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Smart Information and Knowledge Management

Advances, Challenges, and Critical Issues

Springer

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Preface

This is our second book related to intelligent information and knowledge management which is based on the concept of developing a platform to share ideas. The contributors to this book, the authors of carefully selected and peer revived Chapters, are academics, educators, and practitioners who are researching and implementing in real life exciting developments associated with our never ending quest to vanquish challenges of our knowledge-based society.

The opening Chapter of the book titled *Immuno-Inspired Knowledge Management for Ad Hoc Wireless Networks* is authored by Martin Drozda, Sven Schaust, and Helena Szczerbicka. The Authors present the cutting edge research in the new, still emerging area of biologically inspired immune systems development. This research has already showed promising results in the field of smart misbehavior detection and classification of data in general. In this Chapter the Authors perform a very comprehensive overview of the recent developments in the area of biologically inspired classification approaches to detect possible threats and misbehavior, especially in the area of ad hoc networks. They also discuss exciting challenges in translating functionality of biological immune system to technical systems. The Chapter that follows is titled *Immune Decomposition and Decomposability Analysis of Complex Design Problems with a Graph Theoretic Complexity Measure* and is authored by Mahmoud Efatmaneshnik, Carl Reidsema, Jacek Marczyk, and Asghar Tabatabaei Balaei. The authors introduce a new approach to decomposition challenge of large, complex problems in general, and design problems in particular. A measure of decomposition quality is introduced and its application in problem classification is highlighted. The measure proposed by the Authors is complexity based (real complexity) and can be employed for both disjoint and overlap decompositions. After discussing the advantages of their approach and illustrating it with examples, the Authors conclude with distinct future directions of their research. The next Chapter is titled *Towards a Formal Model of Knowledge Sharing in Complex Systems* and is authored by Nadim Obeid and Asma Moubaiddin. The Authors develop and discuss a novel multi-agent system that assists in the process of knowledge sharing between various groups of workers and decision-makers. In the proposed platform each agent is a knowledge broker and controller responsible for specialized knowledge needs. The Authors use Partial Information State approach for agents' knowledge representation and present a multi-agent based model of argumentation and dialogue for knowledge sharing. The approach is illustrated with examples and the Chapter concludes with clear vision of further research towards application of the proposed platform to support strategic and tactic reasoning for rational agents. The Chapter that follows is titled *Influence of the Working Strategy on A-Team Performance* and is authored by Dariusz Barbucha, Ireneusz Czarnowski, Piotr Jędrzejowicz, Ewa Ratajczak-Ropel, and Iza Wierzbowska. The Authors first introduce and discuss the issues related to A-Team (defined as a problem solving system of autonomous agents and common memory) performance during the process of agents' cooperation in an attempt to improve a solution to a

given problem. Then the Chapter focuses on investigation of influence of different strategies on A-Team performance. To implement various strategies the A-Team platform called JABAT is used by the Authors. Different working strategies are evaluated by computational experiment using several benchmark data sets. The Authors show that designing effective working strategy can considerably improve the performance of an A-Team system and formulate some rules useful in A-Team development and implementation. The next Chapter is titled *Incremental Declarative Process Mining* and is authored by Massimiliano Cattafi, Evelina Lamma, Fabrizio Riguzzi, and Sergio Storari. In this Chapter the Authors introduce and discuss the current state of the art in research developments and directions related to the area of Business Processes Management (BPM) that studies how to describe, analyze, preserve and improve organisational processes. They focus on subfield of BPM called Process Mining (PM) which aims at inferring a model of the processes from past experience. The Authors introduce and define a novel activity as part of PM – Incremental Process Mining. To solve this problem, they modify the process mining that actually performs theory revision. Through the illustrative experimental results the Authors show that incremental revision of an existing theory or a model can be superior over learning or developing a new one from scratch. Conclusions of the Chapter define new research directions leading to even deeper understanding of the difference between learning from scratch and revision. The following Chapter titled *A Survey on Recommender Systems for News Data* is authored by Hugo L. Borges and Ana C. Lorena. The Chapter introduces to the reader the research area called Recommender Systems (RS) which focuses on the structure of evaluations. The Authors present and discuss very rich and interesting origins of RS that are linked to cognitive science, approximation theory, information retrieval, prediction theories and are also related to management science and to the process of modelling options made by consumers in marketing. Next they introduce formal definition of RS and show that it is one of the major tools that helps to reduce information overload by acting as a filter and by customizing content for the final user. The Authors illustrate their arguments with some interesting news recommendation related cases. The next Chapter is titled *Negotiation Strategies with Incomplete Information and Social and Cognitive System for Intelligent Human-Agent Interaction* and authored by Amine Chohra, Arash Bahrammirzaee, and Kurosh Madani. The Authors divide their Chapter into two parts. The first part aims to develop negotiation strategies for autonomous agents with incomplete information, where negotiation behaviors are suggested to be used in combination. The suggested combination of behaviors allows agents to improve the negotiation process in terms of agent utilities, number of rounds, and percentage of agreements that were reached. The second part of this Chapter aims to develop a SOcial and COgnitive SYStem (SOCOSYS) for learning negotiation strategies from human-agent or agent-agent interactions. Both parts of the Chapter suggest interesting avenues of future research toward development of fully intelligent negotiation system that should combine in an efficient way behaviours developed in this Chapter in the first and second part with fuzzy and prediction behaviours. The following Chapter is titled *Intelligent Knowledge-Based Model for IT Support Organization Evolution* and is authored by Jakub Chabik, Cezary Orłowski, and Tomasz Sitek. The Authors develop, from conceptualization to implementation, a smart knowledge-based model for predicting the state of

the IT support organization. As such organizations face the complex problem of predicting and managing their transformation process, the focus of the Authors of this Chapter is to develop support tools that can add the above tasks. The tools the Authors propose are based on fuzzy modeling mechanisms and reasoning using uncertain and incomplete knowledge and information. After developing the tools, the Authors illustrate their application through the experimental case study related to the banking sector. The next Chapter addresses one of the fascinating future challenges of our digital society – digital preservation. It is titled *Modeling Context for Digital Preservation* and authored by Holger Brocks, Alfred Kranstedt, Gerald Jäschke and Matthias Hemmje. The Authors, after introducing the notion of context in digital preservation, identify relevant components of context and the interrelationship between the different aspects of context, and propose a generic model to represent the required context information. They chose the Open Archival Information System (OAIS) as the conceptual framework for introducing context to digital preservation. The formalism the Authors propose in a very comprehensive way relates to ontologies and business process models. The Chapter presents exemplary illustrations of the proposed formalism. The two cases presented are the scenarios in the domain of document production, archival, access and reuse within digital archives and libraries. The scenarios show that the context of archiving process adds eminent information with respect to preservation. This context information should be modeled and preserved together with the content data as an essential prerequisite for future access, understanding and reuse of data. The Chapter that follows is titled *UML2SQL—a Tool for Model-Driven Development of Data Access Layer* and authored by Leszek Siwik, Krzysztof Lewandowski, Adam Woś, Rafał Dreżewski, and Marek Kisiel-Dorohinicki. The Authors of this Chapter address a number of issues related to a tool that is used for model driven development of data access layer. The tool is called UML2SQL which is an open source application and includes an object query language allowing for behavior modeling based on Unified Modelling Language (UML) activity diagrams, and thus effectively linking structural and behavioral aspects of the system development. The Authors present and discuss in a comprehensive way the UML2SQL architecture, its processes and schemes which make this tool a distinct one in the data access domain. The Chapter includes also an illustrative example of UML2SQL implementation. The next Chapter is titled *Fuzzy Motivations in Behavior Based Agents* and authored by Tomas V. Arredondo. The Author presents a fuzzy logic based approach for providing biologically inspired motivations to be used by agents in evolutionary behaviour learning. In the presented approach, fuzzy logic provides a fitness measure used in the generation of agents with complex behaviours which respond to user expectations of previously specified motivations. The developed technique is shown as a simple but very powerful method for agents to acquire diverse behaviours as well as providing an intuitive user interface framework. The approach developed is supported by illustrative examples related to navigation, route planning, and robotics. The following Chapter is titled *Designing optimal operational-point trajectories using an intelligent sub-strategy agent-based approach* and authored by Zdzislaw Kowalczuk and Krzysztof E. Olinski. The Chapter introduces and discusses an intelligent sub-strategy agent-based approach to optimization, in which the search for the optimal solution is performed simultaneously by a group of agents. In this novel approach presented by the

Authors, compilation of the partial solutions delivered by the agents, which results in shifting the operational point from the initial to the designed terminal point, forms the final solution being sought. The Chapter includes illustrative examples and discusses further research steps that would consider sensitivity of this approach to the specification of elementary control strategies and to the applied arrangement of the decision points in the state space. Another direction suggested by the Authors of further developments in this area relates to more complex agent behaviours and interacting mechanisms at higher level of intelligence. The Chapter that comes next is titled *An Ontology-based System for Knowledge Management and Learning in Neuropediatric Physiotherapy* and authored by Luciana V. Castilho and Heitor S. Lopes. The Authors begin with very comprehensive literature review in the area of knowledge management and ontologies setting the research needs and background for their own proposition. Next, they propose a novel methodology for modelling and developing an ontology-based system for knowledge management in the domain of Neuropediatric Physiotherapy together with its application aiming at supporting learning in this domain. The related knowledge acquisition process involved knowledge capture from domain experts and compilation of information that could be gathered from reference textbooks. The knowledge that was captured was represented as ontology. Knowledge base was developed allowing for its reuse for substantial enhancement of educational and learning processes in the area of Physiotherapy. The last Chapter of this selection is titled *Mining Causal Relationships in Multidimensional Time Series* and authored by Yasser Mohammad and Toyoaki Nishida. The Authors develop and introduce a novel approach to mine multidimensional time-series data for causal relationships. The idea of analyzing meaningful events in the time series rather than by analyzing the time series numerical values directly is the main novelty feature of the proposed system. The Authors include mechanisms supporting discovery of causal relations based on automatically discovered recurring patterns in the input time series. The mechanisms are integrated variety of data mining techniques. The proposed approach is evaluated using both synthetic and real world data showing its superiority over standard procedures that are currently used. Comprehensive conclusion of the Chapter discusses future directions of this promising research.

The very briefly introduced Chapters of this book represent a sample of an effort to provide guidelines to develop tools for intelligent processing of knowledge and information that is available to decision makers acting in information rich environments of our knowledge based society. The guide does not presume to give ultimate answers but it poses models, approaches, and case studies to explore, explain and address the complexities and challenges of modern knowledge administration issues.

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