Preface

Over the last decade, we have witnessed an increasing use of Web Semantics as a vital and ever-growing field. It incorporates various subject areas contributing to the development of a knowledge-intensive data web. In parallel to the movement of concept from data to knowledge, we are now also experiencing the movement of web from document model to data model where the main focus is on data compared to the process. The underlying idea is making the data machine understandable and processable. In light of these trends, conciliation of Semantic and the Web is of paramount importance for further progress in the area. The 17 chapters in this volume, authored by key scientists in the field are preceded by an introduction written by one of the volume editors, making a total of 18 chapters. Chapter 1, Introduction, by Sarika Jain provides an overview of technological trends and perspectives in Web Semantics, defines Semantic Intelligence, and discusses the technologies encompassing the same in view of their application within enterprises as well as in web. In all, 76 chapter proposals were submitted for this volume making a 22% acceptance rate. The chapters have been divided into three sections as Representation, Reasoning, and Security.

- Representation: The semantics have to be encoded with data by virtue of technologies that formally represent metadata. When semantics are embedded in data, it offers significant advantages for reasoning and interoperability.
- Reasoning: When "Semantic Web" will finally happen, machine will be able to talk to machines materializing the so-called "intelligent agents." The services offered will be useful for web as well as for the management of knowledge within an organization.
- Security: In this new setting, traditional security measures will not be suitable anymore; and the focus will move to trust and provenance. The semantic security issues are required to be addressed by the security professionals and the semantic technologists.

This book will help the instructors and students taking courses of Semantic Web getting abreast of cutting edge and future directions of semantic web, hence providing a synergy between healthcare processes and semantic web technologies. Many books are available in this field with two major problems. Either they are very advanced and lack providing a sufficiently detailed explanation of the approaches, or they are based on a specific theme with limited scope, hence not providing details on crosscutting areas applied in the web semantic. This book covers the research and practical issues and challenges, and Semantic Web applications in specific contexts (in this case, healthcare). This book has varied audience and spans industrial professionals, researchers, and academicians working in the field of Web Semantics. Researchers and academicians will find a comprehensive study of the state

of the art and an outlook into research challenges and future perspectives. The industry professionals and software developers will find available tools and technologies to use, algorithms, pseudocodes, and implementation solutions. The administrators will find a comprehensive spectrum of the latest viewpoint in different areas of Web Semantics. Finally, lecturers and students require all of the above, so they will gain an interesting insight into the field. They can benefit in preparing their problem statements and finding ways to tackle them.

The book is structured into three sections that group chapters into three otherwise related disections:

Representation

The first section on Representation comprises six chapters that specifically focus on the problem of choosing a data model for representing and storage of data for the Web. Chapter 2, Convology: an ontology for conversational agents in digital health by Dragoni et al. propose an ontology, namely, Convology, aiming to describe conversational scenarios with the scope of providing a tool that, once deployed into a real-world application, allows to ease the management and understanding of the entire dialog workflow between users, physicians, and systems. The authors have integrated Convology into a living lab concerning the adoption of conversational agents for supporting the self-management of patients affected by asthma. Dubey et al. in Chapter 3, Conversion between semantic data models: the story so far, and the road ahead, provide the trends in converting between various semantic data models and reviews the state of the art of the same. In Chapter 4, Semantic interoperability: the future of healthcare Burse et al. have beautifully elaborated the syntactic and semantic interoperability issues in healthcare. They have reviewed the various healthcare standards in an attempt to solve the interoperability problem at a syntactic level and then moves on to examine medical ontologies developed to solve the problem at a semantic level. The chapter explains the features of semantic web technology that can be leveraged at each level. A literature survey is carried out to gage the current contribution of semantic web technologies in this area along with an analysis of how semantic web technologies can be improved to better suit the health-informatics domain and solve the healthcare interoperability challenge. Haklae Kim in his Chapter 5, A knowledge graph of medical institutions in Korea, has proposed a knowledge model for representing medical institutions and their characteristics based on related laws. The author also constructs a knowledge graph that includes all medical institutions in Korea with an aim to enable users to identify appropriate hospitals or other institutions according to their requirements. Chapter 6, Resource description framework based semantic knowledge graph for clinical decision support systems, by Lourdusamy and Mattam advocates the use of Semantic Knowledge Graphs as the representation structure for Clinical Decision Support Systems. Patnaikuni and Gengaje in Chapter 7, Probabilistic, syntactic, and semantic reasoning using MEBN, OWL, and PCFG in healthcare, exploit the key concepts and terminologies used for representing and reasoning uncertainties structurally and semantically with a case study of COVID-19 Corona Virus. The key technologies are Bayesian networks, Multi-Entity Bayesian Networks, Probabilistic Ontology Web Language, and probabilistic context-free grammars.

Reasoning

At the scale of www, logic-based reasoning is not appropriate and poses numerous challenges. As already stated in different chapters of Section 1, RDF provides a machine-processable syntax to the data on the web. Reasoning on Semantic Web involves deriving facts and relationships that are not explicit in the knowledge base. This section groups 10 contributions based on reasoning within the knowledge bases. There is an absence of a reference model for describing the health data and their sources and linking these data with their contexts. Chapter 8, The connected electronic health record: a semantic-enabled, flexible, and unified electronic health record, by Sassi and Chbeir addresses this problem and introduces a semantic-enabled, flexible, and unified electronic health record (EHR) for patient monitoring and diagnosis with Medical Devices. The approach exploits semantic web technologies and the HL7 FHIR standard to provide semantic connected EHR that will facilitate data interoperability, integration, information search and retrieval, and automatic inference and adaptation in real-time. Jain et al. in Chapter 9, Ontology-supported rule-based reasoning for emergency management, have proposed an ontology-supported rule-based reasoning approach to automate the process of decision support and recommending actions faster than a human being and at any time. Chapter 10, Healthcare-Cube Integrator for Healthcare Databases by Trivedi et al. proposes the Healthcare-cube integrator as a knowledge base that is storing health records collected from various healthcare databases. They also propose a processing tool to extract data from assorted databases. Chapter 11, Smart mental healthcare systems, by Dalal and Jain provides an architecture for a smart mental healthcare system along with the challenges and benefits incurred. Chapter 12, A meaning-aware information search and retrieval framework for healthcare, by Anoop et al. discusses a framework for building a meaning-aware information extraction from unstructured EHRs. The proposed framework uses medical ontologies, a medical catalog-based terminology extractor and a semantic reasoner to build the medical knowledge base that is used for enabling a semantic information search and retrieval experience in the healthcare domain. In Chapter 13, Ontology-based intelligent decision support systems: a systematic approach, Saha et al. emphasize several machine learning algorithms and semantic technologies to design and implement intelligent decision support system for effective healthcare support satisfying quality of service and quality of experience requirements. Jacyntho and Morais in Chapter 14, Ontology-based decision-making, have described the architecture and strengths of knowledge-based decision support systems. They have defined a method for the creation of ontology-based knowledge bases and a corresponding fictitious health care case study but with real-world challenges. As the data are exploding over the web, Daoui et al. in Chapter 15, A new method for profile identification using ontology-based semantic similarity, aim to treat and cover a new system in the domain of tourism in order to offer users of the system a set of interesting places and tourist sites according to their preferences. The authors focus on the design of a new profile identification method by defining a semantic correspondence between

keywords and the concepts of an ontology using an external resource WordNet. Compared to the objective type assessment, the descriptive assessment has been found to be more uniform and at a higher level of Bloom's taxonomy. In Chapter 16, Semantic similarity-based descriptive answer evaluation, Shaukat et al. have put in efforts to deal with the problem of automated computer assessment in the descriptive examination. Lastly in this section, Chapter 17, Classification of genetic mutations using ontologies from clinical documents and deep learning, by Bedi et al. have presented a framework for classifying cancerous genetic mutation reported in EHRs. They have utilized clinical NLP, Ontologies and Deep Learning for the same over Catalog of Somatic Mutations in Cancer Mutation data and Kaggle's cancer-diagnosis dataset.

Security

Though posed as the future of web, is semantic web secure? In the semantic web setting, traditional security measures are no more suitable. This section closes the book by providing Chapter 18, Security issues for the semantic web, by Pranav et al. providing the security issues in the semantic web. This chapter also suggested ways of potentially aligning the protocols so as to make them more robust to be used for semantic web services.

As the above summary shows, this book summarizes the trends and current research advances in web semantics, emphasizing the existing tools and techniques, methodologies, and research solutions.

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