Preface

The chapters of this book provide an excellent overview of current research and development activities in the area of Web Semantics and ontology. They supply an in-depth description of different issues in Web Semantics and ontology, including modelling of Web Semantics and ontologies, using ontologies in enterprise systems, querying and knowledge discovering of ontologies, and adopting policies and building applications. Each chapter contains a thorough study of the topic, systematic proposed work, and a comprehensive list of references. Following our call for chapters in 2005, we received more than 30 chapter proposals. Each proposed chapter was carefully reviewed and eventually, 12 chapters were accepted for inclusion in this book. This book brought together academic, researchers, and practitioners from many different countries, including Argentina, Australia, Belgium, Canada, France, Greece, India, Italy, Spain, and USA. Their research and industrial experience, which are reflected in their work, will certainly allow readers to gain an in-depth knowledge of their areas of expertise.

Intended Audience

*Web Semantics and Ontology* gives readers comprehensive knowledge on the current issues of Web Semantics and ontologies. The book describes the basic need arisen from Web Semantics, the underpinning background of Web Semantics, the infrastructures, languages, and tools for Web Semantics; and real-world application domains of Web Semantics. This book is intended for indi-
viduals who want to enhance their knowledge of issues relating to modelling, adopting, querying, discovering knowledge, and building ontologies and Web Semantics. Specifically, these individuals could include:

- **General public interested in the Internet technology**: General publics who are interested in the Web technology will find this book useful as it covers current issues and practice of Web Semantics and ontology. This book can be used as a reference book on Web Semantics and ontology.

- **Information technology researchers**: Researchers who are primarily interested in current issues of Web technologies will find this book useful, as it presents issues and state of the art of Web Semantics. The topics that might give them particular interest include ontology, enterprise systems, modelling, knowledge discovery, queries, policies, and other issues.

- **Information technology students and lecturers**: The chapters in this book are grouped into four parts to cover important issues in the area. This will allow students and teachers in Web Semantics fields to effectively use the appropriate materials as a reference or reading resources. These categories are: (1) ontology modelling; (2) enterprise systems; (3) retrieval and knowledge discovery; and (4) policies and applications. Since this book covers the issues of Web Semantics and ontology comprehensively, it can be used as a textbook at a graduate level.

- **Web software developers**: Software developers will find this book useful particularly in the area of practical Web development involving OWL, XML, RDF, metadata, and UML. The final part of this book on applications would be useful for developers in learning on how a large scale application is built.

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**Prerequisites**

The book as a whole is meant for anyone professionally interested in Web Semantics and ontology and who in some way wants to gain an understanding on how the issues in modelling and using ontologies in enterprise systems, as well as information retrieval and knowledge discovery of Web Semantics. Each chapter may be studied separately, or in conjunction with other chapters. As each chapter may cover topics different from other chapters, the prerequisites for each may vary. However, we assume the readers have at least a basic knowledge of:
• Web information systems and its applications,
• Information modelling,
• Enterprise information systems, and
• Queries and knowledge discovery.

**Overview of Web Semantics and Ontology**

Over the last years there has been a steady shifting from the Internet as we know it — unstructured, or at best, semistructured, to a more structured Web, referred to as the *Web Semantic*. Web Semantics is used to denote the next evolution step of the Web, which establishes a layer of machine understandable data. The data is suitable for automated agents, sophisticated search engines, and interoperability services, which provide a previously not reachable grade of automation. The ultimate goal of Web Semantic is to allow machines the sharing and exploitation of knowledge in the Web way, i.e., without central authority, with few basic rules, in a scalable, adaptable, extensible manner. In other words, Web Semantics is the key of the next generation of Web information system, where information is given a well-defined meaning, better enabling people and programs to work in cooperation with each other.

The emergence of Web technology has made global information sharing possible. Sharing of knowledge is motivated by Semantic Web whereby there is a necessity to make content searching more efficient and meaningful by providing contextual and structural information about the presented contents. This becomes possible through the establishment of an appropriate standard to define the conceptual level of a metalanguage, and such a standard is known as an *Ontology*, which is described as sharable conceptualization of specific domain of interest in a machine-understandable format.

Web Semantics aids the efficiency of searching in the World Wide Web, by providing more information about the presented texts. Although the applications are many, the most common examples are intelligent search engine with data mining capabilities, integrated decision support system applications, integrated enterprise applications, and so forth. The structuring of information on the Web will bring the Internet to the next era. The infrastructure to build such structured Semantic Web has been established, including the suitable language for representation of the data (XML), translation to HTML for presentation/display purposes (XSL), specification of metadata (RDF, XML-Schema, DTD), and finally the establishment of an appropriate standard to define the conceptual level of the metadata languages or the ontology (OWL, DAML-OIL).
Ontologies are the backbone that keeps the Semantic Web together, because they enforce an agreement at least on how the structure of information should be defined. In cases where different organizations cannot agree on the same structure, they would still use the same way of defining their structure as formulated in the ontology. This will enable the development of a tool that can translate between the different structures, thus enabling communication. While the collection of data or information on the Internet can be seen as a static data repository with possible regular incremental update, the user applications and requirements that utilize the collection of data for their individual purposes will change over time. For this reason, ontologies need to be dynamic and adaptable to cater for the diversity of users’ needs and requirements, and the complexity of different applications that need to be integrated.

The new era of Web Semantic has enabled users to extract semantically relevant data from the Web. Web ontology plays an important role in the Semantic Web as it defines shared uniform structures which define how Web information is grouped and classified regardless of the implementation language or the syntax used to represent the data. However, as Web ontology grows and evolves, there are many issues to be addressed, including how it may be adopted in large organizations, how it can be queries, how the security may be guaranteed, etc.

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**Organization of This Book**

The book is divided into four major sections:

1. *Web Semantics and Ontologies Modelling*
2. *Ontologies and Enterprise Systems*
3. *Ontologies-Based Querying and Knowledge Discovery*
4. *Applications and Policies*

Each section in turn is divided into several chapters:

**Section I** focuses on modelling of Web Semantics and ontology. This section includes chapters on ontology extraction using views, patters, and modelling language. Section I consists of three chapters.

**Chapter I**, contributed by Wouters, Rajagopalapillai, Dillon, and Rahayu, investigates the use of materialized ontology view as an alternative efficient version in utilizing a whole large ontology. They describe the formalism of the materialized view for Web Semantic with conceptual and logical extensions.
The view provides the required conceptual and logical semantics to develop ontological bases. They also present a schemata transformation methodology to materialize Web Semantic view using an ontology extraction methodology framework where materialized ontology views are instantiated.

**Chapter II**, presented by Kamthan and Pai, focuses on patterns, which are refined from past experience due to recurring problems. They describe a process of creating an ontology in the language OWL for Web Application Patterns, called OWAP. The features during OWAP design, implementations and testing are also described.

**Chapter III**, presented by Caliusco, Maidana, Galli, and Chiotti, introduces contextual ontology, where an ontology is presented with its context definition. This contextual ontology needs to be expressed in a language at run-time, particularly for the analysis and design phase of a Web domain. They present a metamodel for modelling explicit and formal contextual ontologies to model contextual ontologies.

**Section II** concentrates on enterprise systems, covering major issues of ontology management in large-scale enterprise systems, enterprise information systems, and semantic annotation systems for text-based document systems. This section also consists of three chapters: Chapters IV, V, and VI.

**Chapter IV**, presented by Lee, Goodwin, and Akkiraju, describes their work on developing an enterprise-scale ontology management system that provides APIs and query languages, and scalability and performance that enterprise applications demand. They describe the design and implementation of the management system that programmatically supports the ontology needs of enterprise applications in a similar way a database management system supports the data needs of applications.

**Chapter V**, presented by Rifaih and Benharkat, concentrates on studying the application of context and ontology which can serve as a formal background for reaching a suitable enterprise information system. They focus on formalism for contextual ontologies based combining description logics and modal logics. This in turn helps to overcome an ontology-phobia. They also show some examples the usefulness of these contextual ontologies for resolving the semantic sharing problems in some enterprise information systems.

**Chapter VI**, contributed by Reeve and Han, focuses on semantic annotation to be a key component in Semantic Web. They propose semi-automatic semantic annotation systems for text-based Web documents. This semantic annotation provides services supporting annotation, including ontology and knowledge base access and storage, information extraction, programming interfaces, and end-user interfaces.
Section III focuses on querying and knowledge discovery of ontology. It consists of three chapters covering acquiring new knowledge in ontology, dynamic knowledge discovery, and metadata and Web Semantic mining.

Chapter VII, presented by Dey and Abulaish, presents a text-mining based ontology enhancement and query processing system. The system supports ontology enhancement by identifying, defining, and adding new precise and imprecise concepts descriptions mined from text documents. They adopt a fuzzy reasoning method for query processing.

Chapter VIII, presented by Castano, Ferrara, and Montanelli, focuses on dynamic knowledge discovery, which is a capability of each node in a P2P or Grid network of finding knowledge in the system about information resources matching. They describe the models and techniques for ontology metadata management and ontology-based dynamic knowledge discovery in open distributed systems. They also describe the HELIOS peer-based system.

Chapter IX, written by Aufaure, Le Grand, Soto, and Bennacer, presents a state-of-the-art review of techniques covering metadata and ontologies, Semantic Web information retrieval, and automatic semantic extraction. They also describe open research areas and major current research programs in this domain.

Finally, Section IV presents applications and policies. This section consists of three chapters, Chapters X, XI, and XII. These chapters present applications in geospatial and pervasive computing, as well as policies for the security management.

Chapter X, written by Winter and Tomko, presents a review of the ways of georeferencing in Web resources. They present a case study which investigates the possibilities of translating the semantics of georeferences in Web resources to landmarks in route directions. They also show that interpreting georeferences in Web resources enhances the perceivable properties of described features.

Chapter XI, presented by Tsounis, Anagnostopoulos, Hadjiethymiades, and Karali, focuses on pervasive computing which creates an environment that seamlessly integrate devices with computing and communication capabilities. Since it poses an interoperability issues, they argue that the use of Web Semantic technology, like ontologies, may resolve these issues.

Finally, Chapter XII, written by Clemente, Pérez, Blaya, and Skarmeta, focuses on policies. They argue that by appropriately managing policies, a system can be continuously adjusted to accommodate variations imposed by constraints and environmental conditions. They present an evaluation of the use of ontology languages to represent policies for distributed systems.
How to Read This Book

Each chapter in this book has a different flavor from any others due to the nature of an edited book, although chapters within each part have a broad topic in common. A suggested plan for a first reading would be to choose a particular part of interest, and read the chapters in that part. For more specific seeking of information, readers interested in ontological views and extractions, ontological representation using OWL, ontological modelling language may read the first three chapters. Readers interested in looking at ontological management and adaptation in enterprise systems, as well as annotation systems may study the chapters in the second part. Readers, who are interested in ontological queries, metadata, knowledge discovery, and Semantic Web mining, may go directly to the third part. Finally, those interested in applications in geospatial Semantic Web, pervasive computing, and security management, may go directly to the final part of this book.

Each chapter opens with an abstract that gives the summary of the chapter, an introduction and closes with a conclusion. Following the introduction, the background and related work are often presented in order to give readers adequate background and knowledge to enable them to understand the subject matter. Most chapters also include an extensive list of references. This structure allows a reader to understand the subject matter more thoroughly by not only studying the topic in-depth, but also by referring to other work related to each topic.

What Makes This Book Different?

Web Semantics is a growing area in the broader field of Web technology. A dedicated book on important issues in Web Semantics and ontology is still difficult to find. Most books narrowly focus on one particular aspect of Web Semantics, such as RDF, etc. This book is therefore different in that it covers an extensive range of topics including ontological modelling, enterprise systems, querying and knowledge discovery, and wide range of applications.

This book gives a good overview of important aspects in the development of Web Semantics. The four major aspects covering ontological modelling, enterprise systems, Semantic Web mining, and applications, described in four parts of this book respectively, form the comprehensive foundations of Web Semantics and ontology.

The uniqueness of this book is also due to the solid mixture of both theoretical aspects as well as practical aspects of Web Semantics and ontology develop-
ment. The application chapter presents a case study on geospatial Web Semantics. Other potential applications in pervasive computing environment are also presented. Throughout the book, languages and tools for Web Semantics and ontology are described. These include OWL, XML, metadata, RDF, etc. Theoretical issues, including security management and annotation, are also covered. Issues of adopting ontology in enterprise systems are also comprehensively discussed.

A Closing Remark

We would like to conclude this preface by saying this book has been compiled from extensive work done by the contributing authors who are researchers and industry practitioners in this area and who particularly have expertise in the topic area addressed in their respective chapters. We hope that readers benefit from the works presented in this book.

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