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Computational Intelligence for Semantic Knowledge Management

New Perspectives for Designing and Organizing Information Systems

Springer

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If at first you don't succeed, try, try, try again.
—William Edward Hickson

Preface

In last years, knowledge management is becoming a big challenge especially due to the massive quantity of data available in digital form on the web or in large enterprises. Hence, there is a large interest in research and industrial activities devoted to design and develop advanced Knowledge Management Systems (KMSs). KMSs are systematic frameworks destined to capture, acquire, organize, and communicate both tacit and explicit knowledge in the most effective way.

More recently, the Semantic Web perspective has added to KMSs a new capability, that is, to offer more intelligent services by facilitating machine understanding of content. Hence, there is the birth of the so-called Semantic Knowledge Management (SKM) including a collection of methods, paradigms, and technologies for efficiently supporting the representation and management of tangible knowledge assets. Thanks to its flexibility, scalability, and robustness in the representation of information, SKM is enabling the design and development of innovative information systems in distributed environments, ensuring:

- Semantic interoperability and integration of data, information, and processes, through an ontological representation of information and
- Efficient extraction of interesting information from data in large databases by means of sophisticated Semantic Knowledge Discovery techniques.

However, in spite of their numerous benefits, SKM methods are not yet able to address some of the problems that intrinsically characterize the representation of knowledge, such as the vagueness and uncertainty of information. Computational Intelligence (CI) methodologies, due to their natural inclination to deal with imprecision and partial truth, are opening new positive scenarios for designing innovative SKM architectures. For instance, fuzzy logic has inspired the development of different fuzzy extensions of several XML-based languages to enhance the description power of current languages for Semantic Web. At the same way, biological-inspired optimization methods such as genetic algorithms and particle swarm optimization have been witnessed in reducing the complexity of several computational problems inherent the semantic representation of information, such

as ontology alignment and matching, query processing, semantic storage, and web-scale reasoning.

This edited book volume is primarily intended to be a collection of chapters written by experts in the field of the usage of CI methods to the context of the SKM. The book is organized into six chapters. A summary of the chapters follow:

- Fuzzy logic is applied in the chapter by Raciel Yera, Jorge Castro, and Luis Martínez entitled "Natural Noise Management in Recommender Systems using Fuzzy Tools" for dealing with identification of natural noise in Recommender Systems (RSs). RSs are information filtering systems aimed to predict the probability of a user preferring a particular item out of a given set of items. These systems require the elicitation of user preferences, which are not always precise because there are external factors such as human errors or the inherent vagueness associated with human beings. Such imprecise behaviors are identified as Natural Noise (NN), and can negatively affect the RS performance. The authors propose two fuzzy models for NN management in a flexible way, which guarantee robust modeling of the uncertainty associated with the user profiles. Two case studies are developed to show that the proposed approaches lead to improvements in the accuracy of RSs.
- Statistical- and semantic-based approaches are used in the chapter by Loredana Caruccio, Vincenzo Deufemia, Salvatore Esposito, and Giuseppe Polese entitled "Combining Collaborative Filtering and Semantic-based Techniques to Recommend Components for Mashup Design" in order to support web mashup development. Mashups merge data from different web sources to create new functionalities, and hence it requires to manage a large amount of heterogeneous knowledge. Currently, researchers are investigating both semantic and statistical approaches to detect mashup components that best match user needs. In this chapter, the authors present a hybrid recommendation approach combining both the statistical nature of collaborative filtering and semantic methods to select the mashups on the web that are more suitable for satisfying user needs. A prototype of the proposed approach is used to prove its validity during three experimental sessions.
- Semantic maps are used in the chapter by Francesco Camastra, Angelo Ciaramella, Antonio Maratea, Le Hoang Son, and Antonino Staiano entitled "Semantic Maps for Knowledge Management of Web and Social Information" in order to extract potentially useful knowledge from World Wide Web (WWW). Due to the continuous increase in volume and to the mainly unstructured nature of most of the data stored in the WWW, several challenging problems have emerged, the most important being how to find relevant information for a specific task. In the chapter, the authors address two representative tasks: first, to provide a compact and structured representation of the main concepts in a Web document; second, to represent and synthesize the information content of Twitter conversations in the form of semantic maps. The results of the experiments involving the corpus Reuters and real data show good performance of the semantic proposed approaches.

- Local search meta-heuristics are applied in the chapter by Giovanni Acampora and Autilia Vitiello entitled "A Study on Local Search Meta-heuristics for Ontology Alignment" to reconcile different knowledge sources. Currently, the most popular representation methods for the knowledge are the ontologies, however, the variety of ways that a domain can be conceptualized results in the development of heterogeneous ontologies with overlapping parts. In order to address this problem, a so-called ontology alignment process is required. In the chapter, the authors propose to implement an ontology alignment process, for the first time, by means of local search algorithms. As shown by the results of a set of experiments involving well-known benchmarks, Tabu search is the best performer among the compared local search meta-heuristics.
- Decision trees are used in the chapter by Sriparna Saha, Shreyasi Datta, and Amit Konar entitled "Decision Tree Based Single Person Gesture Recognition" in order to classify emotions by managing knowledge captured from human behaviors. Classifying emotions starting from human gestures can be utilized to control a machine according to the human emotional state. Human gestures for the present work are captured using a Kinect Sensor which tracks the skeleton of the person standing in front of it within a finite amount of distance using a set of visible and IR cameras. The results of the experiments conducted on 10 subjects show the good performance of the proposed approach.
- The integration between type-2 fuzzy logic and evolutionary computation is used in the chapter by Sriparna Saha, Pratyusha Rakshit, and Amit Konar entitled "Modified Type-2 Fuzzy Gesture Space Induced Physical Disorder Recognition" in order to manage information captured by human gestures and recognize physical disorders. The gestural features of a subject suffering from the same physical disorder exhibit wide deviations for different instances. This fluctuation is the main source of uncertainty in the physical disorder recognition problem. The authors address this problem by means of Type-2 Fuzzy Sets. Moreover, Type-2 fuzzy sets are formulated by solving an optimization problem by means of the Artificial Bee Colony. As shown the results of the experimental session, the proposed approach improves the state of the art.

Before concluding, we wish to thank various people for their contribution to this book. First, we would like to express our sincere thanks to the authors of the chapters for having made available their experiences related to their research and also for carefully addressing reviewers' comments. In addition, we are indebted to the reviewers for providing useful comments on the chapters. Besides, our thanks are due to Springer for publishing this book and for assisting us during the different steps of the publication process. Lastly, we are grateful to our families for their continuous support.

We strongly hope this book will stimulate and support the activities of researchers in the field of the computational intelligence and in the semantic web area.

Happy reading!

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Acronyms

ABC	Artificial Bee Colony
BoW	Bag of Words
CE	Combined Error
CF	Collaborative Filtering
CFRS	Collaborative Filtering Recommender System
CI	Computational Intelligence
CMDO	Classification using Multilayered Domain Ontology
CW	Computing with Words
EEG	ElectroEncephaloGram
FE	Function Evaluation
FN	False Negative
FOU	Footprint of Uncertainty
FP	False Positive
GRS	Group Recommender System
GT2FS	Generalized Type-2 Fuzzy Set
ICT	Information and Communication Technology
IoT	Internet of Things
IR	Infra-Red
IT2FS	Interval Type-2 Fuzzy Set
KMS	Knowledge Management System
KNN	K-Nearest Neighbor
LCA	Lowest Common Ancestor
LMA-NN	Levenberg–Marquardt Algorithm induced Neural Network
MAE	Mean Absolute Error
MST	Minimum Spanning Tree
NNM	Natural Noise Management
OA	Ontology Alignment
OAEI	Ontology Alignment Evaluation Initiative
PCA	Principal Component Analysis
PW	Programmable Web

QE	Quantization Error
RBFN	Radial Basis Function Network
RS	Recommender System
SDK	Software Development Kit
SKM	Semantic Knowledge Management
SOM	Self-Organizing Map
SVM	Support Vector Machine
T1	Type-1
T2	Type-2
T2FS	Type-2 Fuzzy Set
TE	Topographic Error
TF-IDF	Term Frequency and Inverse Document Frequency
TN	True Negative
TP	True Positive
WWW	World Wide Web