programs.

The scholarly value of this book and its contribution will be to the literature in the information systems/e-business discipline. Most of the publications are more focused toward the computer science audience and many are compilations of proceedings papers from conferences in computer science and artificial intelligence. This book is intended to bring a business perspective to this promising new technology—the Semantic Web.

Chapter Overview

Chapter I introduces an innovative semantic technology allowing for the automated online configuration and assembling of packaged travel products for individual customers. Dynamic packaging applications require a suitable integration of heterogeneous, autonomous, and distributed tourism information systems. This integration is a complex and difficult issue. The Semantic Web, a relatively new concept, brings a set of emerging technologies and models that need to be explored and evaluated to assert their use for the implementation of more integrated dynamic packaging applications. In this chapter, the author analyzes dynamic packaging application requirements and presents an architecture that enables the integration of tourism data sources and creation of dynamic packages using semantic annotation, semantic rules, ontologies, Web services, and Web processes.
Chapter II proposes a semantically enriched service-oriented business applications (SE-SOBA) framework that will provide a dynamically reconfigurable architecture enabling enterprises to respond quickly and flexibly to market changes. The authors also propose the development of a pure semantic-based implementation of the universal description, discovery, and integration (UDDI) specification, called pure semantic registry (PSR), which provides a flexible, extendable core architectural component allowing the deployment and exploitation of Semantic Web services. The implementation of PSR involves the development of a semantic-based repository and an embedded RDF-based reasoning engine, providing strong query and reasoning capabilities to support effective service discovery and composition. The authors claim that when SE-SOBAs are combined with PSR and rule-based formalizations of business scenarios and processes, they constitute a holistic business-driven semantic integration framework, called FUSION, applied to intra- and inter-organizational enterprise application integration (EAI) scenarios.

Chapter III focuses on business process design as middle point between requirement elicitation and implementation of a Web information system. The authors attempt to solve both the problem of the notation to adopt in order to represent in a simple way the business process and the problem of a formal representation, in a machine readable format, of the design. They adopt Semantic Web technology to represent process and explain how this technology has been used to achieve their goals.

Chapter IV contends that the Semantic Web will require semantic representation of information that computers can understand when they process business applications. Most Web content is currently represented in formats such as text, that facilitate human understanding, rather than in the more structured format, that allow automated processing by computer systems. This chapter explores how natural language processing principles, using linguistic analysis, can be employed to extract information from unstructured Web documents and translate it into extensible markup language (XML)—the enabling currency of today’s e-business applications, and the foundation for the emerging Semantic Web languages of tomorrow. The authors developed a prototype system and tested the system with online financial documents.

Chapter V presents an emerging technology like business process execution language (BPEL), and its implementation in BPEL for Web services (BPEL4WS) as a rich set of possibilities in describing business processes. They contend that BPEL further adheres, as a technology, in a consistent way to the underlying Web service-based implementation technology and is a perfect fit for service oriented architectures as they are currently implemented in many business organizations as a successor to EAI. However, BPEL4WS, in its current implementation, will only serve in a static way for production workflows. In this chapter, the authors discuss how Semantic Web services through a semantic service-oriented architecture (SSOA) can be used to extend BPEL4WS to create ad hoc and collaborative workflows.

Chapter VI provides a vision that with the evolution of the next generation Web—the Semantic Web—e-business can be expected to grow into a more collaborative ef-
fort in which businesses compete with each other by collaborating to offer the best products to the consumers. Electronic collaboration involves data interchange with multimedia data being one of them. Digital multimedia data in various formats have increased tremendously in recent years on the Internet. An automated process that can represent multimedia data in a meaningful way for the Semantic Web is highly desired. In this chapter, the authors propose an automatic multimedia representation system for the Semantic Web.

Chapter VII addresses the issues of evolving software agents in e-commerce applications. Even though agent-based e-commerce has been booming with the development of the Internet and agent technologies, little effort has been devoted to exploring the learning and evolving capabilities of software agents. An agent structure with evolutionary features is proposed with a focus on internal hierarchical knowledge. The authors argue that the knowledge base of an intelligent agent should be the cornerstone for its evolution capabilities, and that the agent can enhance its knowledge base by exchanging knowledge with other agents. In this chapter, product ontology is chosen as an instance of a knowledge base. The authors propose a new approach to facilitate ontology exchange among e-commerce agents. The ontology exchange model and its formalities are elaborated. Product-brokering agents have been designed and implemented, which accomplish the ontology exchange process from request to integration.

Chapter VIII describes how Web services are self-contained, self-describing modular applications. Different from traditional distributed computing, Web services are more dynamic with regards to service discovery and run-time binding mechanisms. This chapter provides an in-depth discussion on research related to Web services discovery. The authors present some basis knowledge for the Web services discovery and their Semantic Web-based solution for quality of service (QoS)-aware discovery and measurement. It complements OWL-S to achieve better services discovery, composition, and measurement.

Chapter IX introduces how to effectively organize ontology languages and ontologies and how to efficiently process semantic information based on ontologies. In this chapter, the authors propose the hierarchies to organize ontology languages and ontologies. Based on the hierarchy of ontologies, the conflicts in different ontologies are resolved, thus the semantics in different ontologies are clear without ambiguities. These ontologies can be used to efficiently process the semantic information in Semantic Web and e-business.

Chapter X presents arguments in favor of an integrative, systems-based model of knowledge sharing that can provide a way of visualizing the interrelated elements that comprise a knowledge management system. This original model, building on a rhetorical process model of communication, includes both the objective and subjective elements within human cognition. In addition, it clarifies the purpose and method elements at the center for any effective knowledge system. The model centers on the purpose elements of intentions and audience, and the method elements
of technical tools and human processes. The output of knowledge sharing includes objective products and subjective interpretations. Feedback verifies the timeliness and efficiency in the process of building both information and knowledge.

Chapter XI introduces a new approach named semantic knowledge transparency, which is defined as the dynamic on-demand and seamless flow of relevant and unambiguous, machine-interpretable knowledge resources within organizations and across inter-organizational systems of business partners engaged in collaborative processes. Semantic knowledge transparency is based on extant research in e-business, knowledge management, and Semantic Web. In addition, theoretical conceptualizations are formalized using description logics and ontological analysis. As a result, the ontology supports a common vocabulary for transparent knowledge exchange among inter-organizational systems of business partners of a value chain, so that semantic interoperability can be achieved. An example is furnished to illustrate how semantic knowledge transparency in the e-marketplace provides critical input to the supplier discovery and selection decision problem while reducing the transaction and search costs for the buyer organization.

Chapter XII introduces an application of the Semantic Web based on ontology to the tourism business. Tourism business is one promising area of Semantic Web applications. To realize the potential of the Semantic Web, we need to find a “killer” application of the Semantic Web in the knowledge management area. Finally, the authors discuss the relationship between the Semantic Web and knowledge management processes.

Chapter XIII presents an ontology-based query formation and information retrieval system under the m-commerce agent framework. A query formation approach that combines the usage of ontology and keywords is implemented. This approach takes advantage of the tree structure in ontology to form queries visually and efficiently. It also uses additional aids such as keywords to complete the query formation process more efficiently. The proposed information retrieval scheme focuses on using genetic algorithms to improve computational effectiveness.

Chapter XIV proposes a system that, when mature, should be able to support the needs of travelers in automatically composing and executing their travel arrangements using software agents. The authors argue and illustrate how Semantic Web technologies combined with software agents can be used in the proposed system. Finally, they show how RDF demarcated data is to be used to support personal information delivery. They conclude with the description of the current state of implementation and plans for further development of the system.

Chapter XV proposes an ontology using OWL for the Australian timber sector that can be used in conjunction with Semantic Web services to provide effective and cheap business-to-business (B2B) communications.

From the perspective of the timber industry sector, this study is important because supply chain efficiency is a key component in an organization’s strategy to gain a competitive advantage in the marketplace. Strong improvement in supply chain
performance is possible with improved B2B communication which is used both for building trust and providing real time marketing data.

Traditional methods such as electronic data interchange (EDI) used to facilitate B2B communication have a number of disadvantages, such as high implementation and running costs and a rigid and inflexible messaging standard. Information and communications technologies (ICT) have supported the emergence of Web-based EDI which maintains the advantages of the traditional paradigm while negating the disadvantages. This has been further extended by the advent of the Semantic Web which rests on the fundamental idea that Web resources should be annotated with semantic markup that captures information about their meaning and facilitates meaningful machine-to-machine communication.

Chapter XVI provides an illustration of how Semantic Web technologies can be used for searching medical information on the Web. There has been a paradigm shift in medical practice. More and more consumers are using the Internet as a source for medical information even before seeing a doctor. The well-known fact is that medical terms are often hard to spell. Despite advances in technology, the Internet is still producing futile searches when the search terms are misspelt. Often consumers are frustrated with irrelevant information they retrieve as a result of the wrong spelling. An ontology-based search is one way of assisting users in correcting their spelling errors when searching for medical information.

Chapter XVII discusses Semantic Web standards and ontologies in two areas: (1) the medical sciences field and (2) the healthcare industry. Semantic Web standards are important in the medical sciences since much of the medical research that is available needs an avenue to be shared across disparate computer systems. Ontologies can provide a basis for searching context-based medical research information so that it can be integrated and used as a foundation for future research. The healthcare industry will be examined specifically in its use of electronic health records (EHR), which need Semantic Web standards to be communicated across different EHR systems. The increased use of EHRs across healthcare organizations will also require ontologies to support context-sensitive searching of information, as well as creating context-based rules for appointments, procedures, and tests so that the quality of healthcare is improved. Literature in these areas has been combined in this chapter to provide a general view of how Semantic Web standards and ontologies are used and to give examples of applications in the areas of healthcare and the medical sciences.
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